Updated:
6/22/11 @ 3:00pm
Added PowerPoint presentation for Item 11 - Text Amendment; Synthetic Turf
WITHDRAWN: Item 10 - Rezoning N of N 650 Rd & E of E 1250 Rd

6/20/11 @ 1:40pm
Added request for deferral of Item 11 - Text Amendment; Synthetic Turf
Added communications for the following items:
Item 2 - Text Amendment; Chp 20; Planned Development Overlay District
Item 6 - Comprehensive Plan Amendment to H2020 Chp 11
Item 11 - Text Amendment; Chp 20; Synthetic Turf as Landscaping Material
Added Item 12 - Agritourism Committee Recommendations

6/16/11 @ 1:30pm
Added the following:
Staff Memo for Item 6 - Comprehensive Plan Amendment to H2020 Chap 11
Misc Item - FDP Bauer Farm

LAWRENCE-DOUGLAS COUNTY METROPOLITAN PLANNING COMMISSION
CITY HALL, 6 EAST 6TH STREET, CITY COMMISSION MEETING ROOM
AGENDA FOR PUBLIC & NON-PUBLIC HEARING ITEMS
JUNE 20 & 22, 2011 6:30 - 10:30 PM

GENERAL BUSINESS:

PLANNING COMMISSION MINUTES

Receive and amend or approve the minutes from the Planning Commission meeting of May 23 & 25, 2011.

COMMITTEE REPORTS

Receive reports from any committees that met over the past month.

COMMUNICATIONS

a) Receive written communications from the public.
b) Receive written communications from staff, Planning Commissioners, or other commissioners.
c) Receive written action of any waiver requests/determinations made to the City Engineer:
d) Disclosure of ex parte communications.
e) Declaration of abstentions from specific agenda items by commissioners.

ELECTION OF OFFICERS FOR 2011-2012

Accept nominations for and elect Chair and Vice-Chair for the coming year.

AGENDA ITEMS MAY BE TAKEN OUT OF ORDER AT THE COMMISSION’S DISCRETION
PUBLIC HEARING ITEMS:

Recess LDCMPC
Convene Joint Meeting with Eudora Planning Commission

ITEM NO. 1 CONDITIONAL USE PERMIT FOR A PRESCHOOL; 2084 N 1300 RD (SLD)

CUP-4-2-11: Consider a Conditional Use Permit for a Preschool located at 2084 N. 1300 Road. Submitted by Kristine Lawhorn for United Methodist Church of Eudora, property owner of record. Joint meeting with Eudora Planning Commission.

Adjourn Joint Meeting
Reconvene LDCMPC

ITEM NO. 2 TEXT AMENDMENT TO CITY OF LAWRENCE DEVELOPMENT CODE; CHP 20; PLANNED DEVELOPMENT OVERLAY DISTRICT (MJL)

TA-3-4-11: Consider Text Amendments to the City of Lawrence Land Development Code, Chapter 20, Article 6 & 7, regarding revisions to the district criteria and development standards in the Planned Development Overlay District. Initiated by City Commission on 4/5/11. Deferred by Planning Commission on 5/25/11.

ITEM NO. 3 CONDITIONAL USE PERMIT FOR A RETAIL NURSERY; 1185 N 1250 RD (SLD)

CUP-3-1-11: Consider a Conditional Use Permit for a Retail Nursery located at 1185 N. 1250 Road. Submitted by Lawrence Landscape Inc., property owner of record.

ITEM NO. 4A RS7 TO RM12D; 4.6 ACRES; 25TH TERRACE & O’CONNELL RD (SLD)

Z-4-13-11: Consider a request to rezone approximately 4.6 acres from RS7 (Single-Dwelling Residential) to RM12D (Multi-Dwelling Residential), located at 25th Terrace and O’Connell Road. Submitted by Johnson Group Engineering, for Fairfield Investors LLC, property owner of record.

NON-PUBLIC HEARING ITEM:

ITEM NO. 4B PRELIMINARY PLAT; FAIRFIELD FARMS; 25TH TERRACE & O’CONNELL RD (SLD)

PP-4-5-11: Consider a Preliminary Plat for Fairfield Farms, a revision to an approved residential plat known as Fairfield Farms East Addition No. 1, specifically modifying Blocks 1 and 2 and Blocks 14 and 15 to combine 44 lots and rights-of-way into 14 lots with abutting right-of-way, located at 25th Terrace and O’Connell Road. Submitted by Johnson Group Engineering, for Fairfield Investors LLC, property owner of record.

PUBLIC HEARING ITEMS:

ITEM NO. 5 CONDITIONAL USE PERMIT FOR INDOOR SPORTS CENTER; 1898 E 56 RD (SLD)

CUP-4-3-11: Consider a Conditional Use Permit for an indoor sports center, located at 1898 East 56 Road, Lecompton. Submitted by PLS Landscape for Price Property LLC, property owner of record.
ITEM NO. 6 COMPREHENSIVE PLAN AMENDMENT TO H2020 - CHP 11 (LBZ)

CPA-4-4-10: Consider Comprehensive Plan Amendment to Horizon 2020 - Chapter 11 - Historic Resources. Initiated by Planning Commission on 4/26/10.

**DEFERRED**

ITEM NO. 7 U-KU TO RM64-PD; .8 ACRES; 1043 INDIANA ST (LBZ)

Z-4-15-11: Consider a request to rezone approximately .8 acres from U-KU (University – Kansas University) to RM64-PD (Multi-Dwelling Residential), located at 1043 Indiana Street. Submitted by Paul Werner Architects, for Triple T LLC, property owner of record.

MISCELLANEOUS NEW OR OLD BUSINESS

NON-PUBLIC HEARING ITEM:

MISC ITEM NO. 1: FINAL DEVELOPMENT PLAN; BURGER KING – BAUER FARM PCD; 4671 BAUER FARM DRIVE (SLD)

FDP-5-2-11: Consider Final Development Plan for a 2,855 SF drive-thru restaurant [Burger King – Bauer Farm PCD], located on approximately 0.7 acres, at 4671 Bauer Farm Drive. Submitted by Bartlett & West Engineering for Genesh Inc., property owners of record.

Consideration of any other business to come before the Commission.

Recess until 6:30pm on June 22, 2011.
COMMUNICATIONS

a) Receive written communications from staff, Planning Commissioners, or other commissioners.
b) Disclosure of ex parte communications.
c) Declaration of abstentions from specific agenda items by commissioners.

AGENDA ITEMS MAY BE TAKEN OUT OF ORDER AT THE COMMISSION’S DISCRETION

REGULAR AGENDA (JUNE 22, 2011) MEETING

NON-PUBLIC HEARING ITEMS:

ITEM NO. 8 EXTENSION REQUEST FOR REVISED PRELIMINARY PLAT; MERCATO; N OF HWY 40 & E OF HWY K-10 (MKM)

PP-10-05-09: Extension request for a Revised Preliminary Plat for lots 7, 8, and 9 Block Four and Lots 2, 3, and 4, Block Seven as shown on the approved Preliminary Plat for Mercato dated 4/26/06; N of Hwy 40 & E of Hwy K-10.

ITEM NO. 9 PRELIMINARY PLAT; KASOLD WATER TOWER ADDITION; SE OF TAM O’SHANTER & KASOLD DR (MKM)

PP-4-4-11: Consider a Preliminary Plat for Kasold Water Tower Addition, approximately .5 acre containing 1 lot, located southeast of the Tam O’Shanter and Kasold Drive intersection, a waiver from Section 20-811(c) which requires a 6 ft wide sidewalk along arterial streets, and a variance from Section 20-810(d)(4)(i) which requires 150 ft of right-of-way for a principal arterial. Submitted by the City of Lawrence, property owner of record.

PUBLIC HEARING ITEMS:

**WITHDRAWN**

ITEM NO. 10 A TO B-1; 2.9 ACRES; N OF N 650 RD & E OF E 1250 RD (MKM)

Z-4-12-11: Consider a request to rezone approximately 2.9 acres from A (Agricultural) to B-1 (Neighborhood Commercial), located North of N. 650 Road and East of E. 1250 Road. Submitted by Stanley Zaremba, property owner of record.

ITEM NO. 11 TEXT AMENDMENT TO CITY OF LAWRENCE DEVELOPMENT CODE; CHP 20; SYNTHETIC TURF AS LANDSCAPING MATERIAL (MKM)

TA-4-6-11: Consider Text Amendments to the City of Lawrence Land Development Code, Chapter 20, Articles 10 and 17, regarding synthetic turf as landscaping material. Initiated by City Commission on 5/3/11.

No action being taken on Item 12

ITEM NO. 12 AGRI-TOURISM COMMITTEE RECOMMENDATIONS (MKM)

Agri-Tourism Committee recommendations

**DEFERRED**

ITEM NO. 13 CONDITIONAL USE PERMIT FOR FRATERNAL ORDER OF POLICE; 768 E 661 DIAGONAL RD (MKM)
CUP-12-8-10: Consider a Conditional Use Permit for the Fraternal Order of Police shooting range, located at 768 E. 661 Diagonal Road. Submitted by Dan Affalter, for Fraternal Order of Police, property owner of record. Deferred by Planning Commission on 4/25/11.

PUBLIC COMMENT SECTION

ADJOURN

CALENDAR

PCCM Meeting: (Generally 2nd Wednesday of each month, 7:30am-9:00am)

Sign up to receive the Planning Commission agenda or weekly Planning Submittals via email: http://www.lawrenceks.org/subscriptions
PLANNING COMMISSION MEETING
May 23 & 25, 2011
Meeting Minutes DRAFT

May 23, 2011 - 6:30 p.m.
Commissioners present: Blaser, Burger, Culver, Finkeldei, Harris, Hird, Liese, Rasmussen, Singleton
Staff present: McCullough, Stogsdill, Larkin, M. Miller, Zollner, Ewert

MINUTES
Receive and amend or approve the minutes from the Planning Commission meeting of April 25, 2011.

Motioned by Commissioner Harris, seconded by Commissioner Singleton, to approve the April 25, 2011 Planning Commission minutes.

Commissioner Rasmussen said on the issue concerning the sand quarry his point by point criteria comments were not included in the minutes.

Motion carried 9-0.

COMMITTEE REPORTS
Receive reports from any committees that met over the past month.

Commissioner Hird said the Agri-Tourism committee met and would present to the Planning Commission a written report possibly in June.

COMMUNICATIONS
Mr. Scott McCullough, Planning Director, reviewed new attachments/communications that were posted to the online Planning Commission agenda after the initial posting date.

EX PARTE / ABSTENTIONS / DEFERRAL REQUEST
• Ex parte:
  Commissioner Finkeldei said he had a short conversation with a board member of the West Hills Neighborhood Association, Robert Lewis, regarding Item 11.
  Commissioner Hird said he had a relatively short conversation with Mr. Matt Gough regarding Item 9, Inverness District Plan.

• No abstentions.

Commissioner Blaser stated that Items 6 and 7 would not receive public input tonight.
ITEM NO. 1  I-2 TO A; 32 ACRES; 670 N 1800 RD (MKM)

Z-3-10-11: Consider a request to rezone approximately 32 acres from I-2 (Light Industrial) to A (Agricultural), located at 670 N 1800 Rd. Submitted by Paul Werner Architects, for Rockwall Farms L.C., property owner of record. Joint meeting with Lecompton Planning Commission.

STAFF PRESENTATION
Ms. Mary Miller presented the item.

APPLICANT PRESENTATION
Mr. Paul Werner, Paul Werner Architects, said this was a clean-up item for Berry Plastics and that they agreed with the staff report.

PUBLIC HEARING
Mr. Walt Spencer, lives south of Berry Plastics, said there were very few places in Douglas County with I-2 zoning. He wondered what the purpose of the rezoning was.

Mr. Scott McCullough said the staff report articulated the purpose for the rezoning and that it grew out of concern for the representation that was made to accommodate Berry Plastics at the location. He stated if you took Berry Plastics away from the property and put the test of the Comprehensive Plan to it there were factors that supported I-2 zoning and factors that may not support I-2 zoning. He said there seemed to be agreement between the applicant and staff that reverting back to agriculture right now would address a lot of the potential concerns for uses in the Commercial districts that would remain with I-2 unless it was rezoned or zoned and maintained I-2 with conditions. He said the purpose of the Berry Plastics and the consequence of a second lot was to accommodate Industrial uses, not the gamut of uses that includes Commercial uses found in the County Code. He said if I-2 zoning was maintained staff would recommend some of the Commercial uses be conditioned away. He said there was an argument that there was value in having a little bit of Industrial inventory there but the Commercial components of that did not come into the discussion before.

Commissioner Rasmussen asked if this would create an unusually shaped lot with a narrow corridor. He asked if it would be a useable lot in the future.

Mr. McCullough said it was useable for some of the infrastructure to the Woods development and Berry Plastics. He said even if it was maintained at I-2 it would most likely be used for agricultural purposes until development occurred.

Commissioner Rasmussen asked if the property could be used for anything other than agriculture given its size and shape constraints.

Mr. McCullough said it could be used for development. He said staff would not assume a house would be built there. He said it acted as a holding pattern until there was a user identified and analyzed that specific user and development.

The two Lecompton Planning Commissioners present, Amber Nickel and Leigh Ann Woody, were satisfied with the staff report.

COMMISSION DISCUSSION
Commissioner Burger asked if any communication was received from the Lawrence Chamber of Commerce.

Mr. McCullough said no.

Commissioner Hird asked if the applicant would agree to conditional zoning if the land remained I-2.

Mr. Werner said the applicant would agree with that. He said the 32 acres was deceiving because only about 8 acres at the front was useable. He said the narrow strip going to the north was shared access and not usable. He said I-2 was appropriate but they would agree to just about anything to keep Berry Plastics on task. He suggested publishing it differently when it was heard by County Commission.

Commissioner Harris asked if the item could be advertised differently to avoid confusion.

Mr. McCullough said staff would have to look at that. He said procedurally denying the rezoning request or maintaining I-2 with conditions was accurate and within the Planning Commissioners range. He said one of the concerns was because there was significant representation that the 1000’ setback from the road would be beneficial in maintaining the rural character. He said upon County Commission receiving knowledge of the lot split they required the applicant to at least go through the process and learn from the public if there were issues with that.

Commissioner Harris inquired about the original notification for the rezoning.

Mr. McCullough said it would have been a 1000’ buffer area.

Commissioner Harris asked if the people who were notified previously were notified again for this rezoning.

Mr. McCullough said yes, if they fell within the 1000’ notification boundary.

**ACTION TAKEN**

Motioned by Commissioner Harris, seconded by Commissioner Singleton, to approve the rezoning request for approximately 32 acres from I-2 (Light Industrial) to A (Agricultural) District and forward it to the Board of County Commissioners with a recommendation for approval based on the findings of fact found in the body of the staff report.

Unanimously approved 9-0.
ITEM NO. 2 FINAL DEVELOPMENT PLAN; PRAIRIE WIND; 3 ACRES; 2620 HASKELL AVE (MKM)

FDP-3-1-11: Consider a Revised Final Development Plan for Prairie Wind, including the addition of one single-family dwelling unit for a total of 18 homes, on approximately 3 acres, located at 2620 Haskell Ave. Submitted by Tenants to Homeowners, Inc., property owner of record.

STAFF PRESENTATION
Ms. Mary Miller presented the item.

Commissioner Rasmussen inquired about the restrictions.

Ms. Miller said with single lot developments there needed to be some sort of restrictions or covenants that state who would maintain the common space between the homes. She stated Tenants to Homeowners would maintain it and the covenants were already recorded.

Commissioner Burger asked about the reasons for changing the architectural element.

Ms. Miller said Tenants to Homeowners could explain that.

APPLICANT PRESENTATION
Ms. Rebecca Buford, Executive Director of Tenants to Homeowners, said they would be adding extra detail for this development such as front porches and railings. She stated they were trying to give it a traditional look that would fit in the Prairie Park neighborhood. She said the streetscape drawing was a good indication of what it would look like. She said they would use materials that would lower maintenance costs for affordable housing such as cement board siding, durable materials, and high energy efficient windows.

PUBLIC HEARING
Ms. Debbie Brown inquired about the green space. She wondered if the detention pond would be useable.

Ms. Miller said it was counted as green space and would be an attractive detention pond.

Ms. Brown asked how big the green space would be and how much space would be between each house.

Ms. Miller said .16 acres and that each house would be separated by 10-12’.

Ms. Brown asked about the street being T-shaped

Ms. Miller said a hammerhead street was requested by the Fire Department.

Ms. Brown was concerned about standing water and drainage issues.

Ms. Miller stated the City Stormwater Engineer said that with the grading it should improve drainage for the properties to the south.

Ms. Brown wanted to know if there was a guarantee.
Mr. McCullough said it would be reviewed by the City Stormwater Engineer for best practice methods.

**COMMISSION DISCUSSION**
Commissioner Finkeldei felt that Tenants to Homeowners would be a good owner to the property and would probably be better than any private homeowners association in maintaining it. He thought this was an improvement for the neighborhood and great infill development.

**ACTION TAKEN**
Motioned by Commissioner Finkeldei, seconded by Commissioner Singleton, to approve the Final Development Plan based upon the findings of fact presented in the body of the Staff Report subject to the following conditions:

1. Provision of a revised Final Development Plan with the following changes:
   a. Conditions of approval, Note 8 shall be revised to reference the elevations on the ‘Final’ Development Plan rather than the ‘Preliminary’.
   b. General Note 10 shall be revised to indicate that the declaration of covenants, conditions, and restrictions of the Home Owners Association shall be recorded prior to the recording of the Final Development Plan.
   c. The plan should be revised to show trees located at least 8 ft from underground water or sanitary sewer lines or an exhibit may be provided which shows the trees in relation to the underground lines to verify that adequate space is being provided for tree placement.

   Unanimously approved 9-0.
ITEM NO. 3 PRELIMINARY P LAT; H UNTERS RIDGE ADDITION; 35 ACRES; NORTH SIDE OF W 6TH ST BETWEEN QUEENS RD & STONERIDGE DR (MKM)

PP-3-3-11: Consider a Preliminary Plat for Hunters Ridge Addition, an approximately 35 acre subdivision containing 4 lots, located on the north side of West 6th Street between Queens Road & Stoneridge Drive. Submitted by Pat Kelly for Pear Tree Village L.P., property owner of record.

STAFF PRESENTATION
Ms. Mary Miller presented the item.

APPLICANT PRESENTATION
Mr. Seth Reece, Olson & Associates, said he reviewed all staff conditions and was agreeable to all of them. He thanked staff for their work.

COMMISSION DISCUSSION
Commissioner Finkeldei said it was good to see the project moving forward.

ACTION TAKEN
Motioned by Commissioner Finkeldei, seconded by Commissioner Hird, to approve the Preliminary Plat of the Hunters Ridge Addition and forwarding the plat to the City Commission for acceptance of dedications of easements subject to the following conditions:

1. Provision of a revised plat with the following changes:
   a. Areas along Queens Road, Stoneridge Drive, and Overland Drive with restricted access shall be shown graphically on the plan and labeled ‘no access’.
   b. The water and sanitary sewer lines and associated easements shall be revised on the preliminary plat per the Fire Code Official and City Utility Engineer’s approval prior to the plat being placed on the City Commission agenda for acceptance of dedication of easements.
   c. A phasing schedule shall be shown on the plat, if phasing of final platting is proposed.
   d. Building envelopes shall be shown for Lots 2 and 3 along with a note that the setbacks were taken from Section 20-601(a) of the Development Code, as amended November 29, 2010.
   e. Sidewalks shall be shown along all streets and the width of the existing and new sidewalks shall be noted.
   f. The legal description shall be revised to extend to the section line on the east.
   g. One-half of the required right-of-way for Queens Road, 40 ft, shall be dedicated with this plat.
   h. A note shall be added which states that an access and maintenance agreement for lots which share the common access drives shall be recorded prior to recording of the final plat.
   i. An access easement shall be provided for the common access drives.
   j. A note shall be added which states that ‘Timing of development of Lots 3 and 4 will be linked to improvements to Queens Road. Building permits will not be issued for Lots 3 or 4 until Queens Road has been improved to City Standards.’
   k. The plat shall designate the Detention Basins as drainage easements.
   l. The size and location of detention basins shall be shown and detention basins shall be labeled on the plat.
   m. The following note shall be added: "The detention basin/drainage easements will be privately-owned and maintained. The developer is responsible for establishing ownership and maintenance of same via individual owner maintenance. No fences or structures..."
other than necessary retaining walls and/or guardrails will be allowed in within the drainage easements. They will remain free of any natural or non-natural structures or vegetative barriers (including but not limited to trees, shrubbery, berms, fences, and walls).” (City Code 20-1101(f))

Unanimously approved 9-0.
ITEM NO. 4 A & B2 TO B2; 6 ACRES; 751 HWY 40 (MKM)

Z-3-7-11: Consider a request to rezone approximately 6 acres from A (Agricultural) and B2 (General Business) to B2 (General Business), located at 751 Hwy 40. Submitted by Kathleen Baker Wolfe, property owner of record.

STAFF PRESENTATION
Ms. Mary Miller presented the item.

Commissioner Finkeldei inquired about additional access off of Hwy 40.

Ms. Miller said that would be determined by KDOT.

Commissioner Finkeldei inquired about the distance for entrances from other roads.

Ms. Miller said the County Access Management Standards were different in the county and would be determined by the county engineer.

Commissioner Harris asked if there was an existing business in that area that wanted to expand.

Ms. Miller said not that she knew of. She did not know who would be using the location. She said she received a phone call from a neighbor to the south concerned with the aesthetics of a commercial use. She said the County Zoning Regulations would require the same condition that new uses be reviewed for compatibility with adjacent properties. She said when the Site Plan was reviewed by staff they would look at buffering, landscaping, orientation of the building, and parking lots to make sure it was compatible.

Commissioner Harris inquired about the interpretation of the language for allowing the use there. She thought it was saying an existing business could be expanded but not allowed to add a new business.

Ms. Miller said that language was referring to commercial areas, not commercial uses. She said a commercial area could expand to accommodate an existing or new business.

APPLICANT PRESENTATION
Ms. Kay Wolfe said when she purchased the property she was told by her real estate agent that the property was zoned commercial, which was not true. She felt the area would be perfect for a small business such as a gas station. She said she was moving and would like to sell the property before moving.

PUBLIC HEARING
No public comment.

COMMISSION DISCUSSION
Commissioner Harris asked where the language she mentioned earlier.

Mr. McCullough directed her to where the language was located in the staff report. “Existing commercial areas that are located at the intersection of a hard surfaced County Route and a state or federally designated highway should be allowed to expand if the necessary infrastructure (water, road, approved wastewater treatment facility, etc.) is available.”
Commissioner Harris inquired about notification.

Mr. McCullough said the notification radius was 1000’.

Commissioner Harris asked how many households that included.

Ms. Miller said 16.

Commissioner Culver asked how long the section of B2 zoned land had been zoned that way.

Ms. Miller said since 1966.

Commissioner Liese inquired about a letter included in the packet that raised concerns about the auto junkyard.

Mr. McCullough said staff could pursue that with the County Zoning office to see if it was a compliance matter.

Ms. Miller said she believed the auto use was installed before site planning was required. She said anything new would need to be site planned and reviewed for buffering and landscaping.

**ACTION TAKEN**

Motioned by Commissioner Singleton, seconded by Commissioner Liese, to approve the rezoning request for approximately 6 acres from A (Agricultural) District and B-2 (General Business) to B-2 (General Business) and forwarding it to the Board of County Commissioners with a recommendation for approval based on the findings of fact found in the body of the staff report.

Unanimously approved 9-0.
ITEM NO. 5  A TO R-T; 209 ACRES; 778 E 1300 RD (MKM)

Z-3-9-11: Consider a request to rezone approximately 209 acres from A (Agricultural) to R-T (Rural Tourism), located at 778 E 1300 Rd. Submitted by Grob Engineering Services, for Sadies Lake LC, property owner of record.

STAFF PRESENTATION
Ms. Mary Miller presented the item.

Commissioner Finkeldei asked if the Site Plan would be approved by County Commission.

Ms. Miller said that was correct.

Commissioner Harris asked how large the conference center could be.

Ms. Miller said for the Woods project a 55,000 square foot conference center was approved so this conference center could be larger which could be something the County Commission would look at. She said the type of road was different and that the 55,000 square foot conference center was appropriate for the Woods since it was on N. 1800 Road but this project was on a township road so it probably would not be as large.

Commissioner Harris asked if that would be up to the County Commission to decide.

Ms. Miller said that was correct, as well as the township and county engineer providing their input on how much traffic that road could handle.

APPLICANT PRESENTATION
Mr. Dean Grob, Grob Engineering Services, said the reduced buffer did not lend itself well to the conference center or other larger buildings because of its total size. He said regarding the hunting aspect of the property the owners wanted to maintain any hunting rights they currently have. He said commercial hunting and guided tour hunting would not be a permitted uses in the R-T zoning and would have to be a Conditional Use Permit. He stated the owners were hunters and may have guests hunt with them but they had no desire to pursue a Conditional Use Permit. He did not believe hunting would increase with more cabins, but instead decrease due to safety reasons. He said west of the property was a minimum maintenance road that the owners had no desire to extend. He said the existing FEMA floodplain cuts off that end of the property so there was nothing to be gained by extending the road to the south.

Commissioner Hird inquired about the cost for road improvements.

Mr. Grob said presently it was a minimum maintenance road but basically there was no road there.

Commissioner Hird asked where the minimum maintenance part of it located.

Mr. Grob pointed on the overhead to where it was located. He said there was a piece of right-of-way that was vacated to the south.

Commissioner Harris asked for clarification about the hunting. She asked if the proposed zoning did not allow hunting.
Mr. Grob said commercial hunting and guided hunting tours would not be permitted in R-T zoning, but the owner would still retain property owner hunting rights.

Commissioner Harris said she did not understand how that would work.

Mr. McCullough said staff could not give a definitive answer because there may be some differences in terms of a single user. He said the gray area was if there could be exempt agricultural based hunting and a commercial property with cabins.

Commissioner Harris said she wanted to be sure the applicant knew the restrictions on the uses. She also asked if it was possible to build some of the cabins closer to the floodplain line than what was requested.

Mr. Grob said it was a matter of trying to fit everything within the layout of the land. He was okay with a condition that stated within the reduction could only be cabins versus anything else. He said it was possible to squeeze a cabin between the 200’ buffer and the floodplain. He said there was only one actual residence/house across from the property.

Commissioner Finkeldei inquired about the setback requirement from the buffer line.

Mr. Grob said he wanted a little wiggle room to figure it out.

PUBLIC HEARING

Mr. Robert Eye, attorney representing Mr. Newton McCluggage, said some of the comments heard tonight clarified some things and raised additional concerns. He stated if there were 13 cabins on the property there would be the opportunity for 13 hunting parties and that nothing in the plan would limit it. He said there was no limitation on the use or patron use of the property for hunting. He expressed concern for the potential of a 55,000’ conference center. He said a conference center was contrary to rural character according to Horizon 2020. He was concerned that this was a sensitive area with slopes and that additional development might cause additional erosion or change drainage patterns. He also expressed concern regarding traffic. He said a 55,000’ conference center would have the potential for many more cars. He felt that access to water should be available before the plan went forward and that if water was not available the rezoning would be a mute point.

Commissioner Hird said regarding Mr. Eye’s argument about hunting parties, the way it was zoned now (agricultural) there could be 100 hunting parties. He asked where the number for 13 hunting parties came from.

Mr. Eye said the number came from 13 cabins.

Commissioner Hird asked if he was suggesting that there would be 13 hunting parties on 209 acres.

Mr. Eye said the way the applicant structured the rezoning request there would be nothing to prohibit that. He said it would clearly not be a safe thing to do.

Commissioner Hird said the only thing preventing that would be common sense.

Mr. Eye said that was correct.

Mr. Bill Mitchell, neighbor to the east across the minimum maintenance road, said he was relieved to hear he would not be required to co-share on the upgrading of the road. He hoped they would
disallow the requested variance of 150’ and require the statutory 200’. He disagreed with Mr. Grob’s comment about the number of houses across 1300 Road. He said there were four houses across the road. He said the justification for this was to make room to build cabins and the real justification for narrowing the buffer was that there were existing trees and elevation drop. He felt the minimum 200’ should be preserved. He stated the conceptual Site Plan may morph into something else. He felt it was only fair that neighbors be given notification of all future Site Plans and changes of use. He said if the rezoning was approved he would like to see some limitations placed on the hunting, such as bow hunting for deer or small caliber shotguns for birds. He stated Rural Tourism zoning was new and unknown making the neighbors the guinea pig.

APPLICANT CLOSING COMMENTS
Mr. Grob said Mr. Mitchell was correct, there were four residences on the west side of the property. He said the one residence he spoke of earlier was the one in the setback reduction.

Commissioner Harris said she was leaning toward deferral to clear up issues on hunting and water. She asked if the applicant would be okay with that.

Mr. Grob said that would be fine if the Commission desired to do so. He said he spoke with the Rural Water District and meters were available. He said it was more of a matter of improvements may need to be made to the infrastructure. He said the property owner could currently hunt and they wanted to maintain that right.

COMMISSION DISCUSSION
Commissioner Finkeldei asked staff about Mr. Mitchell’s request for notification.

Ms. Miller said county Site Plans do not receive notification.

Mr. McCullough said it could be added as a condition to the rezoning.

Commissioner Finkeldei said the request regarding reduction of the buffer zone was to allow flexibility for the cabin sites during the rezoning stage. He said during the Site Plan stage they would know exactly where the cabins would be at and someone could object at that time and ask the County Commission to move it.

Ms. Miller said she believed they could, yes.

Commissioner Hird said if deferring this was the wise choice then he was fine with that. He was concerned about the notice requirement and said if this was deferred he hoped there would be notice. He said he was not nearly concerned about the hunting issue as others may be. He said with his personal experiences of hunting, two hunting parties with rifles on 209 acres, would be a problem. He said three hunting parties shooting shotguns at quail would be no problem. He said a 22 caliber rifle bullet would travel 2 miles so using a small caliber was not the answer, he said it was common sense. He said he did not want to see any commercial hunting but that it was not being requested by the applicant. He felt it was a slippery slope of restricting land owners right to hunt their own land.

Commissioner Rasmussen said he would rather deal with this tonight than delay it. He did not see a problem with including a requirement that notification be provided to the property owners along that road.
Commissioner Singleton agreed with Commissioner Rasmussen. She said the hunting issue could be researched and investigated and presented to the County Commissioners. She said Commissioner Hird was correct, hunting parties have to self regulate with noise, space, and the number of people. She would like to see this plan go on with a requirement for Site Plan notification to the neighbors in the immediate area when it goes to County Commission.

**ACTION TAKEN**

Motioned by Commissioner Singleton, seconded by Commissioner Finkeldei, to approve the rezoning request for approximately 209 acres from A (Agricultural) District to R-T (Rural Tourism), with a reduced buffer width of 150 ft along the west property line and forwarding it to the Board of County Commissioners with a recommendation for approval based on the findings of fact found in the body of the staff report subject to the following conditions:

1. The rezoning will not be placed on the Board of County Commission’s agenda for consideration until the Rural Water District has determined adequate water capacity is, or can be made, available to serve the facility.
2. Property owners on the portion of E 1300 Road which is used to access the subject property from Hwy 59 shall be notified when a site plan has been submitted for the rural tourism use.

Commissioner Finkeldei asked staff about a condition regarding notification.

Mr. McCullough said he would consult with the County Attorney, Evan Ice, about notification. He said that type of condition could create procedural issues in the future if staff does not pick up on the condition.

Commissioner Finkeldei said regarding the hunting issue, if for some reason it was discovered that hunting would not be allowed at all, the applicant may have to make a decision about proceeding with the rezoning. He said he was voting in favor with the assumption that hunting would still be allowed for the owners and their guests, but not for commercial hunting.

Commissioner Hird inquired about the issue of the gravel road accessing this site.

Mr. McCullough said the County Engineer reviewed the traffic study and would be reviewed upon Site Plan submittal.

Ms. Miller said the Township did not have objections to the number of traffic that would be traveling. She said when a Site Plan was submitted with the exact number of cabins and square footage of the lodge that was when it would be decided if any upgrades would be needed to the road.

Commissioner Hird asked with Rural Water District.

Ms. Miller said Rural Water District 2.

Commissioner Hird said he currently served on the Rural Water District 2 board and that they meet Thursday.

Commissioner Finkeldei said in theory it was possible to have a 55,000 square foot building but that the County Commission would not approve something that large.

Commissioner Harris said she would vote against the motion and would prefer to see cabins built as close as possible to the buffer boundary indicated in the Code.
Motion carried 8-1, with Commissioner Harris voting in opposition.
ITEM NO. 6    COMPREHENSIVE PLAN AMENDMENT TO H2020 - CHP 11 (LBZ)

CPA-4-4-10: Consider Comprehensive Plan Amendment to Horizon 2020 – Chapter 11 - Historic Resources. Initiated by Planning Commission on 4/26/10.

STAFF PRESENTATION
Ms. Lynne Braddock Zollner presented the item.

COMMISSION DISCUSSION
Commissioner Finkeldei inquired about Goal # 6. He said he did not necessarily disagree with it but that it seemed odd to mix in using locally grown materials in the historic preservation chapter.

Commissioner Rasmussen asked how historic preservation could be married with the requirements of new construction.

Ms. Zollner showed a diagram on the overhead regarding sustainability. She said historic preservation was starting to blend with the sustainability movement. She stated the goal was an overall sustainable community by putting together cultural, environmental, and economic targets. She said the chapter tries to integrate historic preservation as a part of the sustainable community movement. She stated the National Trust for Historic Preservation was spending a lot of time trying to help Americans make the bridge between sustainable communities and sustainable design, instead of just thinking about historic preservation as saving old buildings. She said it was really about the building materials, reducing fill and landfill, and using locally manufactured products. She stated the goal of the chapter was the Historic Resources Commission trying to respond to the national trend on how to incorporate this into the larger picture.

Commissioner Finkeldei felt that some of the language did not belong in this chapter. He said he did not disagree with it but felt that a few provisions seemed out of place. He felt the following wording was a proper mix of the two: ‘Building energy codes that focus on energy saving and consumption give existing structures proper credit for embodied energy and discourage teardowns.’ He encouraged staff to look at some of the other language again.

Commissioner Rasmussen felt it was out of place to be talking about new construction for a new building in the historic resources section. He said he would be fine with language regarding putting a solar panel on a historic home or incorporating new technology on a historic structure but felt that language about new construction was out of place. He said they were good ideas but he needed to hear more about why they were in this chapter and not somewhere else. He said he liked Goal # 3 regarding incentivizing.

Commissioner Harris agreed with comments made by Commissioners Finkeldei and Rasmussen.

Commissioner Finkeldei suggested the language for Policy 4.1 (c) ‘Revitalizing the Watkins Community Museum’ be changed to something else so as not to insinuate that it was not living up to its potential.

Commissioner Hird thanked staff for their work. He agreed with the comments made by everyone.
Commissioner Liese agreed with all the comments stated. He said he liked the concept but felt that introducing sustainability in this chapter just because it was in vogue subtracted from the overall strength.

NO ACTION TAKEN
ITEM NO. 7 TEXT AMENDMENT TO CITY OF LAWRENCE DEVELOPMENT CODE & DOUGLAS COUNTY CODE; MINOR & MAJOR SUBDIVISIONS (SMS)

TA-3-3-10: Consider Text Amendments to the joint city/county subdivision regulations in the City of Lawrence Land Development Code, Chapter 20, Article 8 and the Douglas County Code, Chapter 11, Article 1 to revise requirements and standards related to the processing of Minor and Major Subdivisions, including minor housekeeping changes. Initiated by City Commission on 2/16/10.

STAFF PRESENTATION
Ms. Sheila Stogsdill presented the item.

COMMISSION DISCUSSION
Commissioner Harris said in the past when she talked with people who lived in the county who weren’t familiar with the development process about subdivision regulations they would say there weren’t interested in that because it was for big subdivisions. She said she would tell them it was about land division, not about big subdivisions. She suggested changing the title of the document to land division or land subdivision.

Commissioner Finkeldei thanked staff for starting this topic.

ACTION TAKEN
Motioned by Commissioner Finkeldei, seconded by Commissioner Hird, to re-initiate the text amendments (TA-3-3-10) since the review resulted in a number of proposed changes not originally contemplated.

Unanimously approved 9-0.
ITEM NO. 8  CONDITIONAL USE PERMIT; FRATERNAL ORDER OF POLICE SHOOTING RANGE; 768 E. 661 DIAGONAL RD (MKM)

CUP-12-8-10: Consider a Conditional Use Permit for the Fraternal Order of Police shooting range, located at 768 E. 661 Diagonal Road. Submitted by Dan Affalter, for Fraternal Order of Police, property owner of record. Deferred by Planning Commission on 4/25/11.

Item 8 was deferred prior to the meeting.
MISCELLANEOUS NEW OR OLD BUSINESS

MISC NO. 1  PLANNING COMMISSION TRAINING SESSION

Reminder regarding Planning Commission training session: July 15th  8:00am - 5:00pm in the City Commission room.

Commissioner Hird said he would not be present at Wednesday’s Planning Commission meeting. He thanked Commissioner Harris for her years of service.

Consideration of any other business to come before the Commission.

Recess at 9:00pm until 6:30pm on May 25, 2011.
Reconvene May 25, 2011 – 6:30 p.m.

Commissioners present: Blaser, Burger, Culver, Dominguez, Finkeldei, Harris, Liese, Rasmussen, Singleton
Staff present: McCullough, Stogsdill, Day, Larkin, Leininger, Warner, Ewert

BEGIN PUBLIC HEARING (MAY 25, 2011):

COMMUNICATIONS
Mr. Scott McCullough said there was a PowerPoint presentation added to the packet.

EX PARTE / ABSTENTIONS / DEFERRAL REQUEST
- Ex parte:
  Commissioner Rasmussen said he had discussions with City Commissioner Dever concerning the Inverness Park Comprehensive Plan and they talked about possible uses for the north side of that area.

  Commissioner Finkeldei said he had a very short conversation with Ms. Margaret Lewis, West Hills Neighborhood Association, wondering if he had seen the deed for Kappa Delta regarding Item 11. He told her he had seen it.

- No abstentions.
ITEM NO. 9 COMPREHENSIVE PLAN AMENDMENT TO H2020 - CHP 14 (DDW)

CPA-3-1-11: Consider Comprehensive Plan Amendment to Horizon 2020 – Chapter 14 to include the Inverness Park District Plan.

STAFF PRESENTATION
Mr. Dan Warner presented the item.

Commissioner Rasmussen asked how Option 3 could be proposed with high density since there was already development there.

Mr. Warner said it was not completely developed, there was still about 5 acres left that could be developed.

Mr. McCullough said it was developed with the maximum number of dwelling units on about 2/3 of the area leaving open space undeveloped land. He stated they built out to the current zoning category but left a portion undeveloped and the only way to get additional density on the property was to rezone to a higher level and develop to that new maximum number of dwelling units.

Commissioner Rasmussen inquired about a landscape plan for the vacant area.

Ms. Day said the area was left open and that a piece of it had floodplain and drainage encumbrance. She stated the landscape applied toward the two streets, Clinton Parkway and 24th Place.

Commissioner Rasmussen asked if it could just be a vacant lot with dirt and no grass.

Ms. Day said anytime there was property there needed to be grass, or at least seeded.

PUBLIC HEARING
Mr. Matt Gough, Barber Emerson, advocated for Option 3 on behalf of two interested users, Remington Square LC (Mr. Tim Stultz) and Hy-Vee, who were under contract to acquire the southwest corner of Clinton Parkway and Crossgate. He said when Horizon 2020 was adopted in 1997 it included a land use map for all of the property at that time annexed into the city. He said the Inverness Park District was a big white blob. Since that time the property was annexed and for the most part developed. He asked Planning Commission to consider whether or not some of these projects would be worthy of Option 3 type uses proposed. He said the first tract was the 5 acre parcel owned by Remington Square, and currently had a pending rezoning application from RM15 to RM24 with a staff recommendation of approval. He said the request was made to allow the developer to construct more one bedroom apartments. He said the property had significant special assessments on it, most of which were necessary to provide water improvements and drainage culverts needed to make the whole area developable. He said Hy-Vee hoped to have a rezoning application before Planning Commission in August. He said Option 3 was the only option that would work for both of the potential users. He said approval of Option 3 did not rezone the properties and in each instance the projects would come before Planning Commission on their own merits to be considered for rezoning and there would be additional opportunities for people to speak on them specifically. He said his concern with Options 1 and 2 was that someday someone may want to amend the plan to do something more like Option 3 because RSO use of the property had not been popular. He displayed a map on the overhead with the residence locations of all the public comments received. He stated some of the comments were regarding property values. He displayed the 2009 and 2011 appraised values for everyone who submitted a comment and overall there was a .34% decrease in
appraised values from 2009 to 2011, which was the timeframe Remington Square apartments were built. He said comparing that with the county overall, all residential property in the county experienced a significant decrease in 2009. He said there was no specific data that stated anyone’s property value decreased because of multi-family.

Commissioner Rasmussen asked what the plan was for the Remington Square area.

Mr. Gough said that was undetermined at this time. He said the current Site Plan calls it open space.

Commissioner Rasmussen said he thought when the apartments were proposed that the 5 acre tract was identified as open green space that would be useable for the people that live in the apartments.

Mr. Gough said he did not have an answer to that.

Commissioner Harris asked if the Remington Square property would be the only one contributing to the special assessments.

Mr. Gough said the assessments were formed approximately 7-8 years ago and were much higher and spread among all the properties in the area. He said since the Remington Square property was one of the larger square footage properties and probably took the largest percentage of the specials.

Commissioner Harris asked if the corner properties would share the costs of the special assessments when they develop.

Mr. McCullough said he assumed they would.

Commissioner Liese thanked Mr. Gough for presenting data on property values. He said when he went and looked at the property it was around rush hour and it was very congested and difficult to navigate. He inquired about a traffic study.

Mr. Gough said at this time there was no traffic study. He said one of the components that would come forth with the Hy-Vee plan would involve some sort of traffic analysis because of the access issues involved with that site.

Mr. McCullough said that road was studied and generally speaking the infrastructure was put in place with enough capacity to take on pretty healthy development in the area so there has not been any bump up against capacity issues from a traffic engineering standpoint. He said there was always the discussion of quality of life issues with congestion.

Ms. Jamie Hulse said she supported options that did not allow additional multi-family. She was concerned about the change in property values over time. She wondered why RM24 wasn’t the original rezoning request if that was the plan along.

Commissioner Finkeldei asked if she supported the change to commercial on both ends.

Ms. Hulse said what neighbors were told about the corner of Inverness and Clinton Parkway was that if they didn’t support the Casitas project that something bigger and worse could be built. She said based on the drawings shown tonight the only way to build something bigger would be with a Special Use Permit. She said she was still not clear on that issue.

Commissioner Finkeldei asked if she would prefer commercial on the two ends.
Ms. Hulse said there would probably be neighborhood support for the Hy-Vee commercial as long as it did not allow multi-family. She said what happened with The Grove was that the neighbors were told it could not be tied to that specific project so the neighbors supported it because they supported senior housing and when that didn’t happen The Grove was put in instead. She said The Grove was a much more intensive project than what the neighbors were told originally. She said there was lack of trust with the neighborhood. She said there had been mixed comments from neighbors about commercial at the corner of Inverness and Clinton Parkway due to concerns with the kids walking back and forth.

Commissioner Liese thanked Ms. Hulse for her constructive and positive emails.

Mr. Davis Loupe wondered why the plan was even created. He thought it came out of the dispute that neighbors had about the last multi-family. He said the original plan from years ago for the area called for mixed use. He said most of the neighbors did not want more multi-family. He said apartments were mainly geared toward students and they want to live in the newest apartment complex so the older ones decline over the years. He said he disagreed with the idea that plot # 2 had undeveloped land. He thought that was to remain open space. He stated there was no grass on the open space and it still looked like a construction site. He supported Option 2 if it did not allow multi-family.

Commissioner Singleton asked why the neighbors were opposed to additional multi-family.

Mr. Loupe said because there was already so much of it. He stated that nobody in the neighborhood knew that Remington Square was happening.

Commissioner Singleton asked how apartment buildings had a negative impact on him.

Mr. Loupe said it was a lot of density and that in 5-10 years from now they could deteriorate and make the neighborhood less attractive. He said he would rather see commercial there than more dense apartments.

COMMISSION DISCUSSION
Commissioner Harris asked staff if the neighbors were notified about Remington Square.

Mr. McCullough said 200’ mailed notification was sent, signs posted at the site, as well as the newspaper legal notice.

Commissioner Rasmussen said he used to live on Shady Brook Lane when the whole Inverness Park area was proposed. At the time he was not too keen on a lot of apartments being built there. He liked the fact that the whole north part was supposed to be residential office and supposed to be a senior living area along Crossgate. He said he really empathized with the people who lived there in the single-family homes that have seen more and more intensive use put upon this land. He said because he had lived there he was not too favorable for Option 3. He felt that property was originally zoned for residential-office and then it was changed to multi-family residential. And now it was being considering for it to go to a more dense use, which he was not in favor of. He did think some types of commercial could benefit the neighborhood. He said he would not mind seeing lot 1 more akin to what was at Bauer Farm with commercial uses or something like the southeast corner of Bob Billings and Wakarusa where there were restaurants, beauty shops, coffee shops, etc. He said he would support commercial on those two ends. He said the overall Comprehensive Plan took a nodal approach and he thought there was concern discussed a few years ago about commercial
development between the nodal area at Kasold and Clinton Parkway and the next nodal area at Wakarusa and Clinton Parkway. He said there was validity to that concern but there had been talk about trying to create more walkable/livable neighborhoods. He said if there was convenience store, restaurants, shops that people could walk to, it would go toward a more walkable/livable neighborhood. He said the northeast corner of Clinton Parkway and Wakarusa was designed for commercial development but a lot of earthwork would have to happen for development to occur. He said maybe the appropriate approach was not to leapfrog around with development but instead gradually build it out along the Clinton Parkway corridor. He said he was not in favor of additional multi-family density increases so he would tend to support Option 2, instead of Option 1.

Commissioner Finkeldei said they should look more at Option 2 or 3. He felt there should be commercial in some of the areas. He did not feel that lot 1 should be multi-family. He thought staff should look at CN2 and 50%. He said he supported Walgreens at the other corner and that commercial would be good. He said he did not like the idea of talking about a plan at the same time there was a pending application. He said it was strange to be talking about Option 2 versus Option 3 in the abstract of whether or not they support something being built on the 5 acres. He stated in general he may not support any type of multi-family at that location if it was 4 bedroom apartments that were big and dense. He said on the other hand if it was a specific plan with 1 bedroom apartments that was an extension of something that already existed he might be okay with that. He said no matter what they do with the plan, whether they choose Option 2 or 3, they still have a plan to consider. He said he was more focused on lots 1, 4, 5, and 6 and bringing back Remington Place and Hy-Vee to consider. He said in general he supported Option 2 or 3.

Commissioner Harris agreed with Commissioner Rasmussen and did not support anymore high density residential in the area. She said regarding the staff report conclusion she felt that City Commission was asking staff to think about whether the recommendation made sense in the bigger picture so they asked staff to initiate the plan to look at the whole context and decide from there. She felt it would be proper for staff to change their mind if the plan in fact said that it would be a good way to go for the whole area. She believed some commercial in the area could benefit the existing neighbors but needed to be done carefully since Clinton Parkway was such a major street. She said that the commercial area could become a regional serving property and add more traffic to the area than a neighborhood business would. She liked the idea of creating places in the neighborhood that could be walked to for amenities. She suggested staff provide more education to the neighbors to clear up any confusion about the options that different zoning categories could bring. She said she understood concerns from the neighbors.

Commissioner Finkeldei agreed with Commissioner Harris. He thought it would be helpful to get staffs opinion.

Commissioner Singleton shared Commissioner Finkeldei’s theoretical concerns about discussing a neighborhood plan when they know a development proposal would be coming soon. She expressed concern about water drainage for Options 2 and 3. She said she was fine with commercial on the two corners.

Commissioner Dominguez said he voted for the Walgreens proposal and would support commercial development. He agreed with the neighbors about no more multi-family. He said he would vote for Option 2. He would also like to see the staff recommendation.

Commissioner Culver said in general he would support Option 2 or 3 and felt that commercial on either corner would make sense. He said he was a little torn on lot 2, although he agreed with
neighbors about the concern of high density residential increasing, he also had concerns about that land not being used. He said he would like direction from staff regarding lot 2.

Commissioner Blaser said that commercial on lots 1 and 3 would be good but felt that access would be an issue in both cases. He said he would support higher density on lot 2 because he saw it as infill and infill helped reduce sprawl. He said the area was a ways from residential. He said he had not observed the traffic problems in the area that Commissioner Liese mentioned earlier. He said he understood the neighbors concern about large student housing ending up where they thought senior housing would go but he said the senior housing could have been high density too. He felt the buffer on Inverness was good, regardless of which Option was chosen. He said he would pick Option 3 because he did not think the extra density would be noticed by the housing area to the west.

Commissioner Rasmussen said Planning Commission seemed to support commercial for lots 1 and 3. He suggested staff include discussion about how Planning might be able to influence the type and style of development. He said he hoped the back of the stores wouldn’t face Clinton Parkway. He said he would like to hear discussion about how Planning might be able to serve that area as an attractive corridor.

Commissioner Harris inquired about the empty land in the Remington Place Addition. She asked if the area was completely built out yet to its allowed density.

Mr. McCullough said it was.

Commissioner Harris said that area could be a very attractive open space for the neighborhood. She said if they allow the space to be developed, when the plan was to have lower density, they would be setting a precedent for other developments in the area. She did not think it was a good idea.

Commissioner Burger encouraged staff to revise the plan so neighbors could understand it. She said she was glad this was still a working document and that there was opportunity for more education for the neighbors. She did not support the increase in density. She said she was surprised that this project was going into this neighborhood. She did not like any of the three options because the area would be wonderful for a new urbanism concept. She gave the example of the Hollywood neighborhood in north Boulder, Colorado. She said she was not sure she would equate Hy-Vee with Walgreens as far as what it would do to the community but the neighborhood seemed to be okay with it.

Commissioner Liese said commercial uses on the corners of Inverness and Crossgate was a no brainer if done well. He wished the potential developer could put a park there. He also wished neighbors could be guaranteed that if this development occurred with higher density that it would improve the community not be a detrimental.

Mr. McCullough thanked the Commission for the good direction. He said every plan was unique. He said Remington Square, The Grove, and Legends at KU were all different in that the original plan did sort of self limit in terms of the intensity of the density. He said they did the maximum number of units but they were 1 bedroom units. He said there was opportunity in the plan for some detail description about what a development should be in terms of granting density but having some equivalent compatibility to what was there today. He said the east commercial proposed property was easy to determine what it would be, something small such as a gas station or convenience store. He said the other corner was a substantial piece of property that could hold a medium box retail store, for example. He said City Commission tasked them with looking at some of the nuances and trying to understand what intensity of development should go on these undeveloped parcels.
Commissioner Liese inquired about the need for apartments.

Mr. McCullough said the Planning office did not track that information.

**NO ACTION TAKEN**
ITEM NO. 10  COMPREHENSIVE PLAN ANNUAL REVIEW (MJL)

Receive the Comprehensive Plan Annual Review and initiate recommended comprehensive plan amendments to be considered at future meetings.

STAFF PRESENTATION
Ms. Michelle Leininger presented the item.

Commissioner Harris thanked staff for their work. She said she would like to see an overall analysis in the annual review of how Planning Commission uses the Comprehensive Plan as a tool in making land use decisions.

Commissioner Rasmussen inquired about the status of the Northeast Sector Plan.

Mr. McCullough said it was heard once by County Commission and scheduled to be heard again so it was still very viable. He said after that it would move on to City Commission.

Commissioner Rasmussen asked when City Commission would hear the Environmental Chapter.

Mr. McCullough said June 7th.

PUBLIC HEARING
No public comment.

ACTION TAKEN
Motioned by Commissioner Finkeldei, seconded by Commissioner Singleton, to initiate Comprehensive Plan Amendments for Planning Commission consideration at future public hearings.

Motion carried 9-0.
ITEM NO. 11 PRELIMINARY PLAT; KAPPA DELTA ADDITION; 1.8 ACRES; 1602 HIGH DR (SLD)

PP-3-2-11: Consider a Preliminary Plat for Kappa Delta Addition, a 1.8 acre subdivision containing one lot, located at 1602 High Drive. Submitted by Bartlett & West, for Zeta Epsilon House Corporation, property owner of record.

STAFF PRESENTATION
Ms. Sandra Day presented the item.

APPLICANT PRESENTATION
Mr. Darron Ammann, Bartlett & West, said he was aware of the communications sent by the neighborhood and appreciated their comments and concerns. He said he tried to get a neighborhood meeting set up but the neighborhood by-laws require a certain amount of time be given for notification so it did not work out. He said he made phone calls to a few people that were not returned. He said the rock garden deed was a mystery item that they did not know about. He stated when the survey manager pulled the new title deed description for the entire property the issue never came up. He said what they were doing at this time had no impact on platting the parcel lines and trying to combine the piece of property. He said this was a procedure to get a page and a half legal description reduced. He said he had several conversations with the applicant about doing some improvements to the property at some point in the future. He did not know what those improvements would be or when they would take place. He said there would be upgrades to the parking and maintenance upgrades to the building, such as a new roof.

Commissioner Harris inquired about the site improvements.

Mr. Ammann said in order to do any improvements the property needed to be platted because it had never been platted. He said the applicant was looking to enhance parking improvements and potentially a building addition in the far future. He stated the applicant wanted to work with the neighborhood and be a good neighbor.

Commissioner Harris asked if parking may be put on the piece of land the neighborhood thinks was restricted from adding parking.

Mr. Ammann said at this point in time his answer was that it was undetermined. He said probably not because they wanted to keep as much green space as possible in the front of the property.

Commissioner Dominguez inquired about the plan.

Mr. Ammann said platting needed to be done in order to move forward with a Site Plan at some point in the future. He said currently there was no concept of what would be done other than improve parking. He said the rock garden area was a private thing that was done between two private parties.

PUBLIC HEARING
Mr. Kurt Falkenstien, West Hills Neighborhood Association, said they had the indenture and were interested in keeping the rock garden as green space. He felt the Preliminary Plat should not be approved because the document specifically said it should not be.

Commissioner Dominguez asked how Mr. Falkenstien found out about the Preliminary Plat.
Mr. Falkenstien said word of mouth.

Commissioner Liese said the document was very interesting and asked staff to clarify if it was irrelevant to the Planning Commission decision.

Mr. McCullough said the City would have no regulatory authority to enforce the private deed restriction.

Mr. Randy Larkin, staff attorney, said it was an agreement between outside parties and the City would not get involved in enforcing those types of agreements or covenants between third parties. He said the platting process would establish the footprint for what it would be. He said the deed had no relevance to the platting process.

Commissioner Liese asked if he was indirectly advising Planning Commission to not consider it in their deliberations about the proposed plat.

Mr. Larkin said it had no effect on the process.

Mr. McCullough said staff was directly advising them to not necessarily consider it. He said it was always good information to know about these things but that there was no current proposal to impact the area at all, just simply platting and creating boundary lines. He said Site Planning could be a different story and when the notice goes out for the Site Plan the issue might come up again, although the staff legal position would still be the same. He stated as a plat issue it had very little relevance.

Commissioner Singleton asked if the neighborhood association was aware that by platting all the applicant was doing was combining the property into one lot for the legal description.

Mr. Falkenstien said tonight was the first time he had heard what the applicant was proposing.

Commissioner Singleton said at this point the applicant was just trying to compact the legal description.

Ms. Day said additionally, it would dedicate an easement to cover existing City utilities crossing the property and the additional minimum right-of-way width for the street.

Mr. Falkenstien said if it was at all related to parking and related to the rock garden the neighborhood would like to nip it in the bud tonight.

Commissioner Singleton said the plat had nothing to do with parking.

Commissioner Rasmussen said all Planning Commission would be doing was approving a plat. He asked if he would still recommend denial.

Mr. Falkenstien said no.

Commissioner Harris said one of the things in the deed was that if the property developed with parking or a building the rock garden would revert back to the ownership of the neighborhood association. She wondered if it was platted as one property would there be a mechanism to honor that.
Mr. Larkin said the City was not in a position to honor that and enforce a contract between outside parties. He said if there was violation then one party could possibly take action against the other party.

Commissioner Harris asked if the land could be subdivided.

Mr. McCullough said in the future there could be some sort of court order affecting the subdivision of the property.

Ms. Sarah Casad, 1130 Emery Rd, said the deed included a stipulation that if the land was ever built upon the ownership would revert back to neighborhood association because it was intended as a dedicated buffer. She felt it would change the character of the neighborhood. She said the sidewalk on the west side of Emery was because it would destroy the bird sanctuary on the east side. She suggested two plats, one with the original deeded property.

Ms. Susan Michalski, Kappa Delta Sorority, said the rock garden issue just came up this week. She said they purchased the property 20 years ago and this was never brought to their attention. She said when she took over she found out that none of the property was platted and they wanted to do things right that were not done in the past. She said knowledge of the deed was brand new and that they wanted to start on the right foot. She said when the property was built in the 1950's nobody had cars so they wanted to try and meet City requirements for residence and sidewalks. She said they were not intending to do any major projects or big construction. She said she was more than willing to meet with the neighborhood and address their concerns. She said they loved the green space and did not want anything to happen to it but that there were City requirements for the size of parking stalls and sidewalks that they were looking at from a liability standpoint. She said if they do need to change the parking lot they were not trying to wipe out all the trees.

Commissioner Harris asked if they currently had a parking capacity problem.

Ms. Michalski said when the new City requirements came about there was a certain number of lots required for the number of residents. She said the size, width, and depth of the lot might be an issue but they have not gotten into the details of that.

Commissioner Harris asked if they did not have enough parking spaces for the current residents and their guests the way it was currently configured.

Ms. Michalski said on weekends with visitors parking was always an issue. She said they did not know yet if they could add more asphalt.

Commissioner Dominguez asked if they had been notified by the City that they were in violation of parking.

Ms. Michalski said no.

Commissioner Dominguez asked if they planned on putting in additional parking.

Ms. Michalski said she was not sure. She said they needed to add more asphalt to the parking lot in order to drive across it.

Commissioner Dominguez asked if there was an increase in the number of residents.
Ms. Michalski said no, that the number of residents had decreased. She said they were not looking at building expansions.

COMMISSION DISCUSSION
Commissioner Singleton said the property needed to be platted and it made sense to plat the property, as well as the easement and right-of-way being good for the City. She recognized there may be some issues between the private land owners but it did not look like there was even any suggestion of a Site Plan that would affect the rock garden or the deed.

ACTION TAKEN
Motioned by Commissioner Singleton, seconded by Commissioner Liese, to approve the Preliminary Plat of the Kappa Delta Addition and forwarding it to the City Commission for consideration of dedication of easements and rights-of-way.

Commissioner Finkeldei agreed that Planning Commission does not consider private issues and for that reason he would support the plat. He hoped both sides worked on the issue.

Commissioner Harris said she would support this because platting it would allow the property to develop other areas that did not have anything to do with the garden and they couldn't do it otherwise. She said she did not see the advantage of two plats because it would still belong to the property owner and they could still do what they wanted and then the neighborhood could contest it with the deed. She did not think the neighborhood would lose anything in this process and would still have recourse with the document they had to limit development on that area, whether it was platted or not.

Motion carried 7-2, with Commissioners Burger and Dominguez voting in opposition.
ITEM NO. 12   IG TO RS5; .3 ACRES; 525 & 527 N 7TH ST (DDW)

Z-3-11-11: Consider a request to rezone approximately .3 acres from IG (General Industrial) to RS5 (Single-Dwelling Residential), located at 525 & 527 N 7th Street. Submitted by Nieder Properties, Inc., property owner of record.

STAFF PRESENTATION
Mr. Dan Warner presented the item.

Commissioner Rasmussen asked staff to identify on the overhead which residences were IG.

Commissioner Dominguez asked why property owners would want to rezone from IG.

Mr. Warner said the end result would get the property rezoned to what it was being used for.

APPLICANT PRESENTATION
Mr. Mike Nieder was present for questioning.

PUBLIC HEARING
No public comment.

ACTION TAKEN
Motioned by Commissioner Finkeldei, seconded by Commissioner Singleton, to approve the rezoning request for approximately .3 acres, from IG (General Industrial) District to RS5 (Single-Dwelling Residential) District and forwarding it to the City Commission with a recommendation for approval based on the findings of fact found in the body of the staff report.

Unanimously approved 9-0.

Motioned by Commissioner Finkeldei, seconded by Commissioner Culver, to direct staff to contact other single family developed property owners in the 500 block of N 7th Street to determine interest in rezoning to RS5.

Motion carried 9-0.
ITEM NO. 13   TEXT AMENDMENT TO CITY OF LAWRENCE DEVELOPMENT CODE; SEC 20-403; DETENTION PERMITTED WITH SPECIAL USE (SLD)

TA-3-5-11: Consider a Text Amendment to the City of Lawrence Land Development Code, Chapter 20, Article 4, Section 20-403 to change “Detention” from a use permitted by right in the IG (General Industrial) District to one permitted with Special Use approval. Initiated by Planning Commission on 3/28/11.

STAFF PRESENTATION
Ms. Sandra Day presented the item.

Commissioner Harris asked where other properties in town were zoned GPI.

Ms. Day said GPI properties could include City treatment facilities, schools, emergency services, police stations, fire stations, sewer plants, water treatment plants, and any public property that was not also the hospital.

Commissioner Finkeldei asked if it was safe to say all GPI zoned land was owned by government entities.

Ms. Day said that was correct.

Mr. McCullough said it was predominantly developed with those public uses.

Commissioner Dominguez asked if Planning Commission should determine whether there should be a Special Use Permit or not.

Ms. Day said there were two recommendations. She said with the GPI there was discussion about whether that should be a use by right or under the venue of a Special Use Permit.

PUBLIC HEARING
No public comment.

COMMISSION DISCUSSION
Commissioner Liese said it was his understanding that this was being recommending so they had more control over a decision to place a detention center where the community wanted it.

Commissioner Harris agreed with approval of the first part of the staff recommendation and that for the GPI district a Special Use Permit would absolutely be appropriate.

Commissioner Finkeldei said he did not absolutely agree that a Special Use Permit should be in the GPI district. He was not convinced a Special Use Permit was needed and that it could be awkward between the City and County. He said he would support the first part.

ACTION TAKEN
Motioned by Commissioner Finkeldei, seconded by Commissioner Singleton, to initiate a text amendment to the Land Development Code to require the Detention use to be approved through the Special Use process in lieu of being permitted by right.

Unanimously approved 9-0.
Motioned by Commissioner Finkeldei, seconded by Commissioner Singleton, to initiate a text amendment to Section 20-403 to include Detention as an allowed use in the GPI district (this use could be permitted as either by right or as a Special Use, depending on a more complete analysis of the change).

Commissioner Harris felt a Special Use Permit would be important because there were many GPI properties in residential neighborhoods and it would be a prudent process.

Commissioner Rasmussen said he would not vote in favor of this unless they do specifically recommend a Special Use Permit be required.

Commissioner Burger asked if it was permitted by right would there not be notice to the neighbors.

Mr. McCullough said one of the distinctions between IG and GPI was that there was not an inventory of GPI out there being marketed as GPI zoned property like there was IG. He said the big assumption was that if the County or City wanted to do a detention facility they would have to find a piece of property and go through the public process of rezoning it to GPI with the use known, the same process as a Special Use Permit. He said with IG a piece of property could be found in the community and an administrative Site Plan for a detention facility could be approved without any public process.

Commissioner Rasmussen asked if non-conforming uses could be expanded.

Mr. McCullough said likely they would have to request IG zoning.

Commissioner Rasmussen said it sounded like staff already determined that they need to have detention as an allowed use in GPI.

Mr. McCullough said staff identified that there were non-compliant uses in one of the three industrial categories and detention in two of the industrial categories so it was prudent to go through the process to attempt to remedy the non-conforming governmental uses. He said if it was concluded that it does not belong in GPI staff would need to take action to rezone those properties to IG or IL.

Commissioner Harris asked if there was any other method, such as another zoning category, that could be explored. She said industrial use had different impacts than detention use on the surrounding properties.

Mr. McCullough said staff could expand the analysis to talk about whether this particular use should be permitted in other districts.

Commissioner Rasmussen said his understanding was the motion was to allow detention facilities in a GPI district and put the burden on the staff to recommend Special Use or some other permitted use.

Commissioner Finkeldei said the motion was to initiate the drafting of a Text Amendment to be brought back before Planning Commission for consideration. He said he was leaving it up to staff to say either one of those because he did not want to pre-judge what the Text Amendment might say.

Commissioner Rasmussen asked what the motion was.
Commissioner Finkeldei said the motion was to initiate a Text Amendment to section 20-403 to include detention as allowed by the GPI district.

Commissioner Rasmussen said the motion already jumped to the conclusion that it needed to be an allowed use in GPI. He felt that one of the options that needed to be looked at was whether it should be allowed in GPI.

Commissioner Finkeldei said this would just initiate it and was the start of the process.

Mr. McCullough said what was initiated on all Text Amendments was consideration whether an allowed use was appropriate. He said the analysis would be whether detention should be an allowed use in the GPI district.

Commissioner Rasmussen said he would rather determine whether or not it should be an allowed use, as opposed to determining that it was already allowed.

Commissioner Finkeldei said the motion he made was exactly what Mr. McCullough said, in his opinion. He stated initiating a Text Amendment was initiating the consideration of the Text Amendment. He said he could say it differently or withdraw his motion and vote for Commissioner Rasmussen’s motion because he felt they were talking about the same thing.

Commissioner Finkeldei withdrew his motion, seconded by Commissioner Singleton.

Motioned by Commissioner Rasmussen, seconded by Commissioner Finkeldei, to recommend staff examine what the proper use should be in the GPI district and whether or not detention should be an allowed use, and if so, how should it be an allowed use.

  Motion carried 9-0.
ITEM NO. 14A ANNEXATION; 69 ACRES; SOUTH SIDE OF N 1800 RD & BETWEEN E 900 RD & E 950 RD (SLD)

A-3-1-11: Consider an annexation request for approximately 69 acres, located on the south side of N 1800 Rd (Farmers Turnpike) and between the extended alignments of E 900 Rd and E 950 Rd. Submitted by Steven Rothwell, Timothy W. and Lani S. Rothwell, for Timothy Rothwell, Wilber C. Rothwell, and Donald Kenna Rothwell, property owners of record.

ITEM NO. 14B A TO IG; 69 ACRES; 933, 939, & 943 N 1800 RD (SLD)

Z-3-8-11: Consider a request to rezone approximately 69 acres from A (Agricultural) to IG (General Industrial), located at 933, 939, & 943 N 1800 Rd. Submitted by Steven Rothwell, Timothy W. and Lani S. Rothwell, for Timothy Rothwell, Wilber C. Rothwell, and Donald Kenna Rothwell, property owners of record.

STAFF PRESENTATION
Ms. Sandra Day presented items 14A and 14B together.

Commissioner Dominguez asked what percentage of the property was type I and II soils.

Ms. Day said there were no type I, only type II soils, and that she did not do that analysis.

Commissioner Liese asked if an Urban Growth Area was legally defined.

Ms. Day said it was very specifically defined in Horizon 2020.

Commissioner Liese asked if this was within 3 miles of Lecompton.

Ms. Day said no.

Commissioner Liese asked if the Urban Growth Area expanded with annexation.

Ms. Day said no, it would require a change in the future to the Urban Growth Area.

Mr. McCullough said it was already initiated in a Text Amendment that was deferred until the water and wastewater master plans were completed.

Commissioner Harris inquired about the criteria to evaluate ‘..hinder or prevent the proper growth.’

Ms. Day said the legislation did not give any more guidance than that. She said annexations were evaluated based on policies in Horizon 2020.

Mr. McCullough said the County looks at whether it hinders or prevents the proper growth. He said staff interprets the statute to require the County to act as an arbitrator of whether a request to annex in one city would impact another city. He said in this circumstance there were well defined growth boundaries and planning documents that helped give guidance about whether something in that area of the county would be appropriate in Lawrence.

Commissioner Harris asked if the findings of fact would be the planning documents and the fact that no one from other cities came tonight to say that this would impact their city negatively.
Mr. McCullough said those would be appropriate findings. He said also the finding that Lawrence was planning for infrastructure in that area and no other city was.

Commissioner Harris inquired about the language of one of the conditions regarding building permits.

Ms. Day said the conditions with this request were identical to what they have seen previously. She said in some ways it would be easier to get sanitary sewer to the property than water so the interim ability to use an agreement with the Rural Water District to provide water service could be an option. She said depending on what the end user was they may have to have sanitary sewer, but may be able to do on-site as well.

Commissioner Harris read part of the condition ‘...the uses being those that can be served by rural water or on-site sanitary sewer...’ She thought there were no plans in the near future to extend services until the area in between was developed.

Ms. Day said there were no near plans. She said they did a general assessment of what could or would be needed.

Commissioner Harris asked if the City would pay for the sewer line.

Mr. McCullough said that was undetermined. He said there were different financing mechanisms that would help finance the infrastructure and that it would have to be completely analyzed and determined for opening up an area or specific property.

Commissioner Rasmussen inquired about the long term effect of this provision. He asked if it would always run with the land. He also inquired about being able to get building permits.

Mr. McCullough said the intent was not to allow the user to perpetually go without City services. He said the intent was to have an interim plan established until City services were extended to the area.

Commissioner Rasmussen asked if the provision meant only prior to the extension of City water and sanitary sewer service.

Mr. McCullough said that was the intent of that provision.

Commissioner Culver said regarding an earlier question from Commissioner Dominguez, that type II soils made up 11.3% of the property, according to the staff report.

APPLICANT PRESENTATION
Mr. Matthew Todd, Barber Emerson, thanked staff for their work. He said the location of the property made for an excellent industrial site. He said there was no specific development plan in place but the applicant was asking to be annexed into the City and to be rezoned. He said the Rothwell’s made multiple efforts to contact their neighbors and get them involved. He said regarding water usage the Rothwell’s have been in contact with Rural Water District #6 and received confirmation that the district would be pleased to continue to provide water service if and when the annexation was approved. He said the property was in the Urban Growth Area and that it was a voluntary annexation request which was prioritized by Horizon 2020. He said regarding the earlier concern from Commissioner Harris about the specific findings to whether the annexation would be detrimental to the proper growth and development of the area or any other cities; it would be
appropriate for Planning Commission to make certain findings but ultimately the statute directs for the County Commission to make that determination. He said based on the Sector Plan the Planning Commission may be able to make findings that by approving the rezoning they would be facilitating the growth and development in accordance with the Sector Plan, which would be an appropriate growth and development of the area.

PUBLIC HEARING on Annexation
Mr. Dan Brogran, Trust Company of Kansas, said he was the agent investment advisor for the property owner immediately to the west, and that they had no reservations about the rezoning and annexation.

Mr. Don Rothwell, applicant, said he was not looking to move for 3-4 years. He said he would appreciate their recommendation of approval.

COMMISSION DISCUSSION
Commissioner Harris asked if there had been progress on infrastructure planning since the last annexation request.

Ms. Day said it was still being analyzed between City Utilities staff and the consultant who were going through the modeling process. She said there were some discrepancies in some flow data so they had to go back and revisit that which set them back about 90 days.

Mr. McCullough said regarding the Wastewater Master Plan there had not been much advancement in specifically getting sewer and water to the property since they last had a potential user in the area.

Commissioner Dominguez inquired about the issue of island annexation discussed in the letter sent by Mr. Darrel Ward.

Mr. McCullough said the staff report articulated the annexation policies that supported this annexation. He said the goal was to identify areas for industrial, primary job growth, and employment areas, which was seen as high value to the community.

Commissioner Rasmussen suggested additional language to the beginning of condition 1, ‘Prior to the extension of City water or City sanitary sewer service,…’

ACTION TAKEN on Item 14A
Motioned by Commissioner Rasmussen, seconded by Commissioner Singleton, to recommend approval and forward the recommendation to the City Commission for the approval of the requested annexation of approximately 69 acres located on the south side of N 1800 Road (Farmer’s Turnpike) and between the extended alignments of E 900 Road and E 950 Road subject to the following conditions:
1. Prior to the extension of City water or City sanitary sewer service, building permits may be issued for the property if the City of Lawrence reasonably determines that either City water or City sanitary sewer service is not required to serve the uses on the property, the uses being those that can be served by rural water or on-site sanitary sewer management systems (including, but not limited to sewage storage tanks).
2. The applicant shall execute an agreement not to protest the future annexation of any adjacent rights of way or roadway easements.

Motion carried 8-1, with Commissioner Harris voting in opposition.
Motioned by Commissioner Singleton, seconded by Commissioner Liese, to make a recommendation to the County Commission that they find that the annexation will not hinder or prevent the proper growth and development of the area or that of any other incorporated city located within the Douglas County and that the annexation is compatible with Horizon 2020 and the K-10 and Farmer’s Turnpike Plan.

Motion carried 9-0.

PUBLIC HEARING on Rezoning

Ms. Beth Johnson, Lawrence Chamber of Commerce, stated Lawrence needed more industrial sites. She said Topeka added 1,000 acres of industrial space in the past year with a new business park that they purchased with money through their economic development funds that were put aside each year. She said Topeka gives land away for free to companies and also gives them a check to move their company. She said Lawrence could not begin to compete with that because Lawrence did not have property zoned correctly or infrastructure in place. She said in 2010 the Chamber saw five different opportunities come to them for land along I-70. She showed on the overhead two letters that came to the Chamber in the past two weeks that were specific requests for industrial sites.

Mr. Darrel Ward requested the rezoning be tabled. He stated he did not receive proper notification for commonly owned property. He said his brother received notification, he and his wife received notification, but the commonly owned property did not receive notification. He referenced the Kansas State Statute regarding notice requirements.

Commissioner Singleton asked who the four joint property owners were.

Mr. Ward said himself, his brother, his sister, and his nephew. He expressed concern about inconsistency with notification.

Commissioner Liese asked what Mr. Ward was requesting.

Mr. Ward requested that they table the rezoning request. He said at this meeting he was not trying to argue for or against the rezoning.

Commissioner Rasmussen asked if he received notice concerning the annexation.

Mr. Ward said two of the three properties received notice.

Commissioner Rasmussen asked if he personally received notice.

Mr. Ward said he did.

Commissioner Harris asked Mr. Ward when he receives his tax bill from the County who it is sent to.

Mr. Ward said it is addressed to all the property owners and is sent to his mailing address.

Commissioner Dominguez asked if he wanted to defer the rezoning and then come back and argue against it.

Mr. Ward said he would like it tabled until notification was given. He said the biggest issue was that notification was not provided as per statute.
Commissioner Singleton asked if he discussed it with his sister or nephew.

Mr. Ward said no.

Mr. McCullough said the state statute required newspaper legal notification, sign posting, and mailed notice. He said the intent was to get broad notice out to the stakeholders affected by a zoning application. He said the County Clerk provided a certified property ownership list and it would seem to indicate all the property owners were notified that were required to be notified by statute.

Mr. Ward said there was inconsistency with the mailed notice because not all of the property owners received notice.

Mr. McCullough said the further intent of wide distribution notice was that people would talk amongst themselves or neighbors.

Mr. Ward said he was not an agent for the Planning office and under no obligation to speak to anyone.

Mr. McCullough said preliminary analysis of the record indicated staff did what was required under state statute.

Mr. Ward said he respectfully disagreed.

Ms. Gwen Klingenberg said she was having trouble with the concept that IG was a better product because it had more available. She said she went through the Code and found that IL had 21 more uses than IG. She said IG had uses that they probably would not want, such as explosive storage, industrial intensive, and mining. She said the idea of possibly putting a hotel at this location would do a lot more for the City than just something an IG could. She thought they needed to consider whether they wanted IG or IL. She was in favor of IL because she liked the hotel idea. She said when it came to policy making there needed to be balance. She said the neighborhood was not against IL, they were against IG.

Commissioner Harris asked what her understanding was of what was considered industrial intensive.

Ms. Klingenberg said anything that was obnoxious, major light pollution, major smell pollution, anything dangerous, chemical storage, mining, etc. She did not feel this corner would be appropriate because it was a major center into the community and into Lecompton.

COMMISSION DISCUSSION
Commissioner Rasmussen inquired about why IG was requested.

Mr. Todd said if the property was annexed into the City it needed some sort of City zoning designation. He said IG came from the Sector Plan which already evaluated what the appropriate uses for the area would be. He said at this point in time a specific use for the site was unknown so it would enable the property owners to promote the property adequately and for the Chamber to bring in companies interested in stimulating the economic development of the community. He said there was certainly opportunity for uses in the IL category that also fall in the IG category but at this point in time until a specific use was known or a specific user was interested in the property it needed to have some sort of general industrial zoning classification in order to open it up for potential uses. He
said regarding the issue of notification, the certified list from the County Clerk’s office did have three separate tracts owned by the Ward family but they all had the same mailing address.

**ACTION TAKEN on Item 14B**

Motioned by Commissioner Liese, seconded by Commissioner Singleton, to approve the rezoning request (Z-3-8-11) for 69 acres from County A (Agricultural) District to City IG (General Industrial) District and forwarding it to the City Commission with a recommendation for approval based on the findings of fact found in the body of the staff report.

Commissioner Dominguez said there needed to be a tax base to support nice amenities for the community. He stated he hated for that scenery to go away but that he would support the motion.

Commissioner Harris said she agreed this was a good place for industrial but was uncomfortable with how quickly they were moving toward putting infrastructure there. She said the Comprehensive Plan cautioned against doing that because it was not good for the community to pay for that. She said if there was another mechanism or language in the Comprehensive Plan that said industrial parks would use different rules she would feel more comfortable approving this. She said she would vote against the motion.

Motion carried 8-1, with Commissioner Harris voting in opposition.
ITEM NO. 15  TEXT AMENDMENT TO CITY/COUNTY SUBDIVISION REGULATIONS AND DOUGLAS COUNTY CODE; BUILDING SETBACKS ALONG US HWY 40 (DDW)

TA-4-7-11: Text Amendment to Section 20-814 of the Joint City/County Subdivision Regulations of the Code of the City of Lawrence, Kansas and Chapter 11, Section 814 of the Douglas County Code, which concerns extraordinary building setbacks along US Highway 40, west of K-10 Highway. *Initiated by Planning Commission on 2/23/11.*

STAFF PRESENTATION
Mr. Dan Warner said they were asking to withdraw the Text Amendment.

ACTION TAKEN
Motioned by Commissioner Harris, seconded by Commissioner Singleton, to withdraw Text Amendment, TA-4-7-11, to Section 20-814 of the Joint City/County Subdivision Regulations of the Code of the City of Lawrence, Kansas and Chapter 11, Section 814 of the Douglas County Code, which concerns extraordinary building setbacks along US Highway 40, west of K-10 Highway.

Motion carried 9-0.
ITEM NO. 16  TEXT AMENDMENT TO CITY OF LAWRENCE DEVELOPMENT CODE; MULTI-DWELLING RESIDENTIAL ZONING DISTRICT RM64 (MJL)

TA-3-3-11: Consider Text Amendments to the City of Lawrence Land Development Code, to various sections regarding creation of a new multi-dwelling residential zoning district, RM64. Initiated by City Commission on 4/5/11.

ITEM NO. 17  TEXT AMENDMENT TO CITY OF LAWRENCE DEVELOPMENT CODE; CHP 20; PLANNED DEVELOPMENT OVERLAY DISTRICT (MJL)

TA-3-4-11: Consider Text Amendments to the City of Lawrence Land Development Code, Chapter 20, Article 6 & 7, regarding revisions to the district criteria and development standards in the Planned Development Overlay District. Initiated by City Commission on 4/5/11.

STAFF PRESENTATION
Ms. Michelle Leininger presented items 16 & 17 together.

Commissioner Harris said it seemed to say if there was an RM district next to an RS district and a one-story house on the RS lot you did not have to build a one-story multi-family house, you could build maximum height of two-story.

Mr. McCullough said that was correct, the one-story house would have the ability and right to go up to the maximum of 34’.

Commissioner Harris said she saw a lot of benefits to what was being proposed. She said she also saw the potential for people not liking what happened in the PD districts. She asked if staff anticipated any problems with developing according to the new standards in the PD districts proposed.

Mr. McCullough said it would be case by case proposals to the Planning Commission and City Commission. He felt it was an appropriate tool in the toolbox that was not being used because of all these challenges. He said they could be used to a greater degree to help meet the Comprehensive Plan policies and to get compatible and creative projects going.

Commissioner Harris inquired about applying this in the Oread neighborhood with small homes that were zoned RM instead of RS.

Ms. Leininger said specifically in the Oread neighborhood a lot of those single-family homes were more of the traditional two and three-story houses so some of that was already mitigated by the existing structures. She said neighborhood context could be taken into consideration with the PD overlay.

APPLICANT PRESENTATION
Mr. Paul Werner, Paul Werner Architects, said this started because they wanted more flexibility. He said the first thing they started with was the size. He said staff worked on the height to fix the flaw in the Code. He said the PD Overlay would essentially be on a case by case basis, not city wide. He said regarding the RM64 there was no desire to have 160 units per acre anywhere. He said it came out of the desire for a higher density zoning district. He said he did not know why Horizon 2020 did not support it. He said the land value 20 years ago did not drive the type of projects seen today.
Commissioner Rasmussen asked if he had a preference of RM64 or the PD Overlay.

Mr. Werner said the PD Overlay was his preference because it was more simple.

**PUBLIC HEARING on both items 16 & 17**

Mr. Dennis Brown, Lawrence Preservation Alliance, said the PD Overlay made more sense. He felt this was being brought forward to increase the density for a major project in the 1000 block of Indiana and possibly another in the 1100 block. He said Lawrence Preservation Alliance was not opposed to finding a tool that worked for those specific projects, provided they could pass historic review. He said the concern was what may work there could have a detrimental effect to historic and older housing elsewhere. He stated the RM32 density definition died because it wasn’t specific enough. He said the PD Overlay route allowed for one at a time project review. He expressed concerns about no minimum acreage. He wondered how the PD Overlay would not increase the redevelopment process.

Ms. Gwen Klingenberg, Lawrence Association of Neighborhoods, felt the PD Overlay was the better way to go. She expressed concerns about no minimum acreage and density changes. She was concerned about apartment windows being placed to look directly into single-family homes.

Commissioner Harris asked what she would recommend for acreage.

Ms. Klingenberg said would like at least 1 acre.

Commissioner Rasmussen asked for clarification about her concern regarding height. He said he felt like the house next to his could look into his home and vice versa.

Ms. Klingenberg said in most cases, especially with new development, they were very careful to make sure windows did not look into each other.

Ms. Marci Francisco felt the PD Overlay was a better tool but limited design standards with just height and setbacks. She felt the character of the neighborhood needed to be considered. She said there should be an acreage minimum. She said City Commission should have the ability to increase parking in certain circumstances. She suggested a variety of units with a sliding scale on density/bedrooms.

**ACTION TAKEN on item 16**

Motioned by Commissioner Singleton, seconded by Commissioner Harris, to deny the proposed amendments TA-3-3-11 to the City of Lawrence Land Development Code to the City Commission based on the findings of fact outlined in the staff report

Commissioner Finkeldei said he would vote in favor of the denial of RM64 but would be open at some point to consider something less.

Motion carried 9-0.

**COMMISSION DISCUSSION**

Commissioner Finkeldei asked why staff was recommending 0 acreage.

Mr. McCullough said it allowed for maximum flexibility and all the figures were somewhat arbitrary.
Commissioner Finkeldei inquired about parking and the idea of allowing City Commission to increase or decrease it.

Ms. Leininger said for residential they would go to the Board of Zoning Appeals but for non-residential the City Commission could approve it with a parking study justification for reductions.

Commissioner Finkeldei said he would agree with allowing City Commission to consider an increase or decrease in parking.

Ms. Leininger said the Code requires 1 parking space per bedroom and an extra one for every 10 units. She said not everyone in a bedroom would have a car so it would even out.

Commissioner Singleton asked what language would address the character of the neighborhood.

Mr. McCullough said the character of the neighborhood was one of the golden criteria for any rezoning request process.

Commissioner Harris asked how this Text Amendment would preserve older structures.

Mr. McCullough said the difference in the two Text Amendments was that the RM32 would establish a standard that could have been used by right, the PD Overlay was a rezoning process so it added a few layers of public review.

Commissioner Harris asked how much space was needed to construct underground parking.

Mr. Werner said it had to meet the same dimensional standards as a normal parking lot. He said 50’ wide would be too narrow so a single 50’ lot would be tough. He said if it was turned the other direction 117’ would be better.

Commissioner Rasmussen would like to see examples of how it could be applied to properties.

**ACTION TAKEN on item 17**
Motioned by Commissioner Singleton, seconded by Commissioner Liese, to defer the item until June 20, 2011.

Motion carried 9-0.

**PUBLIC COMMENT SECTION**

**ADJOURN 11:55pm**
# Mid-Month & Regular Meeting Dates

**Mid-Month Meetings, Wednesdays 7:30 - 9:00 AM**

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**Regular Meetings 6:30 PM, Mon & Wed**

**Mid-Month Topics**

- January 24
- February 23
- March 28
- March 30
- April 25
- April 27
- May 23
- May 25
- June 20
- June 22
- July 25
- July 27
- August 22
- August 24
- September 26
- September 28
- October 24
- October 26
- November 14
- November 16
- December 12
- December 14

**Suggested topics for future meetings:**

- How City/County Depts interact on planning issues
- Stormwater Stds Update – Stream Setbacks
- Overview of different Advisory Groups – potential overlap on planning issues
- Open Space Acquisition/Funding Mechanisms (examples from other states)
- TDRs
- Library Expansion Update
- Joint meeting with other Cities’ Planning Commissions
- Joint meeting with other Cities and Townships – UGA potential revisions
- Presentation from KC-metro Planning Directors
- Tour City/County Facilities
- 2010 Census Data

**Meeting Locations**

The Planning Commission meetings are held in the City Commission meeting room on the 1st floor of City Hall, 6th & Massachusetts Streets, unless otherwise noticed.

**Planning & Development Services | Lawrence-Douglas County Planning Division | 785-832-3150 | www.lawrenceks.org/pds**

Revised 5/17/11
June 17, 2011

RE: Text Amendment to City of Lawrence Development Code; CHP 20; Synthetic Turf as Landscaping Material

To Mary Miller,

After reviewing the staff report regarding the above mentioned text amendment going before the planning commission on June 22, 2011, we would like to request this item be deferred until the next planning commission meeting in July.

This should give us enough time to gather more information in response to staff comments regarding the use of synthetic turf.

Respectfully,

Paul Werner

cc: Scott McCullough
ITEM NO. 1  CONDITIONAL USE PERMIT FOR A PRESCHOOL; 2084 N 1300 RD (SLD)

CUP-4-2-11: Consider a Conditional Use Permit for a Preschool located at 2084 N. 1300 Road. Submitted by Kristine Lawhorn for United Methodist Church of Eudora, property owner of record. Joint meeting with Eudora Planning Commission.

STAFF RECOMMENDATION: Staff recommends approval of a Conditional Use Permit for a preschool located at 2084 N 1300 Road.

Reason for Request: “To operate a licensed preschool facility”

KEY POINTS
- Existing Church building includes office and classroom space used for religious education.
- Property is adjacent to K-10 Highway along north property line.
- Property is adjacent to the City of Eudora along the east property line.
- No physical changes to the site are proposed by this use.

ATTACHMENTS
- Site Plan
- Floor plan
- City of Eudora Future Land Use Plan

GOLDEN FACTORS TO CONSIDER

ZONING AND USES OF PROPERTY NEARBY
- City and suburban residential uses are located to the east and southeast.
- Agricultural zoning abuts subject property to the west, south and north of K-10 Highway.

CHARACTER OF THE AREA
- The proximity of the area to the City limits of Eudora creates a suburban character to the area.

SUITABILITY OF SUBJECT PROPERTY FOR THE USES TO WHICH IT HAS BEEN RESTRICTED
- The proposed request will not alter the underlying zoning district.
- Child Care Centers (preschools) are allowed in the A District with a Conditional Use Permit.

ASSOCIATED CASES/OTHER ACTION REQUIRED
- Approval by Board of County Commissioners.

PUBLIC COMMENT RECEIVED PRIOR TO PRINTING
- None to date.
GENERAL INFORMATION

Current Zoning and Land Use: A (Agricultural); Existing Church.

Surrounding Zoning and Land Use: A (County Agricultural District) to the north (north of K-10 highway) and to the west and south.

City of Eudora to the east, east of E 2100 Road/Winchester Road.

A-1 (Suburban Home Residential) to the southwest; existing large lot residential subdivision.

<table>
<thead>
<tr>
<th>Site Summary:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject Property:</td>
<td>35.413 acres</td>
</tr>
<tr>
<td>Existing Building:</td>
<td>14,322 SF</td>
</tr>
<tr>
<td>Off Street Parking Required:</td>
<td>Standard: 1 space per classroom (Section 12-316-1). Maximum 8 class rooms = 8 spaces.</td>
</tr>
<tr>
<td>Off Street Parking Provided:</td>
<td>142 parking spaces provided.</td>
</tr>
<tr>
<td>Approved Site Plan:</td>
<td>SP-10-64-04; original church development</td>
</tr>
<tr>
<td>Proposed Preschool:</td>
<td>2 classrooms currently</td>
</tr>
<tr>
<td></td>
<td>4 classrooms by fall 2011</td>
</tr>
<tr>
<td></td>
<td>8 maximum classrooms</td>
</tr>
<tr>
<td>Class room size</td>
<td>10 children per class room [80 children program maximum]</td>
</tr>
<tr>
<td>Staff</td>
<td>4 staff currently [10 staff maximum at full capacity]</td>
</tr>
<tr>
<td>Hours of Operation</td>
<td>Monday through Friday AM Session (8:15 to 11:15) PM Session (11:45 - 3:15)</td>
</tr>
</tbody>
</table>

Summary of Request

This request is for a Conditional Use Permit to allow a preschool (Child Care Center) to be operated from the existing church. No physical changes to the property are proposed. The church includes a number of existing classrooms. The application indicates that the program will include two to four classrooms initially (10 children per classroom) with future growth of the program up to a total of 8 classrooms (80 maximum children). This maximum is based on the availability of space within the existing building. Other state standards for child care must be met separately.

The proposed hours of operation are from 8:00 to 3:00 with a morning session and an afternoon session. Hours of operation are summarized in the table above. Initially, staff will include a total of four individuals. As the program grows additional staff will be added. Staffing levels are also regulated by state standards. Approval from the County Health Department is also required.

I. ZONING AND USES OF PROPERTY NEARBY

The property is currently zoned A Agricultural. The area east of E 2100 Road/Winchester Road is located within the City of Eudora. A platted rural residential subdivision is located to the southwest. The immediate zoning includes both A and A-1 zoning in the County portion of the surrounding area. Land uses include both residential and agricultural uses.
Staff Finding - This property is located along Kansas Highway 10 and abuts the existing Eudora city limits. Land uses include both residential and agricultural activities.

II. CHARACTER OF THE AREA

This property is located adjacent to the City of Eudora and northeast of an existing rural residential subdivision. The area is transitioning to a suburban character as Eudora expands to the south.

Staff Finding - This is located adjacent to the City of Eudora. As the City develops to the south this area will be incorporated into the city limits. The character of the area is generally one of transition from Agricultural to suburban.

III. SUITABILITY OF SUBJECT PROPERTY FOR THE USES TO WHICH IT HAS BEEN RESTRICTED

Applicant’s response: “Property is properly zoned and equipped for institutional use.”

A Conditional Use Permit (CUP) does not change the base, underlying zoning. Therefore, the suitability of the property for continued church use will not be altered.

The 6.3 acre property is developed with a church and parking lot capable of supporting the proposed child care center. Approval of the request allows for multi-use of an existing building.

Staff Finding - The property is suitable for the uses to which it has been restricted and for the proposed child care center.

IV. LENGTH OF TIME SUBJECT PROPERTY HAS REMAINED VACANT AS ZONED

Staff Finding - The subject property is developed with a church and parking lot (SP-10-64-04). The County Zoning was adopted in 1966, this property has been zoned “A (Agricultural)” since that adoption.

V. EXTENT TO WHICH REMOVAL OF RESTRICTIONS WILL DETRIMENTALLY AFFECT NEARBY PROPERTY

Applicant’s Response: “None”

Section 12-319-01.01 of the County Zoning Regulations recognize that “certain uses may be desirable when located in the community, but that these uses may be incompatible with other uses permitted in a district...when found to be in the interest of the public health, safety, morals and general welfare of the community may be permitted, except as otherwise specified in any district from which they are prohibited.” The proposed use falls under section 12-319-4.30 Child Care Center of the Zoning Regulations for the Unincorporated Territory of Douglas County.

Approval of this CUP will allow the applicant to operate a preschool/Child Care Center as an accessory use to the church. There are no proposed changes to the property that are required to accommodate this use. Existing classroom space used for religious education provides ample room for the weekday program. An existing enclosed playground area provides an outdoor recreation area typically required per State Health Department standards.
Hours of operation are proposed as Monday – Friday from 8:15 to 3:15 for the program operation. Staff generally would be present on site prior to and after the program hours as needed. This time is generally consistent with other non-residential/business activity located in other areas of the City of Eudora. Access to the site is accommodated via N 1300 Road/W. 20th Street. No negative impacts are anticipated by the weekday use of the church building on the surrounding area.

**Staff Finding** - The addition of a daytime use will not affect nearby properties resulting from hours of operation or traffic.

**VI. RELATIVE GAIN TO THE PUBLIC HEALTH, SAFETY AND WELFARE BY THE DESTRUCTION OF THE VALUE OF THE PETITIONER’S PROPERTY AS COMPARED TO THE HARDSHIP IMPOSED UPON THE INDIVIDUAL LANDOWNERS**

Applicant’s Response: “The public will benefit by having additional access to early education.”

Evaluation of the relative gain weighs the benefits to the community-at-large vs. the benefit of the owners of the subject property.

The application lists the proposed use as “preschool”. This use is considered to be a child care center per the definition provided in the County Zoning Regulations. In practice preschools and child care centers are similar terms that tend to be used interchangeably providing elements of both child care and early education based on the structure of the program. This request is intended to operate as a preschool offering early childhood education in a more formal setting. Early education is associated with later educational performance. Provision of these services within neighborhoods allow children to form neighborhood connections earlier in life and are more likely to attend school with peers in the same school district.

- Approval of the request will provide an opportunity for clients of the program to develop neighborhood connections that include future classmates upon entering local schools.
- Approval of the request allows for multi-use of existing building and infrastructure improvements.

**Staff Finding** - Approval of the Conditional Use Permit may benefit the community by adding child care options for residents within the community. This request benefits the community by utilizing existing property and infrastructure improvements.

**VII. CONFORMANCE WITH THE COMPREHENSIVE PLAN**

Applicant’s Response: “The request conforms with Horizon 2020’s goal of increasing the diversity of educational opportunities, creating stronger interrelationships among public and private organizations and ensuring that development is compatible with its surroundings and the community. (Horizon 2020 1-3)”

The property is located within the city of Eudora’s Urban Growth Boundary. The area located along the south side of K-10 Highway west of E 2100 Road/Winchester Road is designated on the future land use Map as planned Mixed Use (Map 10 Eudora Comprehensive Plan). The property is located within the unincorporated area of Douglas County. Horizon 2020 defines the rural area as: “area that is located outside of the designated Urban Growth Areas of the incorporated Cities.” Because of the proximity to the City of Eudora and the existence of the Eudora Urban Growth Boundary,
conformance with the Eudora Comprehensive Plan is considered to take precedence. The Eudora Comprehensive Plan defines mixed use as incorporating:

“…residential, retail and office uses. Retail and office uses may be stand-alone or may be on the ground floor with residential on the upper floors. This category supports a variety of zoning districts; however, the focus of development within the category is not so much as use as it is on design. All development projects should be well planned and designed to ensure a high level of compatibility with surrounding development. Accordingly, the Planned Unit Development process needs to be employed to ensure the objectives of this category and the planning districts are met.”

The plan further defines public and semi-public uses as the following:

“This category includes uses such as schools, churches, post offices, fire stations, libraries, cemeteries, utility facilities, governmental uses and religious institutions. The zoning code may or may not include an exclusive public/semi-public district but these uses are identified on the Future Land Use Map in order to identify actual and proposed uses within the planning area.

The existing church located at 2084 N 1300 Road was built after the land use plan was completed in 2003. Later updates to the plan did not update the area to include the existing church. As noted above the property is not yet located within the Eudora city limits.

The proposed request does not include physical development of the site nor does it propose annexation into the city of Eudora or Eudora city rezoning.

Horizon 2020 does not address Conditional Use Permits as a tool to achieve specific policies. This area is generally anticipated to eventually be incorporated by the City of Eudora. The Eudora Comprehensive Plan supports logical growth along established corridors south of K-10 Highway between Winchester Road and Church Street. The Eudora Comprehensive Plan also includes policies regarding public and semi-public uses. The plan specifically states:

“The City should support the development and expansion of the various organizations serving all residents of all ages and needs, including the City’s youth and the growing segment of the population that is age 65 and older. This includes the City’s educational facilities and nursing homes.”

Horizon 2020 recognizes the importance of urban growth boundaries for all cities in Douglas County. Deference is given to the land use plans articulated in the Eudora Comprehensive Plan.

**Staff Finding** - A Conditional Use Permit can be used to allow specific uses that are permitted in a zoning district with the approval of a site plan. This tool allows development to occur in harmony with the surrounding area. The proposed request is consistent with future land use plans for the City of Eudora.

**VIII. PROFESSIONAL STAFF RECOMMENDATION**

The proposed request abuts the existing Eudora city limits along the east property line and K-10 Highway along the north property line. The proposed request does not include any physical
alteration to the site and is considered to be beneficial in providing additional child care and early education options within the community. The proposed use will co-locate within an existing church and utilize existing infrastructure. The proximity of the property to the City of Eudora suggests an appropriateness to consider land use recommendations based on the Eudora Comprehensive Plan. Support for this argument is included in Horizon 2020 by recognition of urban growth boundaries of the incorporated Cities of Douglas County. Staff recommends approval of the proposed Conditional Use Permit.

STAFF REVIEW (Site Plan)

A site plan was approved by the County Commission in August 2005 for the construction of a 14,322 SF church. The site plan included a conceptual addition to the building but did not include the phasing schedule for the addition. The parking lot was sized to accommodate the 251 projected seats of the sanctuary space. The site plan shows a future parking area that could be expanded in the future if needed.

This proposed request for a preschool does not include any physical changes to the site. Existing religious education classrooms will double as preschool classrooms. The existing outdoor area is fenced and will be used for the preschool during program hours. The initial program proposal will include up to four of the existing eight classrooms in the building. As the program grows additional space and staff will be added. The existing building and parking lot are more than adequate to accommodate the maximum program projection of 80 students.

No conditions of approval are required for this use.
CUP-04-02-11: Conditional Use Permit for a Preschool
2084 N 1300 Road

Lawrence-Douglas County Planning Office
June 2011

Area Requested

Scale: 1 Inch = 2000 Feet
Map 10
Future Land Use Map
City of Eudora, Kansas

LEGEND
- City of Eudora Planning Area
- City of Eudora Corporate Limits
- Roads
- Parcels
- Water Features
- 100-year Floodplain
- 500-year Floodplain
- Major Ridge Lines
- Land Use
  - Rural Policy Area
  - Low-Density Residential
  - Medium-Density Residential
  - High-Density Residential
  - Mixed Use
  - Central Business District
  - Commercial Business Park
  - Industrial Park
  - Public/Semi-Public Parks & Open Space
- Overlays
  - Central Business District
  - K-10 Corridor
  - Gateways

NOTE: Central Business District and K-10 Corridor Overlays as identified by the City of Eudora Zoning Regulations.
PLANNING COMMISSION REPORT
Regular Agenda -- Public Hearing Item

PC Staff Report 6/20/11

ITEM NO. 2 TEXT AMENDMENT TO CITY OF LAWRENCE DEVELOPMENT CODE; CHP 20; PLANNED DEVELOPMENT OVERLAY DISTRICT (MJL)

TA-3-4-11: Consider Text Amendments to the City of Lawrence Land Development Code, Chapter 20, Article 6 & 7, regarding revisions to the district criteria and development standards in the Planned Development Overlay District. Initiated by City Commission on 4/5/11. Deferred by Planning Commission on 5/25/11.

Report revised from May 25, 2011 Report

RECOMMENDATION: Staff recommends that the Planning Commission give direction on the minimum area requirement, density calculation and parking and loading standards and forward a recommendation for approval of the proposed amendments to the City Commission.

Reason for Request: To make the PD overlay more useable for smaller properties.

RELEVANT GOLDEN FACTOR:
- The amendment is in conformance with the comprehensive plan.

PUBLIC COMMENT RECEIVED PRIOR TO PRINTING
- LAN letter
- Kirk McClure letter dated 5/23/11
- Marci Francisco letter dated 5/23/11
- League of Women Voters letter dated 5/22/11

OVERVIEW OF PROPOSED AMENDMENT
The request considered on May 25th included reducing the minimum area of a PD Overlay District from 5 acres to 0 acres, and to modify standards to allow for lesser setbacks if the base district of adjacent properties is the same as the base district of the proposed PD Overlay. The request also proposed to permit a potential density modification to calculate 2-bedrooms or smaller units in multi-dwelling structures as .5 dwelling units for overall density calculations. The PC provided direction to staff on May 25th, see Staff Review section of this report for a discussion on revisions.

CONFORMANCE WITH THE COMPREHENSIVE PLAN
Horizon 2020 speaks to infill development that is compatible to the surrounding development and aesthetics. PD Overlays allow greater flexibility and can help to achieve the goals and policies of the plan.

CRITERIA FOR REVIEW AND DECISION-MAKING
Section 20-1302(f) provides review and decision-making criteria on proposed text amendments. It states that review bodies shall consider at least the following factors:

1) Whether the proposed text amendment corrects an error or inconsistency in the Development Code or meets the challenge of a changing condition; and
Applicant Response:
The proposed amendment does not correct an error in the development code but allows more flexibility regarding the location of PD developments.

This amendment does meet the challenge of a changing condition. It has become more important to develop land responsibly in order to reduce urban sprawl. By allowing a PD to develop with a minimum lot size of 0 acres, as long as it meets the base district zoning requirements, responsible urban and infill development can occur in appropriate locations. We believe the PD may be a valuable tool in order to deal with infill, redevelopment and new development in unique areas of Lawrence. A PD district should allow flexibility to address conditions affecting the proposed development. One tool that will allow flexibility is staff's proposed definition of density per unit which reads, “To calculate density and minimum outdoor area for Multi-Dwelling Structures as .5 dwelling units per acre for studio, 1 and 2 bedroom units and 3 or more bedroom units count as 1 dwelling unit” should be included as part of this TA in order to encourage developers to build 1 and 2 bedroom units. The existing PD setbacks requirement may work on the current minimum site of 5 acres however, on a smaller lot the setbacks are not feasible and will need modified to allow PD development on sites in an established neighborhood, i.e. 20-701(f)(4)(i) will need to be revised because as it currently reads this section would require a much larger setback between a PD district and adjacent district, even if they are both in a RM base district.

Staff Response:
Staff believes that the proposed changes are correcting an error in the code. Under the previous code, the planned development was its own zoning district and was used frequently with little predictability and very detailed standards. With the adoption of the Land Development Code, the planned development option became an overlay which relies more on the standards of the base district. With this being the case, some of the previous code standards for a PD transferred over to the current code such as peripheral boundaries, and additionally increased the minimum area for the district from 2 acres to 5 acres. All of these standards have hindered the utilization of the PD overlay in infill situations where the concept of a PD overlay would be a useful tool.

2) Whether the proposed text amendment is consistent with the Comprehensive Plan and the stated purpose of this Development Code (Sec. 20-104).

Applicant Response:
Horizon 2020 states in several areas that infill development is encouraged. Updating the PD minimum acreage to 0 would allow a way for Horizon 2020’s goals to be met. Horizon 2020 page 5-1 states, “Infill residential development should be considered prior to annexation of new residential areas.” It further states, “A mixture of housing types, styles and economic levels should be encouraged for new residential and infill developments.” Page 5-5 states, “A range of densities and housing types should be encouraged” and page 5-29 states, “Encourage new and existing medium and higher-density residential development which is compatible in size, architectural design, orientation, and intensity with the surrounding land uses in established areas.”

The proposed amendment is consistent with the Development code in that it does not endanger the health, safety and general welfare of the citizens of Lawrence.

Staff Response:
Horizon 2020 supports compatible infill development which is a stated purpose in the Development Code. With the PD Overlay, there is the opportunity for flexibility in the development in order to
achieve greater compatibility with the surrounding existing development. Having a well planned development that fits in with the surrounding properties protects, enhances and promotes the general welfare of the citizens of Lawrence.

Staff Review
At the May 25th Planning Commission meeting, the Commission discussed three items regarding the proposed text amendment and asked staff to provide more information and revise the language for additional discussion. The three items were the minimum district size, ability to increase as well as decrease parking, and the calculated density amendments. Below is a discussion of options for these changes.

- **Section 701(e) Minimum District Size**
The original request from the applicant was to revise the minimum district size from 5 acres to no minimum. Staff is comfortable with the requested 0 acre minimum as the base district has density and dimensional standards which include minimum lot area requirements (smallest is the RS3 which is 3,000 sq ft). The purpose of overlay districts are that the base district holds the regulations and the overlay district is used to alter some of those regulations to meet a specific goal. Below are some options if the Commission feels a minimum district size is appropriate.

  - 3,000 square feet: Utilizing the PD Overlay for 1-3,000 square foot may not be realistic considering the potential cost and time involved in a PD Overlay process when traditional variances would potentially be a better way to address the proposed variance in regulations.
  - 5,850 square feet: The size of an Original Town Center lot.
  - 11,700 square feet: The size of two Original Town Center lots.
  - ½ acre (21,780 square feet): Would equate out to just over 4 Original Town Center Lots (23,400 sq ft).
  - 1-2 acres with the prevision that the City Commission can reduce the size with justification. This was a provision in the previous code Planned Development section. Below is the previous code language. Something similar could be drafted.

20-1003(b)(2) Notwithstanding the provisions of Section 20-1003(b)(1) an application for a Planned Commercial Development on a tract less than two acres may be filed and a public hearing shall be held thereon, as hereinafter provided, but no tentative approval of such application shall be given by the Planning Commission unless it shall first find, upon a showing by the landowner, that the minimum number of acres required in Section 20-1003(b)(1) should be waived because a Planned Commercial Development would be in the public interest, and that two or more of the following conditions exist:

  (A) Such usage of the property would be consistent with the adopted comprehensive plan of the city;
  (B) The property is adjacent to property which has been developed or redeveloped under the Planned Commercial Development District provisions of this article, and a Planned Commercial Development expansion would contribute to the maintenance of the amenities and values of the neighboring property;
  (c) The property is adjacent to or across the street from property which has been developed or redeveloped for commercial purposes and which would not create conditions leading to a continuous linear extension of commercial usage or encroachment into an established residential area; or,
(D) Such use would not impose an adverse impact on any public facilities, utilities, transportation or storm drainage system or upon adjacent property.

- **Section 701(f)(3) Residential Density**
  This section added the previously proposed text change from the RM32 District text amendment (TA-6-8-10 has been withdrawn) and included an example table. This density calculation is in addition to the potential increase by the CC for up to 25% that is already permitted in the section and only for multi-dwelling structures. The original argument with the proposed .5 calculation is that a developer was that the same number of bedrooms could be obtained within the same building shell, even though there would be more dwelling units.

The Planning Commission asked staff to look at different ranges of calculating the density due to public comment that most development would simply contain all 2-bedroom units. Examples of different ranges are given below in a table form. The tables show 3 different calculations:
- .5 for 2-bedroom and under,
- .75 for 2-bedroom and .5 for 1-bedroom and studio, and
- .6 for 2-bedroom and .4 for 1-bedroom and studio.

Please note that the examples are pure and not a mix of unit types which is likely. It is assumed in all the examples that lot size is held constant and all other code requirements can be met.
### .5 dwelling units for 2-br and less

<table>
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<tr>
<th>Dwelling Unit Types</th>
<th>Actual # of Dwelling Units</th>
<th>Calculated # of Dwelling Units</th>
<th># of Bedrooms</th>
<th>Req. Outdoor Area (square feet)</th>
<th>Parking 1/br + 1/10du</th>
<th>Actual # of Dwelling Units with PD Overlay</th>
<th>Potential du with PD Overlay – 25% increase + calc. (calc. du)</th>
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</thead>
<tbody>
<tr>
<td>4-bedroom units</td>
<td>20</td>
<td>20</td>
<td>20 * 4 = 80</td>
<td>20 * 50 = 1,000</td>
<td>80 + 2 = 82</td>
<td>20 + 25% = 25</td>
<td>20 + 25% = 25</td>
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<tr>
<td>2-bedroom units</td>
<td>40</td>
<td>40 * .5 = 20</td>
<td>40 * 2 = 80</td>
<td>20 * 50 = 1,000</td>
<td>80 + 4 = 84</td>
<td>40 + 25% = 50</td>
<td>(40 + 25%) * .5 = 25</td>
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</table>

### .75 dwelling units for 2-br and .5 dwelling units for 1-br and studio

<table>
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<tr>
<th>Dwelling Unit Types</th>
<th>Actual # of Dwelling Units</th>
<th>Calculated # of Dwelling Units</th>
<th># of Bedrooms</th>
<th>Req. Outdoor Area (square feet)</th>
<th>Parking 1/br + 1/10du</th>
<th>Actual # of Dwelling Units with PD Overlay</th>
<th>Potential du with PD Overlay – 25% increase + calc. (calc. du)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-bedroom units</td>
<td>20</td>
<td>20</td>
<td>20 * 4 = 80</td>
<td>20 * 50 = 1,000</td>
<td>80 + 2 = 82</td>
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<td>2-bedroom units</td>
<td>27</td>
<td>27 * .75 = 20</td>
<td>27 * 2 = 54</td>
<td>20 * 50 = 1,000</td>
<td>54 + 3 = 57</td>
<td>27 + 25% = 33</td>
<td>(27 + 25%) * .75 = 25</td>
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<td>1-bedroom units</td>
<td>40</td>
<td>40 * .5 = 20</td>
<td>40 * 1 = 40</td>
<td>20 * 50 = 1,000</td>
<td>40 + 4 = 44</td>
<td>40 + 25% = 50</td>
<td>(40 + 25%) * .5 = 25</td>
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### .6 dwelling units for 2-br and .4 dwelling units for 1-br and studio

<table>
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<tr>
<th>Dwelling Unit Types</th>
<th>Actual # of Dwelling Units</th>
<th>Calculated # of Dwelling Units</th>
<th># of Bedrooms</th>
<th>Req. Outdoor Area (square feet)</th>
<th>Parking 1/br + 1/10du</th>
<th>Actual # of Dwelling Units with PD Overlay</th>
<th>Potential du with PD Overlay – 25% increase + calc. (calc. du)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-bedroom units</td>
<td>20</td>
<td>20</td>
<td>20 * 4 = 80</td>
<td>20 * 50 = 1,000</td>
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<td>20 + 25% = 25</td>
<td>20 + 25% = 25</td>
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<td>2-bedroom units</td>
<td>34</td>
<td>34 * .6 = 20</td>
<td>34 * 2 = 68</td>
<td>20 * 50 = 1,000</td>
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<td>1-bedroom units</td>
<td>50</td>
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<td>20 * 50 = 1,000</td>
<td>50 + 5 = 55</td>
<td>50 + 25% = 62</td>
<td>(50 + 25%) * .4 = 25</td>
</tr>
</tbody>
</table>
• **Section 701(i) Parking and Loading**
  Changes allow for a decrease or increase in parking by the CC for residential uses and decrease in non-residential uses with the submission of a parking study. The original text permitted a decrease for any use by the CC.

  (i) Parking and Loading
  The City Commission may decrease or increase the number of off-Street Parking and loading spaces required for residential uses for good cause shown. The City Commission may decrease the number of off-Street Parking for non residential uses with the submission of a parking study prepared by the applicant as outlined in Section 20-905(b). Parking and loading areas shall comply with all otherwise applicable design standards.

Attached is the draft language in the code sections. The sections that the Planning Commission requested more information on are highlighted and staff will revise these sections accordingly with the Planning Commission recommendation before forwarding the text amendment to the City Commission.

**Staff Recommendation**
Staff recommends that the Planning Commission give direction on the minimum area requirement, density calculation and parking and loading standards and forward a recommendation for approval of the proposed amendments TA-3-4-11 to Land Development Code to the City Commission.
20-602 MEASUREMENT OF AND EXCEPTIONS TO DENSITY AND DIMENSIONAL STANDARDS

(a) Generally
See the rules of Section 20-107(d), regarding the rounding of fractions, for all relevant calculations of minimums and maximums pursuant to this Article.

(b) Lot Area
The area of a Lot includes the total horizontal surface area within the Lot’s boundaries, not including submerged lands, public Access Easements or rights-of-way. For Nonconforming Lots, see Section 20-1504.

(c) Lot Width
Lot Width is the distance between Side Lot Lines measured at the point of the required Front Setback or chord thereof.

(d) Site Area
For purposes of Minimum and Maximum Site Area requirements, site area is the total contiguous land area included within a Zoning District. For example, if the minimum site area requirement of a Zoning District is 2 acres, no property may be rezoned to that District unless it includes a minimum site area of 2 acres or it abuts another Parcel in the same Zoning District and the site area of the combined Parcel is at least 2 acres in area. If there is a maximum site area requirement, no property may be rezoned to that Zoning District unless the maximum site area, including the site area of abutting Parcel in the same Zoning District, does not exceed the maximum site area for that Zoning District.
(c) **Setbacks and Required Yards**

(1) **Front and Exterior Side Setbacks**
Front and Exterior Side Setbacks extend the full width of a Lot and are measured from the Street right-of-way line. The Front and Exterior Side Setbacks will overlap at the outside corner of the Lot. The following exceptions apply:

(i) In any District where 35% or more of the Frontage on one side of a Street between two intersecting Streets is improved with Buildings whose Front Setbacks do not vary more than 15 feet from the required Front Setbacks of the Base District, any new Building erected may comply with the average Front Setback of the existing Buildings.

(ii) The widths of developed Lots will be used to determine the percentage of Frontage that is developed.

(iii) The actual Setbacks of Buildings fronting on the Street will be used to determine the average Front Setback.

(2) **Rule for Through Lots**
A Through Lot shall have two Front Setbacks, at opposite ends of the Lot. The Front Setback provisions of this section shall apply to both. Other sides of a Through Lot shall be subject to Side Setback standards.

(3) **Interior Side Setbacks**

(i) **Measurement**
Interior Side Setbacks extend from the required Front Setback line to the required Rear Setback line and are measured from the Side Lot Line. If no Front or Rear Setback is required, the required Setback area shall run to the opposite Lot Line.

(ii) **Exception**
The width of one Interior Side Setback may be reduced by the Planning Director to a width of not less than 3 feet if the sum of the widths of the two Interior Side Setbacks on the same Lot is not less than the combined required minimum for both Side Setbacks. This reduction may be authorized only when the Planning Director finds the reduction is warranted by the location of existing Buildings or conducive to the desirable
development of two or more Lots.

(4) **Rear Setbacks**

(i) **Measurement**

*Rear Setbacks* extend the full width of the *Lot* and are measured from the *Rear Lot Line*.

a. In calculating the required depth of a *Rear Setback* abutting an *Alley*, the *Rear Setback* may be measured from the centerline of the abutting *Alley*.

b. On *Corner Lots* in RS10 and RS7 Districts, *Structures* may be located at an angle, with the long axis of the *Lot* facing the intersecting *Street Lines*. In such cases, the *Front and Side Setback* standards of Section 20-216(d) apply, but the minimum *Rear Setback* is reduced to 20 feet.

(5) **Setbacks for Speaker Box Systems**

There shall be a minimum of one hundred (100) feet between any speaker box system, such as those commonly used at fast order food establishments, and any residence in a residential district.

(i) **Screening**

(ii) Any area intended or employed for a use that requires Special Use approval under Article 4 shall be located at least 50 feet from any residential *Lot* or District or be so Screened as to provide visual and auditory privacy to such *Lot* or District.

(6) **Permitted Exceptions to Required Yard and Setback Standards**

*Required Yards* and *Setbacks* shall be unobstructed from the ground to the sky except that the following features may be located therein to the extent indicated:

(i) Cornices, canopies, eaves or other architectural features may project into *Required Yards* up to 2.0 feet.

(ii) Unenclosed fire escapes may project into *Required Yards* and/or *Setbacks*, provided that they are set back at least 3 feet from all *Lot Lines*.

(iii) An uncovered stair and necessary landings may project into *Required Yards* and/or *Setbacks*, provided that they are set back at
least 3 feet from all Lot Lines, and the stair and landing may not extend above the entrance floor of the Building except for a railing not exceeding 4 feet in Height.

(iv) Bay windows, balconies, and chimneys may project into Required Yards and/or Setbacks up to 2 feet, provided that such features do not occupy, in the aggregate, more than 1/3 the length of the Building wall on which they are located.

(v) Mechanical Structures are items such as heat pumps, air conditioners, emergency generators, and water pumps. Mechanical Structures are not allowed in required Front or Side Yards, but they may be located in required Rear Yards if they are located at least 5 feet from the Rear Lot Line.

(vi) Vertical Structures are items such as flag poles, trellises and other garden Structures, play Structures, radio Antennas, and lamp posts. Vertical Structures are allowed in Required Yards if they are no taller than 30 feet. If they are taller, they are not allowed in required Setbacks, except that flag poles are allowed in any Required Yard.

(vii) Uncovered horizontal Structures are items such as decks, stairways, entry bridges, wheelchair ramps, swimming pools, hot tubs and tennis courts that extend no more than 2.5 feet above the ground are allowed in required Setbacks; such Structures may be enclosed by fences, in accordance with other provisions of this section but shall not be otherwise enclosed. Swimming pools shall be fenced in accordance with Chapter 5, City Code.

(viii) Covered Accessory Structures (Buildings) are items such as garages, greenhouses, storage Buildings, wood sheds, covered decks, coops for fowl, and covered porches. Covered Accessory Structures that are six feet or less in Height are allowed in required Side and Rear Yards, and covered Accessory Structures greater than six feet in Height are allowed in the required Rear Yard where an Alley abuts the Rear Lot Line, but no covered Accessory Structure is allowed in a required Front Yard.

In addition, coops for fowl shall meet all setback requirements established in Article 5 of Chapter III of the City Code. Setback standards contained in Article 5 of Chapter III of the City Code are not subject to Board of Zoning Appeals review.
(ix) Fences, walls or hedges up to six feet in height (at any point) above the elevation of the surface of the ground may be located in any Required Yard, except:

a. as otherwise provided in City Code Chapter 16, Article 6; and

b. on Corner Lots with a Rear Lot Line that abuts a Side Lot Line of another Lot in a Residential District, no fence, wall or hedge within 25 feet of the common Lot Line may be closer to the Exterior Side Lot Line than one-half the depth of the actual Front Setback of the Lot that fronts on the side Street.

(7) **Setbacks Along Designated Thoroughfares**

The minimum Front and Exterior Side Setbacks for each Lot that abuts a Street shown on the Lawrence/Douglas County MPO Transportation Plan, as amended, shall be measured from the recommended ultimate right-of-way line for each classification of Street.

(f) **Building Coverage**

Building coverage refers to the total area of a Lot covered by Buildings or roofed areas, as measured along the outside wall at ground level, and including all projections, other than Open Porches, fire escapes, and the first 2.0 feet of a roof overhang. Ground-level Parking, open recreation areas, uncovered patios and plazas will not be counted as Building coverage.

(g) **Outdoor Area**

(1) **Purpose**

The required outdoor area standards assure opportunities for outdoor relaxation or recreation. The standards help ensure that some of the land not covered by Buildings is of an adequate size, shape and configuration to be useable for outdoor recreation or relaxation. The requirement for outdoor area serves as an alternative to a large Rear Setback and is an important aspect in addressing the livability of a residential Structure on a small Lot.

(2) **Requirements**
(i) The minimum outdoor area for each Dwelling Unit shall be a contiguous area and may be on the ground or above ground.

(ii) The area shall be surfaced with lawn, pavers, decking, or sport court paving that allows the area to be used for recreational purposes. User amenities, such as tables, benches, trees, planter boxers, garden plots, drinking fountains, spas, or pools may be placed in the outdoor area. It may be covered, such as a covered patio, but it may not be fully enclosed. Driveways and Parking Areas may not be counted toward fulfillment of the outdoor area requirement.

(iii) The required outdoor area may not be located in the required Front Setback or Exterior Side Setback.

(h) Height

(1) Measurement

Building Height is measured as the distance between a reference datum and (1) the highest point of the coping of a flat roof; (2) the deck line of a mansard roof; or (3) the average Height of the highest gable of a pitched or hipped roof. The reference datum is either of the following, whichever yields a greater Height of Building:

(i) The elevation of the highest adjoining sidewalk or ground surface within a 5-foot horizontal distance of the exterior wall of the Building when such sidewalk or ground surface is not more than 10 feet above lowest Grade. (See “Case I” in accompanying illustration.)

(ii) An elevation 10 feet higher than the lowest Grade when the sidewalk or ground surface described in sub-paragraph Section 20-602(h)(1)(i) above is more than 10 feet above lowest Grade. (See “Case II” in accompanying illustration.)
(2) **Height Limit on Projects Adjoining Certain Residential Zoning Districts**

(i) **Applicability**
The Height limitations set out in this Section shall apply to any Building constructed in a non-RS Zoning District on a Parcel adjoining, or separated only by an Alley or a Public Street from, a Parcel of land in any RS Zoning District, except that this limit shall not apply to any Building constructed in the CD Zoning District.

(ii) **Height Limit Related to Setback**
Any Building or Structure to which this Section is applicable shall be set back from the Yard-property line adjoining the RS Zoning District by the minimum Setback established in Section 20-601 when the Building or Structure is the same or lesser Height than the Building or Structure on the adjoining maximum permitted height of the adjoining RS Lot. When the Height of the Building or Structure exceeds the Height of the Building or Structure on maximum permitted height of the adjoining RS Lot, the minimum Setback for the non-RS zoned property shall be equal to the Building’s Height.

(3) **Exceptions**
(i) Except as specifically provided herein, the **Height** limits of this Development Code do not apply to any roof **Structures** for housing elevators, stairways, tanks, ventilating fans, solar energy Collectors, or similar equipment required in the operation or maintenance of a **Building**, provided that such **Structures** do not cover more than 33% of the roof area or extend over ten (10) feet in **Height** above the maximum **Height** allowed by the **Base Districts**.

(ii) Except as specifically provided herein, the **Height** limitations of this Development Code do not apply to radio **Antennas**, television **Antennas**, church spires, steeples, clock towers, water towers, flag poles, construction cranes, or similar attached and non-habitable **Structures**, which may be erected above the **Height** limit, nor to fire or parapet walls provided that such walls may not extend more than five (5) feet above the roof.

(iii) **Telecommunication Towers** may exceed the **Zoning District Height** limit if reviewed and approved as a Special Use in accordance with Section 20-1306.
ARTICLE 7. PLANNED DEVELOPMENTS

20-701 PLANNED DEVELOPMENT OVERLAY DISTRICT

(a) **Purpose**
The PD, Planned Development, regulations are intended to:

1. ensure development that is consistent with the Comprehensive Plan;
2. ensure that development can be conveniently, efficiently and economically served by existing and planned utilities and services;
3. allow design flexibility that results in greater public benefits than could be achieved using conventional Zoning District regulations;
4. preserve environmental and historic resources; and
5. promote attractive and functional residential, nonresidential, and mixed-use developments that are compatible with the character of the surrounding area.

(b) **Procedure**
PDs shall be reviewed and approved in accordance with the procedures of Section 20-1304.

(c) **Developer’s Statement of Intent**
Each PD application shall include a comparison of the proposed development with the standards of the Base District and the otherwise applicable standards of this Development Code. Applications shall also include a Statement by the applicant describing how the proposed development provides greater benefits to the City than would a development carried out in accordance with otherwise applicable Development Code standards.

(d) **Effect of Other Development Code Standards**
Except as expressly authorized by the regulations of this section and approved as part of a PD plan (in accordance with the procedures of Section 20-1304), all of the standards of this Development Code apply to development within a PD District.

(e) **Minimum District Size**
Minimum area for a PD district shall be five acres. There shall be no minimum acreage required for a PD district.

(f) **Standards Eligible for Modification**
As a condition of approval, the Planning Commission or City Commission may designate by ordinance or as a note on the face of the development plan, any specific use, Structure or Building Type which shall be restricted and excluded as part of the Planned Development Overlay District. The City Commission may modify
the following standards during the PD approval process. Standards not listed are not eligible for modification.

(1) **Allowed Uses**

The Planning Commission shall recommend, and the City Commission shall approve, a list of uses allowed in a PD at the time of PD preliminary approval. Regardless of the fact that the approved uses may be determined by reference to a Base District, the list of approved uses shall be incorporated into and made a condition of the PD approval. The City Commission may approve only uses that are allowed in the Base District, provided that:

(i) PDs in Single-Dwelling and Multi-Dwelling (RS and RM) Districts may include land area for commercial uses at a ratio of up to 50 square feet of land area per Dwelling Unit.

(ii) commercial uses, in addition to those otherwise permitted by right, may be approved in a PD in an RS or RM District, if the PD includes a minimum area of 10 acres or more than 100 Dwelling Units.

(2) **Lot Size**

The minimum Lot size standards of the Base District may be reduced by the City Commission, provided that Lot sizes shall be adequate to safely accommodate all proposed Buildings and site features.

(3) **Residential Density**

(i) **Density Increase**

The City Commission may increase the maximum Net Density beyond that of the Base District by up to 25% if the City Commission determines that such an increase is warranted to support the public benefit likely to result from the proposed development.

(ii) **Density Calculation**

For Multi-Dwelling Structures, studio, 1 bedroom and 2 bedroom units shall count as .5 Dwelling Units, and 3 or more bedroom units shall count as 1 Dwelling Unit for the purpose of calculating the maximum Dwelling Units per acre. Minimum outdoor area, as required in Article 20-601(a), shall be met based on the total calculated Dwelling Unit count and not the actual number of Dwelling Units.

**Example of Actual and Calculated Dwelling Unit Count**

<table>
<thead>
<tr>
<th>Dwelling Unit Types</th>
<th>Actual # of Dwelling Units</th>
<th>Calculated # of Dwelling Units</th>
<th># of Bedrooms</th>
<th>Req. Outdoor Area (square feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 4-bedroom units</td>
<td>20</td>
<td>20</td>
<td>20 * 4 = 80</td>
<td>20 * 50 = 1,000</td>
</tr>
</tbody>
</table>
(4) **Setbacks**

The minimum Setback standards of the Base District may be reduced by the City Commission, provided that:

(i) Buildings located within the PD and along any District boundary that is adjacent to RS and or RM Zoning Districts shall be Setback a distance at least equal to the Height of the proposed Building. The zoning district adjacent to the PD district is more intense than the base district of the PD according to the Lesser Change Table in Section 20-1303; and

(ii) All exterior walls of detached Buildings shall be separated by a minimum distance of 10 feet.

(iii) Balconies shall not be located along peripheral site Setbacks adjacent to RS zoned properties unless privacy Screening and Landscaping is included in the design.

(g) **Height**

The City Commission may increase maximum Height limits of the Base District if the Commission determines that such an increase is warranted to support the public benefit likely to result from the proposed development. Height increases shall be permitted only for Buildings set back from the boundary of the PD by the Height of the proposed Building plus 25 feet Base District Setback plus the increase in the height of the Building, so that the primary impact of the increased Height is on property within the PD.
(h) **Balconies**

Balconies above the second Story of a multi-Dwelling Unit Building are prohibited along the exterior of a Planned Development unless the Building Setback is increased to at least double the required minimum Setback and Landscaping is enhanced with two or more of the following features: a minimum 4’ Berm, a solid Screening fence (6’ minimum Height) or a masonry wall (6’ minimum Height). This provision shall apply only to those exterior sides of a Planned Development that are adjacent to RS zoning or to detached Dwelling Units.

(i) **Parking and Loading**

The City Commission may decrease or increase the number of off-Street Parking and loading spaces required for residential uses for good cause shown. The City Commission may decrease the number of off-Street Parking for non residential uses with the submission of a parking study prepared by the applicant as outlined in Section 20-905(b). Parking and loading areas shall comply with all otherwise applicable design standards.

(j) **Buffer Areas**

Development within 60 feet of the peripheral boundary of the PD shall be limited to the following:

1. Use category, Heights, Setbacks and minimum Lot sizes permitted in the Zoning District immediately adjoining the proposed PD on the date of preliminary development plan approval of the PD; and

2. A landscaped buffer, including a Berm (minimum 4’ in Height), a masonry wall (minimum of 6’ in Height) or a fence (minimum 6’ in Height).

(k) **Common Open Space**

1. **Amount Required**

   The PD shall include at least 20% of the total site area as Common Open Space. Environmentally sensitive lands, if present, shall be protected and included within the Common Open Space. 50% of the Common Open Space shall be developed as Recreational Open Space unless environmentally sensitive lands are present, in which case the amount of Recreational Open Space may be reduced to no less than 5% and no more than 10% of the Common Open Space, with the intent being to preserve all or as much environmentally sensitive lands as possible in their natural state.

2. **General Provisions**
See Section 20-703 for General Provisions applicable to Open Space in a PD or Cluster Development.

(4)(k) Additional Requirements and Standards

(1) Unified Control
   No application for a PD will be accepted or approved unless all of the property included in the application is under unified Ownership or a single entity's control.

(2) Street Access
   PDs that will generate 100 or more average daily trips (based on traffic generation estimates of the Institute of Transportation Engineers’ Trip Generation Manual, 7th edition, or subsequent edition, or based on local estimates provided by the City) shall have Access to an Arterial Street using a Frontage or rear Access road or by taking direct Access to a Collector Street.

   Individual residential Building Lot shall not take direct Access to an Arterial Street or a non-Residential Collector Street. Each individual residential Lot shall have Frontage on a public or Private Street that has been constructed to the Public Street standards of the City.

(3) Sidewalks
   Sidewalks built to City specifications shall be built along both sides of all public and Private Streets. On Local Streets, sidewalks shall be at least 5 feet in width; on all other Streets sidewalks shall be at least 6 feet in width.

(4) Landscaping
   The Landscaping and Screening standards of Article 10 apply to PDs. In addition, any part of the development area not used for Buildings, Structures, Parking, Streets, or Accessways shall be landscaped with a sufficient mixture of grass, vegetative Ground Cover, trees, and Shrubs, except those areas designated to be preserved with natural vegetation.

(5) Preservation of Natural Features
   Mature stands of trees or individually significant mature trees, vegetative cover, watercourses and other natural site features shall be preserved to the greatest extent possible. At a minimum the common open space provisions in this section and the standards of Article 10 apply.

(6) Zoning Map
   Approved PDs shall be identified on the Official Zoning District Map.

(7) Additional Conditions
   The Planning Commission may recommend, and the City Commission may impose, other reasonable conditions and standards, as deemed necessary to ensure consistency with the purposes of this section and those of this Development Code. Such conditions may include limitations on the types of uses, Structures or Building Types to be allowed in the PD. When such conditions are imposed, an application will not be deemed approved until the applicant has complied with all of the conditions of approval.

(9)(m) Additional Standards for PD's with Residential and Nonresidential Uses
   In PDs containing both residential and nonresidential uses, the nonresidential uses shall be designed, located, and oriented on the site so that such uses are directly
accessible to residents of the PD. For the purposes of this Section, directly accessible shall mean pedestrian/Bicycle and automobile Access by way of improved sidewalks or paths and Streets that do not involve leaving the PD or using a major Thoroughfare. "Directly accessible" does not necessarily mean that nonresidential uses need to be located in a particular location but that the siting of such uses considers the accessibility of the residential component of the PD to the nonresidential use.
June 14, 2011

RE: PD Text Amendment

Dear Michelle Leininger,

Here are a few comments to follow up on the PC discussion regarding the PD Text Amendment.

First, we would agree that it is easy to let the CC have the authority to increase or decrease the parking requirements of a project.

Second, we would like to discuss the area requirement. After reviewing several small projects, it does appear that there is little need for someone to go the PD route if they just own one lot. However, there are several older projects on two lots which may benefit from this text amendment. So, it would seem a minimum lot area might be a quarter of an acre (.25ac).

Third, regarding the height, we think that the wording should be revised slightly to state that the height can be increased when the setback is increased on the front or side yards, but not required against the alley. This would keep the mass of the buildings further from the street and closer to the alleys.

The final comment relates to the bedroom equivalent. Attached is a spreadsheet which is an effort to try to compare the different numbers that have been suggested and how those numbers may impact the type of units built. I am not sure what can be deciphered from this chart other than the numbers are actually fairly close, so maybe it really does not matter which ratio is used. If someone wants to maximize the number of bedrooms they will still build all four-bedrooms. I think option C is the most accurate, but also creates the most potential for someone to just build one bedrooms. Option A and B are the simplest, but also provide no ‘incentive’ for the construction of one-bedrooms. My thought is, either go with the ratios of Option D which provides some incentive for one bedrooms, or go with A since it is the simplest.

Please let me know your thoughts and we can discuss this at your convenience.

Sincerely,

Paul Werner
### Equivalent Bedroom Count: Comparison of Options

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<th>3 bd</th>
<th>4 bd</th>
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<th>Total # of Units</th>
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[1] based on maximum 4 bedrooms/unit.
### Equivalent Bedroom Count:

#### Comparison of Options:

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<tr>
<th>Option</th>
<th>1 bd</th>
<th>2 bd</th>
<th>3 bd</th>
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### Notes:

1. Based on maximum 4 bedrooms / unit.
Mr. Charles Blaser, Chairman, and Members of the Lawrence-Douglas County Planning Commission:

I am writing with regard to ITEM NO. 16: Text Amendment to City of Lawrence Development Code; Multi-Dwelling Residential Zoning District RM 64 and ITEM NO. 17: Text Amendment to City of Lawrence Development Code; Chapter 20; Planned Development Overlay District.

I am a bit confused by the staff reviews that 1) indicate that RM 64 zoning would be inappropriate because it is considered too high a density and then 2) recommend a change to the Planned Development Overlay District allowing for development to an even higher density.

The staff notes in the review of the Multi-Dwelling Residential Zoning District RM 64 that in 1999 the city had a diagnostic review of the development regulations that state that the RM-3 (43 du/ac) and RD (54 du/ac) Districts of the code at that time “appear to represent a theoretical maximum rather than realistic or meaningful standards” and that it was a conscious decision to reduce the high-density districts when drafting the current code. The Staff Response to the request for RM64 says that Horizon 2020 outlines an overall density range of 16-21 dwelling units per acre for high-density residential districts and that the proposal is almost 3 times higher than the highest density outlined in the plan.

If the proposal for 64 units per acre is not in conformance with the comprehensive plan, why is a proposal that allows for 80 units per acre, almost 4 times higher than the highest density outlined in the plan considered to be in conformance with the plan?

Both approaches can be site specific. The staff is arguing that better planning will result through use of the Planned Development Overlay District. I would be very interested in a discussion of:

- Opportunities for flexibility in development that exist for development on small infill lots
- How a PD Overlay can take into consideration the character of the neighborhood and the surrounding property
- Likely public benefits that might result in a determination from the City Commission that an increase in the maximum Net Density beyond that of the Base District is warranted

The change that has occurred is the consideration of underground parking for development. Although parking is central to this discussion, there is no mention of the fact that twice as much parking would be required for four-bedroom rather than two-bedroom units while the maximum occupancy for unrelated individuals would be the same. It also should be noted that as density increases, demand for on-street parking for visitors increases without any corresponding increase in the number of those spaces available for residents of the area. Additional requirements for visitor parking on site should be considered.

I would also like to see the density calculations give some consideration to counting studio and one-bedroom units differently than two-bedroom units; perhaps counting studio and on-bedroom units as .5 Dwelling Units, and two-bedroom units as .75 Dwelling units or as .4 and .6. If the intention is to seriously encourage a mix of sizes, this would give some incentive for that.

Thank you very much for your good work and your consideration of these proposals.

Marci Francisco, 1101 Ohio, Lawrence, KS 66044
Dear Chairperson Charles Blaser and Planning Commissioners:

The Lawrence Association of Neighborhoods asks that the Planning Commission not support TA-3-4-11: Consider Text Amendments to the City of Lawrence Land Development Code, Chapter 20, Article 6 & 7, regarding revisions to the district criteria and development standards in the Planned Development Overlay District. *Initiated by City Commission on 4/5/11.*

Between the Smartcode and the new RS3 and RS5 and the new MU districts the ability to build houses closer together on smaller lots has already been addressed. PD’s had been used under the older Development Codes in order to build on smaller lots as in my neighborhood, but the addition of the RS3 and RS5 allows for those smaller lot developments.

When would a development need a 0 acres? With this change a small lot development or more units could be built on a presently large lot and may not be in character with the surrounding neighborhood. LAN would agree that a PD overlay would be a valuable tool, but the requested changes from 5 to 0 acres and new density calculations would not be supported by the underlying base zone. The previous codes list 2 acres and if staff feels a reduction is needed then the 2 acres should be considered since this was useful, but 0 acres opens the door to infill property that is not conducive to its neighbors. However, there is a reason the 5 acre requirement was put in place and that reason would have considered what Horizon 2020 states and years of work done by the community.

At the time the new codes were being written there had been a lot of PUD development that had negative impact on the neighboring RS districts and the setbacks were created to protect single family homes from encroaching PD especially multifamily PUD’s for instance Joseph Street and Canyon Court Apartments. The new codes may not have gone far enough in protections of RS districts next to RM districts, but PUD’s are covered for this reason.

Amending the PD Overlay as suggested by Mr. McCullough at the March Planning Commission meeting did not imply the density calculations would be part of the text amendment or drastic changes to the required area, but to “establish a framework that may be more conducive.” These two issues are not conducive to the surrounding neighbors or neighborhood. 20-701 (a) 5 states “promote attractive and functional residential, nonresidential, and mixed use developments that are compatible with the character of the surrounding area.” Residential setbacks and density can be changed by the City Commission so the density calculations are not needed as stated in 20-701 (i).

Again, LAN requests not to support the new density calculations. LAN requests that a PD overlay has benefits, but the 0 acre request and the parking/density calculations not be added as a text amendment. LAN requests that the Planning Commission not support any of the various ways the applicant is asking for higher density in an already dense neighborhood with an across the city application.

Gwendolyn L. Klingenberg
Lawrence Association of Neighborhoods - President
Mr. Charles Blaser, Chairman  
Members  
Lawrence-Douglas County Metropolitan Planning Commission  
City Hall  
Lawrence, Kansas 66044

RE: ITEM NO. 17: TEXT AMENDMENT TO CITY OF LAWRENCE DEVELOPMENT CODE; CHP 20; PLANNED DEVELOPMENT OVERLAY DISTRICT (MJL)

Dear Chairman Blaser and Planning Commissioners:

We do not oppose eliminating the minimum acreage required for a Planned Development Overlay District. However, we do oppose the proposed Text Amendment as currently it would read. The following narrative, we hope, will explain our position.

An important characteristic of all of the Planned Development (PD) Ordinances has been to avoid negative impacts on adjacent properties, especially single family (RS) districts. Through many changes over the years, the Planned Development regulations evolved into those of our current Land Development Code: an overlay district governed by the requirements of the underlying zoning district. The PD district requires a minimum land area of five acres, and also requires an internal peripheral buffer equivalent in dimension standards to its adjacent RS district. This ensures that it will have minimal environmental impact on single family areas at the boundaries. The boundary height restrictions and required setbacks are essential features of our current PD overlay district.

A major problem with the proposed revision of the PD Overlay District is the lack of a reasonable standard for the required setback between an RS District adjoining an RM District. Our interpretation is that there seems to be no equivalent peripheral protections for adjacent modern single family housing with the proposed elimination of the buffer area that is present in our current code.

The buffer area section of the existing PD text is the major standard that protects RS districts. This is what ensures that the setback and height of a Planned Development will be equivalent to the height and setback of the adjoining RS district for a significant area of the boundary—a depth of sixty feet, within the buffer portion of a PD adjoining an RS district. This provision also requires that the existing building in the RS district and a proposed adjoining building in an RM-PD District are the same use category, height, and the lots are the same size. If this holds, then the setback, as we read the current Land Development Code, will be that required for the RM District, or 10 feet. This ensures that the PD buffer area will blend with the adjoining RS district. If the height of an RM-PD building is increased, the PD setback is increased, and in this case the setback must equal the height of the RM building. If the City Commission chooses to increase the height of the PD building beyond what is permitted in the RS district, ‘then height increases shall be permitted only for buildings set back from the boundary of the PD by the height of the proposed building plus 25 feet, so that the primary impact of the increased height is on property within the PD.’
The proposed modifications eliminate this standard so that now there is no clear protective standard that we could find in the TA that substitutes for it. Instead of the RM-PD height standard (without setback increase) being the equivalent of the height of the existing RS District buildings, the Text Amendment eliminates the buffer and changes the PD height standard to the maximum permitted height of the RS districts which is 35 feet. (Most modern single family homes are not as tall as 35 feet.)

As we read the proposed Text Amendment, the adjoining building for an RM-PD building, therefore, can be 35 feet in height with a setback from the adjoining boundary of only 10 feet between the RS and RM-PD districts. If that height is increased beyond 35 feet by, for example, 10 feet, then the setback must be the same plus the increase in the height of the building, or a total setback of 20 feet. We do not believe that these standards would provide the protection to adjacent properties that has been written into the code currently.

Because there are compelling reasons for eliminating the minimum size requirement of the PD Overlay District, we do not oppose the concept. We do, however, oppose the proposed standards that are being substituted in the current proposal for the Text Amendment to the Planned Development Article.

We ask that you reconsider these standards and rewrite the buffer section to provide better protection standards.

Sincerely yours,

Milton Scott
President

Alan Black, Chairman
Land Use Committee
May 23, 2011

Lawrence-Douglas County Planning Commission
City Hall

Re: ITEM NO. 17 TEXT AMENDMENT TO CITY OF LAWRENCE DEVELOPMENT CODE
CHAPTER 20; PLANNED DEVELOPMENT OVERLAY DISTRICT

Planning Commission,

The planning staff recommends adoption of a text amendment that permits:

a. Application of planned developments to parcels of any size, and
b. Adopts a mechanism that counts each studio, one- and two-bedroom unit as only one-half unit for density purposes.

**Definition of a Planned Development**

A planned development overlay is a mechanism that permits the design of a parcel in a manner that may not meet the normal development requirements, such as density and open space, on all parts of the parcel, but taken as a whole it meets the requirements. For example, some parts of a parcel may be allowed to develop with normally prohibited high densities while the remaining parts provide the needed open space bringing the parcel as a whole to a normal density.

In order for this to work, the parcel must be of significant scale. The proposed text amendment can be applied to parcels of any size. This makes the planned development approach simply a mechanism for circumventing density and open space requirements rather than meeting them through unique designs applied to large parcels.
**Exceptions for Most Rental Units**

The text amendment calls for all studio, one-bedroom or two bedroom to be counted as one-half of a unit for density calculation purposes. An unusual counting process such as this may make sense in a few exceptional circumstances. It does not make sense if the applicable units are the majority of the affected units rather than the exception.

The Census Bureau provides evidence of the breakdown of rental units by bedroom size. Studio, one-bedroom and two-bedroom units comprise over two-thirds of all rental units.

<table>
<thead>
<tr>
<th>Renter Occupied</th>
<th>Units</th>
<th>Percent of Total</th>
<th>Cumulative Percent</th>
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</thead>
<tbody>
<tr>
<td>No bedroom</td>
<td>579</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>1 bedroom</td>
<td>4,467</td>
<td>24%</td>
<td>28%</td>
</tr>
<tr>
<td>2 bedrooms</td>
<td>7,613</td>
<td>41%</td>
<td>69%</td>
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<tr>
<td>3 bedrooms</td>
<td>4,304</td>
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<tr>
<td>4 bedrooms</td>
<td>966</td>
<td>5%</td>
<td>98%</td>
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<tr>
<td>5 or more bedrooms</td>
<td>416</td>
<td>2%</td>
<td>100%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>18,345</td>
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<td></td>
</tr>
</tbody>
</table>

Source: U.S. Census Bureau

2005-2009 American Community Survey

Table B25042 Tenure by Bedrooms

Such a counting mechanism that views over two-thirds of the rental units developed as only one-half of the count of units renders density calculations meaningless.

Only the developers want greater density in the already densely developed multi-family neighborhoods. Neighborhood residents do not want greater density. The planning commission should be very suspicious of mechanisms that seek to circumvent reasonable limitations on density.

**Citywide Changes to Solve Individual Problems**

This proposal is being pursued in order to permit the redevelopment of the 1000 block of Indiana Street. It is entirely possible that a redevelopment plan for this site should be adopted that rezones the property and permits increased density. However, the Planning Commission should not adopt text amendments that will apply citywide in order to facilitate the redevelopment of an individual, and possibly unique, parcel of land.
Recommendation

The notion of increased density may be a good idea for the 1000 block of Indiana. That location is well-suited to multi-family housing, and perhaps, if the development is well designed, it may be an acceptable idea to permit greater density on this site than might be permitted under normal zoning constraints.

It is not a good idea to stretch the notion of planned development overlay districts to apply citywide, to apply to parcels of small size, and to artificially permit increased density where it is not desirable.

The Planning Commission should vote against this text amendment.

Yours truly,

Kirk McClure
June 19, 2011

Mr. Charles Blaser, Chairman
Members
Lawrence-Douglas County Metropolitan Planning Commission
City Hall
Lawrence, Kansas 66044

RE: ITEM NO. 2: TEXT AMENDMENT TO CITY OF LAWRENCE DEVELOPMENT CODE; CHAPTER 20;
PLANNED DEVELOPMENT OVERLAY DISTRICT (MJL)

Dear Chairman Blaser and Planning Commissioners:

Regarding the change to Section 20-602(h)(2)(ii) that is being proposed for the general Land Development Code (LDC), we believe that the public is not aware that this section applies generally and not only to Planned Development Overlay Districts. The required setbacks and height that are being changed here will apply everywhere in the city to all applicable districts adjacent to RS districts. (Please see Attachment A.) We ask that you not recommend this amendment to the Land Development Code.

Concerning our letter to you last month on the issue of changes to the PD Overlay District, we supported the suggested reduction in size to correspond to the requirements of the zoning district on which it was placed. We were assuming, incorrectly, that the setbacks, height restrictions, buffering requirements and other restrictions that protected neighboring single family properties would remain in place. We assumed that these restrictions would ultimately determine the area size of a prospective planned development, and not be used, for example, to redevelop a small, single residential lot to a higher density, higher profile apartment building. We ask that you refer to our letter dated May 22, 2011.

We were wrong. The substitute language changing the Planned Development Overlay District Section 20-701(g) offered by staff would not offer protection to neighboring single family areas should an essentially incompatible use be allowed on adjacent property. (Please see Attachment B.) It is obvious that the changes in the PD District that are being offered could be compatible with the Oread Neighborhood, but not to more modern, basically single family neighborhoods with considerably lesser average heights, building bulks, and densities.

Consequently, we ask that you, in fact, not change the entire Land Development Code (LDC) to accommodate the special needs of the Oread Neighborhood. We ask that you consider incorporating the specific changes to the PD district to apply to the Oread Neighborhood Conservation Overlay District, and not to change the general Land Development Code Section 20-602(h)(2)(ii) or the PD Section 20-701(g). If this doesn’t meet the needs of a single developer now, we suggest that those needs be accommodated by other means.

We hope that you will give our concerns serious consideration. Thank you.

Sincerely yours,

Caleb Morse
Member of the Board

Alan Black
Chairman
Land Use Committee

Attachments
ATTACHMENT A

The following is copied directly from the most current June Staff Report Page 76 on their proposal as to how the LDC text is to be modified regarding setbacks and heights. PLEASE NOTE THAT THIS APPLIES GENERALLY TO THE ENTIRE CODE AND IS NOT LIMITED TO PLANNED DEVELOPMENTS.

Section 20-602(h)(2)

"(iii) Height Limit Related to Setback
Any Building or Structure to which this Section is applicable shall be set back from the Yard property line adjoining the RS Zoning District by the minimum Setback established in Section 20-601 when the Building or Structure is the same or lesser Height than the Building or Structure on the adjoining maximum permitted height of the adjoining RS Lot. When the Height of the Building or Structure exceeds the Height of the Building or Structure on maximum permitted height of the adjoining RS Lot, the minimum Setback for the non-RS zoned property shall be equal to the Building’s Height.” [We added the bold emphasis.]

COMMENT: The major change here is from “building or Structure” to “permitted.” This means that a 35-foot apartment is required to be set back only the required yard setback at the sides between the single family neighboring houses which, for example, are generally 20 feet high or less even though the permitted height for all single family houses is 35 feet—the same as for multiple family. Since the houses are required to be set back 5 feet, and the RM buildings also are required to have the same 5-foot setback (Section 20-601), this means that a 35-foot high apartment must be set back only a total of five feet from the lot line, or if both are set back only the required 5 feet, then the distance between the two buildings would be only ten feet. When the apartment exceeds this 35 foot height, then it must be set back the apartment building’s height.

The original language required that the RM building be the same height as the RS building, which makes more sense in terms of protection for the single family houses. Anything higher would have to be set back the height of the RM building. Please remember that height blocks sun.

To repeat, the RS districts permit building heights of 35 feet. Most modern single family homes are considerably less than 35 feet—more like 20 feet or less.

The basic problem here is that this section of the Code will apply to the whole city, whereas the actual buildings in the Oread Neighborhood tend to be unique to that specific neighborhood.
This excerpt is from Page 80 of the Staff Report. (Section 20-701(g) Height, Planned Development Overlay District):

20-701(g) Height
“The City Commission may increase maximum Height limits of the Base District if the Commission determines that such an increase is warranted to support the public benefit likely to result from the proposed development. Height increases shall be permitted only for Buildings set back from the boundary of the PD by the Height of the proposed Building plus 25 feet. Base District Setback plus the increase in the height of the Building, so that the primary impact of the increased Height is on property within the PD.”

COMMENT: This means that the Base District Setback (generally) of 5 feet plus the increase in the height of the building, assuming it’s an increase of one story or 12 feet, would require a setback of a total of 17 feet for a building the height, as an example, of 35 + 12 = 47 feet tall. Based on this new standard, a 25-foot high single family house (two stories), would have a total distance between the buildings of 22 feet, or on the RM side, 17 feet (5 + 12). For a neighborhood like Oread where most buildings are tall and zoned RM regardless of how they are used, this might be acceptable. For most other neighborhoods it would have a blighting effect.

This is why we are suggesting that the Oread Neighborhood needs its own standards, and that they should not apply to the city as a whole, and the required buffer should remain in the Code.

The problem with not having a minimum size is the issue of compatibility. It does take a minimum size to allow a buffer between two essentially incompatible uses, but when infill is involved, it is difficult to prescribe size. On the other hand, if the buffer requirements are kept, they determine minimum size.
ITEM NO. 3  CONDITIONAL USE PERMIT FOR A RETAIL NURSERY; 1185 N 1250 RD (SLD)

CUP-3-1-11: Consider a Conditional Use Permit for a Retail Nursery located at 1185 N. 1250 Road. Submitted by Lawrence Landscape Inc., property owner of record.

STAFF RECOMMENDATION: Staff recommends approval of a Conditional Use Permit for a Retail Nursery located at 1185 N. 1250 Road subject to the following conditions:

1. Approval of a local floodplain development permit prior to start of commercial retail operations.
2. The applicant shall provide a revised site plan with the following note: Chemical or compost toilets may be used only if approved by the County Health Official.

Reason for Request: “To allow retail sales of nursery plants and landscaping supplies.”

KEY POINTS
- Existing business located along hard surface roads (N 1250 and E 1200 Roads).
- Existing zoning is VC (Valley Channel) requiring a local floodplain development permit.
- Property is currently designated floodway per FEMA maps.
- Applicant is seeking a Letter of Map Revision (LOMR) based on site survey data that if approved by FEMA would revise the floodway boundary in this area.

ATTACHMENTS
- Site Plan
- Area Map

GOLDEN FACTORS TO CONSIDER

ZONING AND USES OF PROPERTY NEARBY
- Valley Channel zoning and related agricultural land uses surround subject property.

CHARACTER OF THE AREA
- Property is located south of K-10 Highway within the Lawrence Urban Growth boundary.

SUITABILITY OF SUBJECT PROPERTY FOR THE USES TO WHICH IT HAS BEEN RESTRICTED
- The current zoning designation for the property is VC, a district in which many agriculture-related uses are allowed.
- The proposed request will not alter the underlying zoning district.

ASSOCIATED CASES/OTHER ACTION REQUIRED
- Approval by Board of County Commissioners.
- Approval of a local floodplain development permit or revision to the floodplain boundaries through a Letter of Map Revision (LOMR)
PUBLIC COMMENT RECEIVED PRIOR TO PRINTING

- None to date.

GENERAL INFORMATION

Current Zoning and Land Use: VC (Valley Channel); existing tree farm and nursery stock supply business.

Surrounding Zoning and Land Use: VC (Valley Channel); in all directions. Agricultural uses and rural residences.

<table>
<thead>
<tr>
<th>Site Summary:</th>
<th></th>
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<tbody>
<tr>
<td>Subject Property:</td>
<td>33.5 acres</td>
</tr>
<tr>
<td>Office Building</td>
<td>300 SF</td>
</tr>
<tr>
<td>Storage Building</td>
<td>180 SF</td>
</tr>
<tr>
<td>Shipping Container (storage)</td>
<td>360 SF</td>
</tr>
<tr>
<td>Pole Barn (equipment storage)</td>
<td>1200 SF</td>
</tr>
<tr>
<td>Future Hoop House (greenhouse)</td>
<td>1,920 SF</td>
</tr>
<tr>
<td>Total Building space</td>
<td>3,960 SF</td>
</tr>
<tr>
<td>Total building space excluding (greenhouse)</td>
<td>2,040 SF</td>
</tr>
</tbody>
</table>

Off-Street Parking: Standard: 1 space per 200 feet of floor area, Section 12-316-1 requirement for retail store or personal services establishment and banks.

Excluding storage space total retail area is 300 SF requiring 2 off-street parking spaces.

25 parking spaces provided along existing driveway.

Summary of Request

This request is for a Conditional Use Permit to allow for retail sales and related activities. The site includes several existing and proposed improvements. Structures are minor and generally moveable on the property as needed. The site includes both office/retail space as well as equipment storage related to the landscape business. Storage of materials such as rock, mulch, and gravel are also located on the property and available for retail sales and used in the landscape business. The Zoning Regulations allow an area of not more than 3,500 square feet of net retail space as a maximum Conditional Use. Beyond that size commercial zoning would be required for retail uses. Greenhouses, where plants are grown, and outdoor display areas are not included in the retail space calculation. This particular nursery is geared toward exterior display of products and accommodates a customer’s access to the site to choose specific plants and materials available for sale. The office building provides a point for the retail sales transaction. A key feature of this request defines and limits the activity to nursery related sales and prohibits general assembly activities such as receptions, weddings, and similar uses.

I. ZONING AND USES OF PROPERTY NEARBY

This area is located between K-10 Highway and the Wakarusa River. The area zoning is reflective of the floodplain designation in the area. Uses include rural residences and agricultural fields. A large
pond is located on the subject property that was created as a borrow pit for the construction of K-10 Highway.

**Staff Finding** - This property is located in the area between the K-10 Highway and the Wakarusa area. The development pattern is dominated by agricultural uses.

### II. CHARACTER OF THE AREA

This property is located within the Lawrence Urban Growth Boundary and within the planning area of the *Revised Southern Development Plan*. The area is currently rural in nature, but influenced by the proximity of the Lawrence City Limits, K-10 Highway and the Wakarusa River. The urban area is located between 31st Street and the highway with the agricultural area located to the south. This area has a strong agricultural character at this time.

**Staff Finding** - This area is characterized as an agricultural area on the fringe of Lawrence. The development pattern is characterized by rural residences along the existing county roads and agricultural fields. The proposed use is compatible with the character of the area.

### III. SUITABILITY OF SUBJECT PROPERTY FOR THE USES TO WHICH IT HAS BEEN RESTRICTED

Applicant's response: “Excellent.”

This property is zoned VC (Valley Channel) District. The purpose of this district is identified in Section 12-314 of the County Zoning Regulations and states: “...prevent, in those areas subject to periodic or potential flooding, such development as would result in a hazard to health or safety, and to insure the general public will not be forced to expend exorbitant funds to remedy flood problems.” This district is associated with a designated floodplain. Development is also subject to a local floodplain development permit, separate from the Conditional Use Permit, administered by the County Zoning Administrator. The Planning Commission's action is separate from the Floodplain permitting process.

Uses allowed in the VC district include: farms, truck gardens, orchards, and plant nurseries among other types of open land uses. In addition to the nursery aspect of the existing land use, landscape materials are stored and displayed for sale. The County Zoning Regulations allow for Retail Nurseries that do not exceed a total of 3,500 SF of net retail space excluding greenhouses (future hoop house) and outdoor display areas. This property is currently used as a tree nursery farm and landscaping material storage/sales. A Conditional Use Permit (CUP) does not change the base, underlying zoning. Therefore, the suitability of the property for continued agricultural use will not be altered.

**Staff Finding** - The property is suitable for the nursery uses within the VC District. The total building improvements are less than the maximum 3,500 SF established in the Zoning Regulations.

### IV. LENGTH OF TIME SUBJECT PROPERTY HAS REMAINED VACANT AS ZONED

This property is developed with an active tree farm and several buildings related to the landscape business. The VC (Valley Channel) and VP (Valley Plain) Overlay District were created in response to the 1951 flood and were included in the September 23, 1966 Zoning Regulations when the County
adopted county zoning. The VP district was removed in 1981 when the floodplain management regulations were adopted for the first time and amended into the County Zoning Regulations.

**Staff Finding** - The subject property is an operating tree farm and includes several buildings used for business related activities and storage. The County Zoning Regulations were adopted in 1966 including VC and VP zoning generally reflecting the 1951 flood impact. Valley Channel Zoning as it occurs today has been in place since 1981.

**V. EXTENT TO WHICH REMOVAL OF RESTRICTIONS WILL DETRIMENTALLY AFFECT NEARBY PROPERTY**

Applicant’s Response: “No detrimental affects for nearby properties.”

Section 12-319-01.01 of the County Zoning Regulations recognize that “certain uses may be desirable when located in the community, but that these uses may be incompatible with other uses permitted in a district...when found to be in the interest of the public health, safety, morals and general welfare of the community may be permitted, except as otherwise specified in any district from which they are prohibited.” The proposed use falls under Section 12-319-4.32 Retail Nursery of the Zoning Regulations for the Unincorporated Territory of Douglas County.

The existing business currently includes wholesale transactions as well as limited retail activity. The applicant’s main office is located in North Lawrence where customers seeking design plans are directed. Approval of the request will allow for commercial retail operations at this site. The use is not anticipated to generate significant traffic. The use is immediately adjacent to K-10 highway with a hard surface road between the highway and the property.

This property is located within the regulatory floodplain of Douglas County. The applicant is currently seeking a revision to the adopted floodplain maps that modifies the boundary and removes a portion of the property from the regulatory portion of the floodplain. A local floodplain development permit is required. As such specific building codes must be met for structures. The applicant has been advised of this concern and is taking steps to address these requirements separate from this Conditional Use Permit. No detrimental impacts are anticipated by approval of this proposed request assuming applicable floodplain regulations are applied by the County through the building permit process.

**Staff Finding** - No detrimental impacts are anticipated by the proposed use. This finding assumes that the applicable enforcement of the County floodplain regulations is implemented for this site.

**VI. RELATIVE GAIN TO THE PUBLIC HEALTH, SAFETY AND WELFARE BY THE DESTRUCTION OF THE VALUE OF THE PETITIONER’S PROPERTY AS COMPARED TO THE HARDSHIP IMPOSED UPON THE INDIVIDUAL LANDOWNERS**

Applicant’s Response: “The gain to the public is the availability of a creative retail nursery offering Douglas County Farm Fresh trees and shrubs and ancillary products.”

Evaluation of the relative gain weighs the benefits to the community-at-large vs. the benefit of the owners of the subject property.

In Staff’s opinion, denial of the request for a Conditional Use Permit would affect the individual landowner by prohibiting the scope of retail activity currently provided on this property. The
property could continue to be utilized as a tree farm. The retail use is an allowed use in this district subject to the approval of a Conditional Use Permit.

**Staff Finding** – Approval of this request does not directly harm the public health, safety and welfare. Denial of the request limits the scope of the business for this site.

**VI I. CONFORMANCE WITH THE COMPREHENSIVE PLAN**

Applicant’s Response: “This request is the very essence of compliance to the comprehensive plan Horizon 2020. This request encourages the production and sales of locally grown nursery crops for use in Lawrence and Douglas county, making it just a little greener!”

The property is located within the city of Lawrence Urban Growth boundary. The property is also located within the Revised Southern Development Plan area. The plan was approved in 2008 and adopted into Horizon 2020. Horizon 2020 does not address Conditional Use Permits as a tool to achieve specific policies. This area is anticipated to develop over time as an open space area with auto related commercial uses along the south side of K-10 Highway near the intersection of S. Iowa Street and K-10 Highway. The area south of K-10 Highway is a transition area with substantial open space uses recommended along the corridor.

**Staff Finding** – A Conditional Use Permit can be used to allow specific uses that are not permitted in a zoning district with the approval of a site plan. This tool allows development to occur in harmony with the surrounding area and to address specific land use concerns as the area transitions from a rural to urbanized development pattern.

**STAFF REVIEW (Site Plan)**

Approval of the request would allow the property owner to expand the current operation and engage in retail activities on a larger scale. Current retail sales is limited to only those products produced on site. The site plan shows an area for bulk items such as mulch and decorative rock. A display area is provided at the front of the site and is the primary retail area. The paved and landscaped areas are intended to showcase examples of work and products available.

Minimal improvements to the site are proposed. Most structures are built on skids and are portable. They can be moved movable around or off-site, if needed.

County Health Department approval will be required for the placement of a chemical, compost, or incinerating toilet. The applicant intends to provide a single occupancy facility. Because the use is located in the floodway, this portable/removal facility is preferred by the County Health Department.

The site includes display areas that showcase products and services available such as patios and outdoor kitchen designs. The applicant also intends for an area at the front of the site to be dedicated for additional display. This area would allow for display of pools and other “hardscape” improvements that may be demonstrated for customer’s consideration. The 20’ by 80’ display area is proposed along the front property line. Staff recommends that the display area be setback consistent with the 50’ setback for the Valley Channel District.

**Parking**

The site plan identifies approximately 25 parking spaces to be located along the existing gravel drive to the site. Adequate area exists on site to accommodate overflow parking if needed.
**Limits and Conditions:** The applicant has not proposed any specific limitations for the hours of operation. Typical business hours are assumed. Evening hours and weekend use are also reasonable possibilities for this facility. This site is not designed or intended to be a venue for receptions and other similar public assembly activities. This limitation is reflected as a note on the face of the site plan. Staff does not recommend limiting business hours for this operation.

**Conclusion**
Approval of a CUP can be tailored to address specific issues such as intensity and operation, including time limitations and establish screening requirements. The recommended conditions respond to the specific nature of the request without the associated intensity of full-scale commercial zoning. The proposed CUP as conditioned complies with the County Zoning Regulations and the land use recommendation of *Horizon 2020*. 
CUP-03-01-11: Conditional Use Permit for a Retail Nursery
1185 N 1250 Road

Lawrence-Douglas County Planning Office
June 2011

Area Requested
Scale: 1 Inch = 1500 Feet
No proposed lighting.

Any future lighting will be directed down and shielded.

Maximum height of stockpiled materials will be 10’

No uses such as wedding receptions or other non business related events are proposed.

Office Building on Skids: 18’x20’ 300sqft
Storage Building on Skids: 9’x20’ 180 sqft
Shipping (storage) Container: 9’x40’ 360 sqft
Pole Barn (green roof): 30’x40’ 1200 sqft
Future Hoop House: 24’x80’ 1920 sqft
PLANNING COMMISSION REPORT
Regular Agenda - Public Hearing Item

ITEM NO. 4A  RS7 TO RM12D; 4.6 ACRES; 25TH TERRACE & O'CONNELL RD (SLD)

Z-4-13-11: Consider a request to rezone approximately 4.6 acres from RS7 (Single-Dwelling Residential) to RM12D (Multi-Dwelling Residential), located at 25th Terrace and O'Connell Road. Submitted by Johnson Group Engineering, for Fairfield Investors LLC, property owner of record.

STAFF RECOMMENDATION: Staff recommends approval of the request to rezone approximately 4.6 acres, from RS7 (Single-Dwelling Residential) District to RM12D (Multi-Dwelling Residential) District based on the findings presented in the staff report and forwarding it to the City Commission with a recommendation for approval.

Reason for Request: The current filed plat shows the area that will be replatted being divided into two different zoning classifications. The subject area would be split between RM12D and RS 7. Rezoning will incorporate the subject property into one unified zoning district which in the near future will be replatted into a church lot.

KEY POINTS
- Project should be considered concurrently with the proposed preliminary plat.
- There is an approved neighborhood plan for the area.

ASSOCIATED CASES/ OTHER ACTION REQUIRED
- PP-4-5-11: Preliminary Plat; Fairfield Farms East Addition

PLANS AND STUDIES REQUIRED
- Traffic Study - Not required for rezoning
- Downstream Sanitary Sewer Analysis - Not required for rezoning
- Drainage Study - Not required for rezoning
- Retail Market Study - Not applicable to residential request

ATTACHMENTS
- Area map
- South East Area Plan Future Land Use Map 3-1
- Residential Use Table

PUBLIC COMMENT RECEIVED PRIOR TO PRINTING
- None to date

Project Summary:
This proposed rezoning is intended to establish a zoning district boundary that follows the platted lot lines resulting from a replat of the Fairfield Farms East Subdivision. This request has been reviewed concurrently with the proposed preliminary plat, PP-4-5-11. The intent is to combine several lots and vacate portions of street right-of-way to create a single larger lot for the development of a future church site. This request represents a modification of the existing zoning boundaries to accommodate a revised subdivision lot configuration.
1. CONFORMANCE WITH THE COMPREHENSIVE PLAN

Applicant’s Response: The current and existing zoning is residential neighborhood. This complies with the comprehensive plans for urban growth projections in the subject area.

This property is located within the boundary of the Southeast Area Plan. The plan was amended into Horizon 2020, the City’s comprehensive land use plan on December 1, 2008. The northeast corner of E. 25th Terrance and O’Connell Road included areas of both medium and low density residential development. The more intensive land use is intended to be located adjacent to the abutting collector streets using back to back lot arrangements to transition to the lower density residential area. The plan states: “Map 3-1 provides a general concept for the location of recommended land uses in the Southeast Area. It is not intended to provide a scalable map for determining specific land use/zoning boundaries within this area”.

The plan describes applicable areas for medium density residential land use as:

- Area east of O’Connell Road, generally along the following streets: 25th Way, Ralston Street, Windham Street, Ellington Drive, and Dalton Drive.
- Area east of O’Connell Road, north of E. 28th Street extended, and west of Franklin Road.
- Area west of E. 1700 Road, north of the Kitsmiller Tributary, and just south of E. 28th Street extended.
- Area west of E. 1750 Road (Noria Road), north of the future alignment of the SLT/K-10 Highway, and east of the tributary green space.

The proposed RM12D zoning is identified in the plan as a zoning district that could be considered in either the low density or medium density development areas. Primary uses in the district includes Attached Dwellings, Cluster Dwellings, Duplex, various group living residential uses and community facilities such as schools and daycare centers, nursing homes, and Religious Assembly uses. A list of allowed uses is included with this report as an attachment – Residential Use Table.

Staff Finding - The proposed zoning is consistent with the land use recommendations of the Southeast Area Plan and with the comprehensive plan, Horizon 2020.

2. ZONING AND USE OF NEARBY PROPERTY, INCLUDING OVERLAY ZONING

Current Zoning and Land Use:
RS7 (Single-Dwelling Residential) District; undeveloped property.

Surrounding Zoning and Land Use:
RM12D (Multi-Dwelling Residential District) to the north; undeveloped property.
County A (Agricultural) District to the south; existing rural residential homes.
RS7 (Single-Dwelling Residential) District to the east; undeveloped property.
RS7 (Single-Dwelling Residential) District; and RM12D (Multi-Dwelling Residential District) to the west. Area west of O’Connell Road developed with residential uses.
**Staff Finding** - This property is surrounded by RM12D and RS7 zoning. Only the area west of O'Connell Road is developed at this time.

### 3. CHARACTER OF THE NEIGHBORHOOD

**Applicant's Response:** The neighborhood area is all residential bordered by agricultural. Further north there is some commercial property.

The property is located within the southeast area of Lawrence. Prairie Park Neighborhood is located to the southwest of the proposed rezoning. This proposed request is located within a developing neighborhood that includes a mix of uses. Residential uses dominate the area south of E. 25th Terrace. The subdivisions in the area provide the framework for the neighborhood pattern providing connectivity and access throughout the area. Lot orientation and zoning district boundaries are key features in establishing land use transition from the intensive activity planned along north of E. 25th Terrace and the low density residential uses to the south. Approval of the request allows for the future development of a church site on the southeast corner of E. 25th Terrace and O'Connell Road but would allow for all other uses of the RM12D District. Several non-residential/community facility uses, such as schools and churches, are commonly found in neighborhoods. The proposed request is consistent with anticipated neighborhood development.

**Staff Finding** - The area between O'Connell Road and Franklin Road is a developing neighborhood east of the Prairie Park Neighborhood. E. 25th Terrace is established as the boundary between the residential and commercial land uses planned for the area. The proposed request is consistent with developing character of the area.

### 4. PLANS FOR THE AREA OR NEIGHBORHOOD, AS REFLECTED IN ADOPTED AREA AND OR SECTOR PLANS INCLUDING THE PROPERTY OR ADJOINING PROPERTY

As noted above, this property is within the Southeast Area Plan planning boundary. Land uses include low and medium density residential uses along O'Connell Road and E. 25th Terrace. Both the existing and proposed districts allow certain non-residential uses, including churches. The size of the church and related activities is generally governed by the base zoning district. Land use recommendations found in section 3.11 of the South East Area Plan include: “detached dwellings, attached dwellings, duplex, group homes, public and civic uses”. Religious assembly uses are a type of use generally listed in the Use tables under the Public and Civic Use Group. This request is intended to modify the zoning district boundary but, as noted above, is consistent with the approved planning documents for the area.

**Staff Finding** - The proposed request is consistent with the land use recommendations included in the Southeast Area Plan.

### 5. SUITABILITY OF SUBJECT PROPERTY FOR THE USES TO WHICH IT HAS BEEN RESTRICTED UNDER THE EXISTING ZONING REGULATIONS

**Applicant's Response:** The single church lot would have two different zoning classifications making it difficult to ascertain which zoning regulations apply to the subject property.

Staff concurs with the applicant that dual zoning on single lots is difficult to administer. Previous zoning applications have included amendments of zoning boundaries to follow platted lot lines. Assuming the preliminary plat is approved, the dual zoning would not be appropriate.
Consideration of the rezoning and the preliminary plat concurrently allows for a comprehensive review of intended development. Adequate transition between uses can be provided through both the planning (lot arrangement) and future site plan (required for church development).

**Staff Finding** - The existing zoning is not suitable given the intended development of a church and the replatting of the property to create a single larger lot on the southeast corner of E. 25th Terrace and O'Connell Road.

6. **LENGTH OF TIME SUBJECT PROPERTY HAS REMAINED VACANT AS ZONED**

Applicant’s Response: *Approximately 7 years.*

The property is undeveloped but platted for individual lot development. The property was originally rezoned to RMD (Duplex Residential) District in 2005. The district was renamed to RM12D (Multi-Dwelling Residential) District in 2006 with the adoption of the Land Development Code.

**Staff Finding** - The current zoning of RM12D has been in place since July 2006.

7. **EXTENT TO WHICH APPROVING THE REZONING WILL DETRIMENTALLY AFFECT NEARBY PROPERTIES**

Applicant’s Response: *The change will be negligible and will harmonize with adjoining existing properties. The area directly north is commercial and a church would enhance the area by giving a nice transition from commercial to residential.*

The purpose of this request is to allow for the future development of a Campus or Community Institution, a type of religious assembly. The area south of E. 25th Terrace and east of O'Connell Road is platted for duplex and detached housing but undeveloped at this time. The area west of O'Connell Road and south of E. 25th Terrace is developed with similar uses. The area immediately abutting O'Connell Road on the southwest corner of O'Connell Road and E. 25th Terrace is a 1.9 acre tract dedicated as a drainage easement. Lots abutting O'Connell Road along the west side of the street are situated with either rear or side yards adjacent to the street. The lot arrangement, separation of use and lot orientation allow for a proper transition of uses for the neighborhood.

Land use plans for the area designate both RS and RM12D as options for low density residential development and RM12D for medium density residential development. Approval of the request is a minor modification of the district boundary in the area around O'Connell Road and E. 25th Terrace. No detrimental impact is anticipated by this proposed change.

**Staff Finding** - The existing and planned development pattern including location of streets, lot orientation and planned land uses provide effective transition between uses. The area east of O'Connell Road is undeveloped. No detrimental impacts are anticipated by this application.

8. **THE GAIN, IF ANY, TO THE PUBLIC HEALTH, SAFETY AND WELFARE DUE TO THE DENIAL OF THE APPLICATION, AS COMPARED TO THE HARDSHIP IMPOSED UPON THE LANDOWNER, IF ANY, AS A RESULT OF DENIAL OF THE APPLICATION**

Applicant’s Response: *By rezoning the subject property will be unified into one concurrent zoning district. To leave property as is will divide property into two different zoning districts and make the property ambiguous for its intent as a church lot.*
Evaluation of this criterion includes weighing the benefits to the public versus the benefit of the owners of the subject property. Benefits are measured based on anticipated impacts of the rezoning request on the public health, safety, and welfare.

The purpose of this request is to facilitate the future development of a church on the southeast corner of O'Connell Road and E. 25th Terrace. Churches, and other similar community facilities, can be associated with activities other than just worship. Common uses include religious education, childcare, summer programs as well as group meeting places. The land use known as Religious Institutions is included in the Public and Civic Use Group. These use group categories provide the typology structure for assigning specific uses into categories based on “common function, product or physical characteristic” (Section 20-1702). Many non-residential uses can be found in the residential zoning districts. This allows for land uses that define, support, and revitalize neighborhoods to be located in proximity to residential areas they serve.

However, approval of the request does not guarantee development of the site as a church or other community facility. Public benefits are not assured by the approval of this proposed request. Denial of the request would result in a proposed subdivision lot with dual zoning making development of the property intended for a future church significantly challenging in the future.

**Staff Finding** - Gain to the public is not assured by the approval of this request. However, when considered in conjunction with proposed preliminary plat, for a single lot, approval of the request will result in the simplification of administration of the Development Code for this area.

9. **PROFESSIONAL STAFF RECOMMENDATION**

The proposed request is consistent with neighborhood development patterns that include both residential and non-residential land uses. The rezoning and the replatting that create a larger lot on the southeast corner of E. 25th Terrace and O'Connell Road (both collector streets) provides a transition of land use to the interior portion of the development that is intended for low-density residential development.

The density of development based on the current platted lot configuration for the portion of the area that is currently zoned RM12D is 8.36 dwelling units per acre. Medium density residential development is between 7 and 15 dwelling units per acre as defined in the Southeast Area Plan.

**RM12 D Density Summary**

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<tr>
<td>Dwelling Units/Acre</td>
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19 platted duplex lots
4.573 acres
8.36 dwelling units per acre (density)
The density of development based on the current platted lot configuration for the area that is currently zoned RS7 (proposed to be rezoned to RM12D) has a potential of 4.7 dwelling units per acre.

**RS7 Density Summary**
- 16 platted detached lots
- 3.393 acres
- 4.7 dwelling units per acre (density)

The redistricting of the RS7 and RM12D zoning will result in a revised development pattern for the northwest portion of the residential area of the Fairfield Farms Development.

**Subdivision plat configuration**

<table>
<thead>
<tr>
<th>Subdivision plat configuration</th>
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<tbody>
<tr>
<td>Existing lot configuration</td>
<td>Proposed lot configuration</td>
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</table>

**CONCLUSION**

This request is consistent with plans for the neighborhood and the developing land use pattern of the area. Staff recommends approval of the proposed rezoning.
Z-04-13-11: Rezone 4.6 acres from RS7 to RM12D
25th Terrace & O'Connell Road
ARTICLE 4. USE TABLE

20 401 USE TABLE
The Use Table of this article lists the Principal Uses allowed within all of the Base Districts except the UR District (See Section 20-222(b) for UR District use regulations). The symbols used in the Use Table are defined in the following paragraphs.

(a) Permitted Uses
A “P” indicates that a use is permitted by right, subject to compliance with all other applicable local, State and Federal regulations, including the regulations of this Development Code.

(b) Special Uses
An “S” indicates that a use is allowed only if reviewed and approved in accordance with the Special Use procedures of Section 20-1306.

(c) Accessory Uses
An “A” indicates that a use is permitted as accessory to a Principal Use, subject to compliance with all other applicable local, State and Federal regulations, including the regulations of this Development Code.

(d) Uses Not allowed
Cells containing a dash (–) indicate that the listed use is not allowed in the respective Zoning District.

(e) Use Specific Standards
Many allowed uses, whether permitted by-right or by Special Use, are subject to compliance with use-specific standards and conditions. An Asterisk (*) after the P, S, or A use code identifies the use is subject to use-specific standards and conditions. The sections in which these standards and conditions are located are identified in the far right column titled Use Specific Standard.

(f) Unlisted Uses
If an application is submitted for a use that is not listed in the use table of this section, the Planning Director is authorized to classify the new or unlisted use into an existing land use category that most closely fits the new or unlisted use, using the interpretation criteria of Section 20-1702(b). If no similar use determination can be made, the Planning Director shall initiate an amendment to the text of this Development Code to clarify where such uses will be allowed.
## Article 4 - Use Table

### 20-402 RESIDENTIAL DISTRICT USE TABLE

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<td>S = Special Use</td>
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<td>* = Standard Applies</td>
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<td>- = Use not allowed</td>
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#### Base Zoning Districts

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<th>RS40</th>
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#### PUBLIC AND CIVIC USE GROUP

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**Effective July 1, 2006**

**Land Development Code**

**Amended June 25, 2010**
### Key:
- **A** = Accessory
- **P** = Permitted
- **S** = Special Use
- **S/A** = Standard Applies
- **-** = Use not allowed

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#### Eating & Drinking Establishments

- **Accessory Bar**
- **Bar or Lounge**
- **Brewpub**
- **Fast Order Food**
- **Fast Order Food, Drive-in**
- **Nightclub**
- **Private Dining Establishments**
- **Restaurant, High-turnover**
- **Restaurant, Quality**

#### Office

- **Administrative and Professional**
- **Financial, Insurance & Real Estate**
- **Other**

#### Parking Facilities

- **Accessory**
- **Commercial**

#### Retail Sales & Service

- **Building Maintenance**
- **Business Equipment**
- **Business Support**
- **Construction Sales and Service**
- **Food and Beverage**
- **Mixed Media Store**
- **Personal Convenience**
- **Personal Improvement**
- **Repair Service, Consumer**
- **Retail Sales, General**
- **Retail Establishment, Large**
- **Retail Establishment, Medium**
- **Retail Establishment, Specialty**

*Effective July 1, 2006*

*Land Development Code Amended June 25, 2010*
### Article 4 Use Table

**Effective July 1, 2006**  
**Land Development Code**  
**Amended June 25, 2010**

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</table>
### Key:
- **A** = Accessory
- **P** = Permitted
- **S** = Special Use
- **S*** = Standard Applies
- **-** = Use not allowed

### Base Zoning Districts

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<tr>
<th>Use-Specific Standards (Sec. 20)</th>
<th>RS40</th>
<th>RS20</th>
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<th>RS7</th>
<th>RS5</th>
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### OTHER USES GROUP

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<tr>
<th>Use</th>
<th>Designated Historic Property</th>
<th>Greek Housing Unit</th>
<th>Agricultural Sales</th>
<th>Agriculture, Animal</th>
<th>Agriculture, Crop</th>
<th>Amateur and Receive-Only Antennas</th>
<th>Broadcasting Tower</th>
<th>Communications Service Establishment</th>
<th>Telecommunications Antenna</th>
<th>Telecommunications Tower</th>
<th>Satellite Dish</th>
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<tr>
<td>Greek Housing Unit</td>
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<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>S*</td>
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</table>

### Mining
- Mining: Use not allowed

### Recycling Facilities

<table>
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<th>Use</th>
<th>Large Collection</th>
<th>Small Collection</th>
<th>Processing Center</th>
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**Effective July 1, 2006**

**Amended June 25, 2010**
PLANNING COMMISSION REPORT
NON-PUBLIC HEARING ITEM

PC Staff Report
6/20/11

ITEM NO 4b: PRELIMINARY PLAT; FAIRFIELD FARMS; 25TH TERRACE & O’CONNELL RD (SLD)

PP-4-5-11: Consider a Preliminary Plat for Fairfield Farms, a revision to an approved residential plat known as Fairfield Farms East Addition No. 1, specifically modifying Blocks 1 and 2 and Blocks 14 and 15 to combine 44 lots and rights-of-way into 14 lots with abutting right-of-way, located at 25th Terrace and O’Connell Road. Submitted by Johnson Group Engineering, for Fairfield Investors LLC, property owner of record.

STAFF RECOMMENDATION: Staff recommends approval of the Preliminary Plat of the Fairfield Farms Subdivision and forwarding it to the City Commission for consideration of acceptance of easements and right-of-way and subject to the following condition:

1. Provision of a revised Preliminary Plat note number 18 to include a note that states: Direct access to O’Connell Road south of 25th Terrace shall be subject to review and approval of a traffic study to be submitted with future development applications. Removal of the access restriction does not guarantee a direct access to O’Connell Road in the future for Lot 9, Block 1 Fairfield Farms East Addition.
2. Provision of a revised Preliminary Plat to show in the site summary a total of 125 Lots in the RS7 zone.

Applicant’s Reason for Request: Reconfigure lots and street right-of-way to accommodate a large lot for a future church development.

KEY POINTS
• Preliminary plat includes the entire area of the original. Proposed changes affect only that area south of E. 25th Terrace.
• Development is intended for residential use including a future church site.
• Plat includes vacation of right-of-way and dedication for a segment of 26th Street west of Ralston Street.

SUBDIVISION CITATIONS TO CONSIDER
• This application is being reviewed under the Subdivision Regulations for Lawrence and Unincorporated Douglas County, effective Jan 1, 2007.
• Section 20-810(a) (2) (i) requires subdivisions to comply with all applicable zoning district standards.

ASSOCIATED CASES
• See attachment.

OTHER ACTION REQUIRED
• City Commission acceptance of easements and rights-of-way as shown on the Preliminary Plat.
• Submission and approval of applicable public improvement plans.
• Final Plat submission for administrative review, approval, and recording at Register of Deeds Office.
• Site Plan approval for the proposed development of the church lot.
• Building permits prior to construction activity.

PLANS AND STUDIES REQUIRED
• Traffic Study – 7 step study provided, but does not address direct access along O'Connell Road.
• Downstream Sanitary Sewer Analysis - Approved.
• Drainage Study - Approved.
• Retail Market Study – Not applicable to residential project.

PUBLIC COMMENT RECEIVED PRIOR TO PRINTING
• None

ATTACHMENTS
• Preliminary Plat
• Summary of previous actions

GENERAL INFORMATION
Current Zoning and Land Use:
RS7 (Single-Dwelling Residential) District and RM12D (Multi-Dwelling Residential) District; undeveloped land.
North of E. 25th Terrace: CC200 (Community Commercial) District and IL (Industrial Light) District and County A (Agricultural) District. Undeveloped land except for rural residential home located on county zoned property.

East of O'Connell Road and south of E. 25th Terrance: RM12D (Multi-Dwelling Residential) District and RS7 (Single-Dwelling Residential) District; vacant land.

West of O'Connell Road and south of E. 25th Terrace: RM12D (Multi-Dwelling Residential) District and RS7 (Single-Dwelling Residential) District; existing homes.

To the South, east of O'Connell Road: County A (Agricultural District) and PRD – [Prairie View PRD] existing rural residences and existing townhomes. Also located south two youth facilities; Teen Challenge and O'Connell youth Ranch.

<table>
<thead>
<tr>
<th>Gross Area:</th>
<th>119.896 acres (entire Preliminary Plat)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>PP-06-16-05</td>
</tr>
<tr>
<td>ROW (ac)</td>
<td>24.813</td>
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<tr>
<td>Net area (ac)</td>
<td>95.083</td>
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<tr>
<td>total lots</td>
<td>245</td>
</tr>
<tr>
<td>tracts</td>
<td>3</td>
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</table>

<table>
<thead>
<tr>
<th>Total Lots per District</th>
</tr>
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<tbody>
<tr>
<td>RM12D</td>
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<tr>
<td>RS7</td>
</tr>
<tr>
<td>CC200</td>
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<tr>
<td>IL</td>
</tr>
</tbody>
</table>
STAFF REVIEW

The Preliminary Plat shows the creation of a large lot located on the southeast corner of E. 25th Terrace and O’Connell Road. Residential lots are realigned along the west side of Ralston Street. A new segment of E. 26th Street is proposed intersecting O’Connell Road along the south side of Lot 9, Block 1.

<table>
<thead>
<tr>
<th>Plat boundary and area of change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing lot configuration</td>
</tr>
<tr>
<td>Proposed lot configuration</td>
</tr>
</tbody>
</table>

Zoning and Land Use

The focus of this report is related to the changes proposed south of E. 25th terrace. This application is accompanied by rezoning request Z-4-13-11 that revises the RM12D and RS7 district boundary southeast of the intersection of E. 25th Terrace and O’Connell Road. The area is currently undeveloped. The purpose of the rezoning and the Preliminary Plat are to create a single larger lot for a future church. The platted lots are intended to follow the amended zoning district boundaries.

Streets and Access

- This revised Preliminary Plat retains the existing grid street formation originally established for the area.
- O’Connell Road and E. 25th Terrace are designated collector streets. Subdivision design standards do not recommend direct access to collector streets.

The previous approval included a platted restriction that prohibited direct access from lots to the abutting collector streets. This request modifies that provision and allows for a possible access drive to E. 25th Terrace and to O’Connell Road from Lot 9, Block 1 of the Preliminary Plat potentially to accommodate the anticipated religious assembly use. The residential lots along E. 25th Terrace are prohibited from direct access.

The traffic study submitted for the Preliminary Plat addresses the basic requirements for the subdivision but does not analyze the impact of direct access from Lot 9, Block 1. A detailed review of access to O’Connell Road from Lot 9, Block 1 requires a specific traffic study based on the land use for the property. Approval of this Preliminary Plat accommodates a potential driveway access if justified through a traffic study in the future with the submission of a site plan.

Access for the large lot could be accommodated from any of the abutting streets (E. 25th Terrace, E. 26th Street, or O’Connell Road) depending upon a future site plan and traffic study for the development. This change, if approved, allows the option for possible driveway access to a collector street. Staff recommends a note be added to the face of the Preliminary Plat that indicates that direct access to O’Connell Road shall be subject to review and approval of a traffic study to be submitted in
the future. Removal of the access restriction does not guarantee a direct access to O’Connell Road in the future for Lot 9, Block 1 Fairfield Farms East Addition.

The plat also notes the intent for participation in future benefit districts for Franklin Road improvements and for intersection improvements for both O’Connell Road and Franklin Road with K-10 (General note 21 and 22). As part of a final plat the applicant will be required to execute the appropriate agreements to be recorded with the Final Plat in the future.

Utilities and Infrastructure
City water and sewer service has been extended though this area. Infrastructure planning previously completed anticipated development of this property. The revised Preliminary Plat includes the necessary interior easements to accommodate the revised lot pattern. As part of the Final Plat process, applicable Public Improvement Plans would be required to be submitted and approved for development prior to recording of the Final Plat.

Easements and Rights-of-way
This request includes both vacation of existing right-of-way and easements and the creation of new rights-of-way and easements generally in the area located east of Ralston Street.

Summary
The proposed plat complies with the design standards of the Subdivision Regulations. There appears to be an error in the site summary on page one of the drawings that indicate there are a total of 116 RS7 lots. The plan seems to show a total of 125 lots. Staff recommends the site summary be revised.

STAFF RECOMMENDATION
This Preliminary Plat conforms to the standards and requirements of the subdivision regulations and the land use plans for the area. Staff recommends approval of the Preliminary Plat.
ASSOCIATED CASES

Annexation
- A-12-14-03; Annexation approved 4/13/04 subject to conditions including adoption of an area plan.

Zoning
- Z-06-38-05; 35.835 acres to RM-D
- Z-06-39-05; 12.329 acres to RM-2
- Z-06-40-05; 37.580 acres to RS-2
- Z-06-41-05; 17.889 acres to M-1
- Z-06-42-05; 28.833 acres to C-5
- Z-06-13-08; RM-24 & UR to CC-200; Fairfield Farms East Addition No. 2
- Z-06-14-08; RM-24 & UR to IL; Fairfield Farms East Addition No. 2

Subdivision
- PP-06-16-05; Fairfield Farms East Addition;
- **PP-06-7-08**
- PF-08-30-05; Fairfield Farms West Addition No. 2; (non-residential portion of preliminary plat
- PF-02-04-06; Fairfield Farms West Addition No. 1(residential portion of preliminary plat
- MS-9-3-09; Minor Subdivision of Lot 1, Block 1, Fairfield East Addition No. 1 (IL zoned property)
### Site Summary (PP-6-16-05)

<table>
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<th>Zoning</th>
<th>RS-2 (old)</th>
<th>RM-D (old)</th>
<th>RM-2 (old)</th>
<th>M-1 (old)</th>
<th>C-5 (old)</th>
<th>TOTAL</th>
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<td>Title</td>
<td>Single-Family Residence</td>
<td>Duplex Residential</td>
<td>Multiple-Family Residence</td>
<td>Research Industrial</td>
<td>Limited Commercial</td>
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<tr>
<td>Area</td>
<td>37.580</td>
<td>35.835</td>
<td>12.329</td>
<td>17.889</td>
<td>28.833</td>
<td>119.896</td>
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<td>1.3^4</td>
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<tr>
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<td>21 units/acre allowed</td>
<td>Residential use not allowed</td>
<td>43.5 units/acre allowed</td>
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### Site Summary: Original Approval (Revised Preliminary Plat shown in parentheses)

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<th>Zoning</th>
<th>RS-2 (RS7)</th>
<th>RM-D (RM12D)</th>
<th>RM-2 (CC200)</th>
<th>M-1 (IL)</th>
<th>C-5 (CC200)</th>
<th>TOTAL</th>
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<tr>
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<td>Multiple-Family Residence</td>
<td>Research Industrial/ Limited Industrial</td>
<td>Limited Commercial Community Commercial</td>
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<tr>
<td>Area (acres)</td>
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<td>35.835</td>
<td>12.329</td>
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1. RMD area includes Tract B = to 2.7 acres for drainage and Tract D = 2,372 SF for pedestrian access
2. Excludes large commercial lot
3. Total lots in the RS7 developed with 141 lots not 151 as shown on original preliminary plat.
4. RMD area includes Tract B = to 2.7 acres for drainage and Tract D = 2,372 SF for pedestrian access
5. Tract for City Utility Pump Station
### Site Plan
- SP-7-30-09: Tractor Supply 2420 Fairfield Street.
- SP-9-50-10: Tractor Supply, modification to landscape and exterior display areas.

<table>
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<th>ROW</th>
<th>Min. Lot Size</th>
<th>Max. Lot Size</th>
<th>Avg. Lot Size</th>
<th>Min. Lot Size</th>
<th>Max. Lot Size</th>
<th>Avg. Lot Size</th>
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<td>7,200</td>
<td>15,093</td>
<td>8,091</td>
<td>9,000</td>
<td>16,988</td>
<td>10,564</td>
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<td>7.58</td>
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<td>1.29</td>
<td>1.36</td>
<td>24.813</td>
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6 Excludes large commercial lot
PLANNING COMMISSION REPORT  
Regular Agenda – Public Hearing Item

PC Staff Report  
6/20/11  
ITEM NO. 5  
CONDITIONAL USE PERMIT FOR INDOOR SPORTS CENTER; 1898 E 56 RD (SLD)

CUP-4-3-11: Consider a Conditional Use Permit for an indoor sports center, located at 1898 East 56 Road, Lecompton. Submitted by PLS Landscape for Price Property LLC, property owner of record.

STAFF RECOMMENDATION: Staff recommends approval of a Conditional Use Permit for an indoor sports center/recreation facility located at 1898 E 56 Road [SE1/4 Section 11-Township 12-Range 17] and forwarding of it to the County Commission with a recommendation for approval, based upon the findings of fact presented in the body of the staff report subject to the following conditions:

1. Provision of note on the face of the plan that states: the facility is not an event facility and that the use is restricted to practice only.
2. Provision of a note on the face of the plan that states: This use is limited to not more than two teams or 40 persons maximum at any one practice time.
3. Provision of note on the face of the plan that states: prior to occupancy all applicable building codes shall be met for the proposed change in building use.

Reason for Request: Applicant’s response: “We would like to change our CUP from an event hall to a recreation center. Due to the economy the recreation will be less expensive to create and operate.”

KEY POINTS
- The building was originally constructed as an indoor equestrian arena.
- Previous CUP approved (CUP-1-1-09) for reception hall in 2009.
- This request will replace the previous reception hall use.

ATTACHMENTS
- Area map
- Site Plan

GOLDEN FACTORS TO CONSIDER

ZONING AND USES OF PROPERTY NEARBY
- A (Agricultural) District; existing agricultural properties and scattered rural residences.
- County commercial zoning located along the county road.

CHARACTER OF THE AREA
- Agricultural area of western Douglas County. Highway commercial uses.

SUITABILITY OF SUBJECT PROPERTY FOR THE USES TO WHICH IT HAS BEEN RESTRICTED
- Existing zoning is suitable. Use is allowed within the A District subject to approval of a CUP.
ASSOCIATED CASES / OTHER ACTION REQUIRED

- CUP-6-2-94; Serenata Farms recreation facility; Planning Commission approved in July 1994.
- CUP-1-1-09; reception hall approved by the County Commission in April 2009.
- Approval by Board of County Commissioners.

PUBLIC COMMENT RECEIVED PRIOR TO PRINTING

- Telephone call from Melvin Walter; 1878 E. 78 Road, indicating support of request.
- Telephone call from Dave Henry requesting additional information about request.

<table>
<thead>
<tr>
<th>GENERAL INFORMATION</th>
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</thead>
<tbody>
<tr>
<td>Current Zoning and Land Use:</td>
<td>A (Agricultural) District; existing agricultural property with improvements including a residence, business and accessory structures.</td>
</tr>
<tr>
<td>Surrounding Zoning and Land Use:</td>
<td>A (Agricultural) District to the north east and west; existing agricultural uses. B-2 (General Business) District to the south along the Highway. Existing uses include both commercial and residential uses.</td>
</tr>
<tr>
<td>Site Summary</td>
<td></td>
</tr>
<tr>
<td>Subject Property:</td>
<td>36.90 acres total</td>
</tr>
<tr>
<td>Building:</td>
<td>110’ x 160’ = 17,600 SF (Conversion of an existing agricultural building to an indoor recreation facility for baseball training/practice.)</td>
</tr>
</tbody>
</table>

Summary of Request

The subject property is made up of multiple parcels under the applicant’s ownership. This request is intended to allow for a non-agricultural use of an existing building. The building was originally constructed as an indoor arena for Seranata Farms. A Conditional Use Permit was approved in 2009 to allow for conversion of the building to a reception hall. The applicant has indicated that the cost of the remodel is not feasible. If approved, this request will re-purpose the building to accommodate an indoor baseball training facility. The facility is anticipated to be used during fall/winter and early spring training. The facility may also be used during typically the spring/summer season for additional practice opportunities. The facility will be occupied based on a reserved time. There are no published or set hours of operation at this time. Typically ball practice occurs in the afternoon and evening hours and weekends.

I. ZONING AND USES OF PROPERTY NEARBY

The predominant zoning in the area is A (Agricultural). The area along Highway 40 is zoned B-2 (General Business) District. Highway development includes commercial and residential activities. Other land uses include rural residential and agricultural in the immediate area.

Staff Finding - The predominant use in the area is rural residential and agricultural with scattered county commercial uses located along Highway 40.
II. CHARACTER OF THE AREA

The property is located within the community of Big Springs, southwest of Lecompton (an incorporated city). The property is located outside of the Lecompton 3 mile buffer area. The area is best described as an agricultural community including small business located along the Highway 40 frontage. The area along the highway is currently zoned for commercial uses. The current development pattern does not fully utilize this zoning. The area could be redeveloped with commercial uses thus changing the character of the area.

**Staff Finding** - The subject property is located within Big Springs, a rural community located along Highway 40 in the extreme western portion of Douglas County. The surrounding property includes a variety of parcel sizes and a commercially zoned strip along the Highway.

III. SUITABILITY OF SUBJECT PROPERTY FOR THE USES TO WHICH IT HAS BEEN RESTRICTED

Applicant’s response: *The building is very suitable for ball practice and hitting lessons.*

The subject property includes an existing landscape business. Direct access to the site is from Highway 40 a paved road. A Conditional Use Permit (CUP) does not change the base, underlying zoning. Therefore, the suitability of the property for agricultural uses will not change. The existing building is sufficiently large with high ceiling height to accommodate recreation uses/ball sports. This building has been approved for previous non-residential and non-agricultural related uses in the past. The property is developed with a residence, business, and related accessory structures.

**Staff Finding** - A Conditional Use Permit (CUP) does not change the base, underlying zoning. The property is suitable for the business and residential uses to which it has been restricted and for the proposed recreation use.

IV. LENGTH OF TIME SUBJECT PROPERTY HAS REMAINED VACANT AS ZONED

**Staff Finding** - County Zoning Regulations were adopted in 1966; this property has been zoned “A (Agricultural)” and “B-2” (General Business) prior to a 1984 zoning request (Z-7-10-84) that extended the commercial zoning along the highway. The property is currently developed with multiple buildings including residential, business and agricultural structures and uses.

V. EXTENT TO WHICH REMOVAL OF RESTRICTIONS WILL DETRIMENTALLY AFFECT NEARBY PROPERTY

Applicant’s Response: *This will not affect nearby property. All activity is indoor.*

Section 12-319-01.01 of the County Zoning Regulations recognize that “*certain uses may be desirable when located in the community, but that these uses may be incompatible with other uses permitted in a district...when found to be in the interest of the public health, safety, morals and general welfare of the community may be permitted, except as otherwise specified in any district from which they are prohibited.*” The proposed use is not specifically listed in the County Zoning Regulations. However, several similar uses including athletic fields or baseball fields, recreation facility, sports area or stadium are listed Conditional Uses. These uses include generally larger structures or spaces to accommodate a variety of public assembly activities. This request is most similar to the definition of a recreation facility.
The specific use is intended to focus on only one type of sport and does not include an open field area for games and sporting events.

Approval of the request will not alter the base zoning district. If approved, the existing agricultural building could be renovated (subject to building permit review and approval) for an indoor recreation/training facility.

Approval of this CUP will allow the applicant to operate a recreation facility within an existing building on site. There are no proposed changes to the property that are required to accommodate this use (excluding any applicable building permit requirements as they relate to assembly uses).

The operation of the facility is anticipated to be based on a reserved scheduled time basis. Generally, groups would be less than twenty and travel occurring in multiple cars. Adequate area is provided near the building to accommodate parking for this use.

The property was previously used for a therapeutic equestrian riding facility. This program has been closed for a number of years. A previous application for this same property was approved in 2009 to allow for a reception hall. Much of the surrounding open area is used to cultivate nursery stock related to the landscape business at this location. Approval of the request will introduce moderate activity and traffic to the area. As noted in the application the proposed activity would be completely indoors. As an indoor facility, noise and lights will have minimal impact on the surrounding area.

**Staff Finding** - Approval of the request will allow for use of an existing building originally constructed for a business type use. The proposed use will be conducted indoors. The expected small group use of the building is not anticipated to have a detrimental affect on the surrounding area.

VI. RELATIVE GAIN TO THE PUBLIC HEALTH, SAFETY AND WELFARE BY THE DESTRUCTION OF THE VALUE OF THE PETITIONER’S PROPERTY AS COMPARED TO THE HARDSHIP IMPOSED UPON THE INDIVIDUAL LANDOWNERS

Applicant’s Response: “This facility will provide an area for indoor recreation for children of all ages, while providing additional sales tax revenue for Douglas County.”

Evaluation of the relative gain weighs the benefits to the community-at-large vs. the benefit of the owners of the subject property.

Approval of the request is intended to use an existing structure for an indoor training facility for baseball teams. Use of the building in anticipated being off-season from a spring/summer sport. This activity could coincide with a generally less active time than the existing landscape business. The building was originally designed and constructed as an indoor equestrian arena. Approval of the request will accommodate additional business activity to the area and reuse and existing building. Denial of the request requires the applicant to find an alternative use for the existing structure.

**Staff Finding** - The approval of the CUP would provide additional recreation opportunities to the area. Additional traffic to and from the site is anticipated to be minimal since the proposed operation will mostly likely host one to two teams at a time. Gain to the public health, safety and welfare results from re-use of the existing building and expanded recreational options in the area. There is an identified hardship for the owner to find a viable use for and existing 17,600 SF building designed for a specific purpose.
VII. CONFORMANCE WITH THE COMPREHENSIVE PLAN

An evaluation of the conformance of a Conditional Use Permit request with the comprehensive plan is based on the strategies, goals, policies and recommendations contained within Horizon 2020. The comprehensive plan does not directly address Conditional Use Permits.

The subject property is outside of any identified urban growth area for a nearby city. The closest incorporated boundary is the City of Lecompton. The property is also outside of the 3-mile perimeter of the City of Lecompton.

Key features of the plan are noted in Chapter 3 of Horizon 2020. The plan generally seeks to preserve neighborhoods, facilitate infill development and to limit non-agricultural encroachments. This request intends to re-use and existing building originally constructed for therapeutic riding. Approval of the request allows for re-use of existing improvements within the area without encroaching on other agricultural activities.

Staff Finding - Horizon 2020 does not directly address the issuance of CUPs, however the proposed use provides an active use of a large existing building on this property.

VIII. PROFESSIONAL STAFF RECOMMENDATION

The subject property is not located within any identified Urban Growth Area. The application focuses on the reuse/conversion of an existing building. This request is located along an existing highway. The proposed use is intended to utilize existing built improvements located on the property. The proposed use will occur within an enclosed building and allow for activity during poor weather conditions. No physical changes to the site are proposed with this request.

STAFF REVIEW (Site Plan)

Access to the facility is provided via an existing driveway through the commercial portion of the property. The main entrance to the building is proposed on the west side with the majority of the parking area. The driveway intersects a major thoroughfare. This section of the highway includes wide shoulders that would accommodate turning movements.

Conversion of the building may require improvements to meet minimum County building code requirements prior to occupancy of the structure for the proposed use. Upon submission of a building permit, the maximum occupancy of the structure will be established. The request is intended for an indoor training facility and is not expected to include a high level of interior finish.

A previous CUP for this same property and building was approved in 2009 for a reception hall. That form of recreation facility would have been significantly more intensive than the proposed building use as an indoor baseball training facility.

Parking: A parking standard for this use is not specifically identified in the Zoning Regulations. Similar parking categories that may be considered for a 17,600 SF building are provided below. Staff believes the parking standard for a community center is appropriate for this request.

<table>
<thead>
<tr>
<th>Use (Section 12-316)</th>
<th>Standard</th>
<th>Application to site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Church, auditorium or place of assembly</td>
<td>1 space per 5 seats or bench seating</td>
<td>No fixed seating – assuming 20 persons per team and two teams maximum = 8 spaces required</td>
</tr>
</tbody>
</table>
Public library, museum, art gallery or community center

<table>
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<tr>
<th>10 spaces per use</th>
<th>Plus 1 additional space for each 300 SF of floor area in excess of 1,000 SF</th>
<th>As a single use community center type use base parking would be 10 spaces plus 55 spaces per 1,000 SF = 65 spaces required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auditorium, theater, gymnasium, stadium, arena, or convention hall</td>
<td>1 space per 5 seats or seating spaces</td>
<td>No fixed seating – assuming 20 persons per team and two teams maximum = 8 spaces required</td>
</tr>
<tr>
<td>Amusement place, dance hall, skating rink, swimming pool, natatorium, or exhibition hall without fixed seats.</td>
<td>1 space per 100 SF of floor area</td>
<td>For a 17,600 SF building = 176 spaces required</td>
</tr>
</tbody>
</table>

At this time the occupancy for the building is not established. Occupancy will be established by the County Zoning Office when more details are available about the floor plan and interior arrangement of batting changes and open areas for skill practice. Since a floor plan is not available at this time staff recommends that the use be limited. There is no expectation that more than 40 individuals would utilize the facility at any given time (assuming a maximum of 20 people per team including coaches and spectators/parents). Staff recommends that a note be added to the face of the plan to limit the use to not more than two teams or 40 individuals at any time.

The proposed plan shows a total of 80 parking spaces. The size of the structure could accommodate a much larger group as shown in the parking summary. There are existing driveway paths through the property that provide access for the landscape business. The proposed use for a baseball training facility is a much smaller scope than the previous reception hall application. Because of building concerns expressed by the County zoning Administrator, staff recommends a note be added to the face of the plan that states occupancy of the building is subject to approval and compliance with all applicable building codes for the proposed change in the building use.

Screening: The site includes existing vegetation as shown on the site plan. These natural areas provide buffering between the activity areas of the property and abutting properties. Parking is located on the east and west sides of the building. Screening is used to shield vehicle lights and to buffer noise.

Limits and Conditions: The applicant has not proposed any specific limitations for the hours of operation. Typical business hours are assumed. Evening hours and weekend use are also reasonable possibilities for this facility. Because of the indoor element hours of operation should not impact the surrounding area Staff has not proposed any conditions related to hours of operation or a time limit for this use. Staff has proposed limits on the use to specify that this is not an event facility and to limit the total number of teams/people at any given time. These recommendations are reflected in the conditions of approval.

Conclusion

The proposed CUP as conditioned complies with the County Zoning Regulations and the land use recommendation of Horizon 2020.
CUP-04-03-11: Conditional Use Permit for a indoor sports center
1898 East 56 Road

Lawrence-Douglas County Planning Office
June 2011
Big Springs Indoor Sports Center
1808 E 56 Rd.
Lecompton, KS 66050

Legal Description: 21.4A 11-12-17 ALL THAT PORTION N OF #1 26 1/4 LEE S K TA RW EVC (INV 2000 350 A)

Owner: Price Property LLC

Proposed Use: Practice Facility - 1 Story 16' X 110' X 160' Existing Structure

Parking Provided: 80 Spaces 9' X 17'

Screening around the parking area's shall require installation of similar size and quantity of vegetation if removed or lost due to disease.
Memorandum
City of Lawrence
Planning and Development Services

TO: Planning Commission

FROM: Lynne Braddock Zollner, Historic Resources Administrator

CC: Scott McCullough, Director PDS
    Sheila Stogsdill, Assistant Director

Date: June 16, 2011

RE: CPA-4-4-10 Chapter 11 Historic Resources H2020

At their meeting on May 19, 2011, the Lawrence Historic Resources Commission voted unanimously to recommend to the Planning Commission and the City Commission the adoption of the revised Chapter 11-Historic Resources of Horizon 2020. The Planning Commission received Chapter 11 at the May 23, 2011 meeting. Following are questions (language shown in **bold**) from Commissioners and staff’s responses shown in regular type with recommendations shown in *italics*.

**GOAL # 4: INCORPORATE HERITAGE TOURISM AS AN ECONOMIC DEVELOPMENT PROGRAM**

**POLICY 4.1: DEVELOP A COMPREHENSIVE HERITAGE TOURISM PROGRAM THAT INTEGRATES HISTORIC RESOURCES AND VENDORS INTO PROGRAM PLANNING AND IMPLEMENTATION**

c. Revitalize the Watkins Community Museum.

The use of the word “revitalize” was questioned as the correct word for this idea. Staff would suggest the following to replace 4.1.c

*Support efforts to ensure the Watkins Community Museum is an important visible partner in heritage tourism and community education efforts.*

**POLICY 6.1: ENCOURAGE AND INCORPORATE HISTORIC PRESERVATION IN SUSTAINABLE PLANNING AND BUILDING PRACTICES**

Implementation Strategies:

d. Explore the adoption of building codes that create sustainable communities. Building codes can address issues associated with
   1. Optimizing site potential
   2. Minimizing energy consumption
3. Protecting and preserving water
4. Use of environmentally sound products
5. Enhancing indoor environmental quality
6. Optimizing operational and maintenance practices

Building codes address the redevelopment of existing structures as well as new development. Currently, most building codes are designed for new construction and greenfield development. While there is an existing building code, it is most reflective of new construction techniques and qualifications. For example, energy codes do not give credit for historic construction techniques that are equal or greater than the insulation that is required to meet the code. The above categories can be used for new buildings as well as retrofitting existing buildings with outcomes that create an equal way to compare different types of structures. Historic buildings can show how they optimize operational and maintenance practices just as new construction can. The point to creating codes that are inclusive of the above categories is to create a sustainable community of all building types. (Life safety issues and construction requirements are a separate part of the code.)

**POLICY 6.2: DEVELOP PROGRAMS THAT ENCOURAGE PRESERVATION AS PART OF CREATING A SUSTAINABLE COMMUNITY.**

e. Capitalize on the potential of the Green Economy and develop programs to encourage the manufacture and use of local products that are environmentally sound.

This is a goal for sustainable communities and staff has not identified a link to historic resources. Many historic structures used local products for construction and rehabilitation should use matching or in-kind materials. Staff recommends the removal of this implementation strategy.

e. Capitalize on the potential of the Green Economy and develop programs to encourage the manufacture and use of local products that are environmentally sound.

**Staff Recommendation**

Staff recommends approval of this comprehensive plan amendment to Horizon 2020, Chapter 11 (Historic Resources), for unincorporated Douglas County and the City of Lawrence and recommends forwarding this comprehensive plan amendment to the Lawrence City Commission and the Douglas County Board of County Commissioners with a recommendation for approval.
ITEM NO. 6: COMPREHENSIVE PLAN AMENDMENT TO HORIZON 2020;
UPDATE OF CHAPTER 11 (LBZ)

Consider update to Chapter 11 – Historic Resources. Initiated by Planning
Commission on 4/26/10

STAFF RECOMMENDATION: Staff recommends approval of this comprehensive plan
amendment to Horizon 2020, Chapter 11 (Historic Resources), for unincorporated Douglas
County and the City of Lawrence and recommends forwarding this comprehensive plan
amendment to the Lawrence City Commission and the Douglas County Board of County
Commissioners with a recommendation for approval.

SUMMARY
CPA-4-4-10: An amendment to Horizon 2020 to update the Historic Resources Element
(Chapter 11). This amendment was originally initiated by the Planning Commission at its April
27, 2005 regular meeting at the recommendation of the Comprehensive Plans Committee
(CPC). The CPC reviewed this chapter as part of the annual update process to Horizon 2020,
the comprehensive land use plan for the City of Lawrence and unincorporated Douglas County.
The Update was re-initiated by the Planning Commission at its April 26, 2010 meeting to bring
the format of the review up to date.

STAFF REVIEW
Attached is the proposed amendment to Horizon 2020 to update the Historic Resources Element
(Chapter 11). This amendment was originally initiated by the Planning Commission at its April
27, 2005 regular meeting at the recommendation of the Comprehensive Plans Committee (CPC)
in 2005. The CPC reviewed this chapter as part of the annual update process to Horizon 2020,
the comprehensive land use plan for the City of Lawrence and unincorporated Douglas County.
The Update was re-initiated by the Planning Commission at its April 26, 2010 meeting to bring
the format of the chapter up to date. Following is an abbreviated outline of the process for this
chapter update.

- **February 2001** - City of Lawrence received a Historic Preservation Fund Grant (HPF
  20-01-16416-002) to prepare a Historic Preservation Plan for the City of Lawrence and
  the unincorporated areas of Douglas County.
- **Summer 2002** - City of Lawrence hired a consultant and held public participation
  workshops to identify goals and objectives for a comprehensive preservation plan.
- **April 2003** - draft Preservation Plan Element was distributed for public comment.
- **October 2003** - Historic Resources Commission Public Hearing
- **November 2003** – Historic Resources Commission Study Session
- **May 20, 2004** – Historic Resources Commission Public Hearing The HRC voted to
  accept the document as presented and forward Horizon 2020 Preservation Plan Element
  to the Planning Commission, City Commission and County Commission for review and
  approval, if appropriate.
- **July 20, 2004** – City Commission receives the Preservation Plan Element and forwards
  it to the Planning Commission for review and action.
August 11, 2004 – Planning Staff presents the Preservation Plan Element to the Planning Commission. Planning Commission sends the document to CPC for review.

May 2005 – CPC completes review of Chapter 11 and directs staff to place it on the Planning Commission agenda.

May 25, 2005 – Planning Commission Public Hearing 8-1 Vote with conditions

February 27, 2006 – Board of County Commissioners tabled the Chapter update until the subdivision regulations were adopted.

January 21, 2010 – Historic Resources Commission Requests Staff bring Chapter 11 back for review and update.

February 18, 2010 – Public hearing at HRC

March 25, 2010 – Public hearing at HRC. HRC directs staff to include sustainability issues as a goal with specific objectives and implementation strategies.

June 17, 2010 – Public hearing at HRC. Additional direction from HRC as to content of sustainability goals.

December 16, 2010 – Public hearing at HRC. Direction to work with the Sustainability Advisory Board.

May 11, 2011 – Sustainability Advisory Board Meeting

May 19, 2011 – HRC Public Hearing

May 23, 2011 – Planning Commission

Changes to Chapter 11 and the Historic Preservation Plan Document since the HRC and Planning Commission reviewed the document in 2005 include the following:

1. The Chapter 11 and the Historic Preservation Plan Document have been reformatted to be current with the format of Horizon 2020.
2. The Historic Preservation Plan Element has been updated and reorganized to include changes in organization names and programming.
3. Goal Six has been added by the HRC and public input to include sustainable preservation goals, policies and implementation strategies.

Staff reviewed this amendment based upon the comprehensive plan amendment review criteria listed below.

COMPREHENSIVE PLAN AMENDMENT REVIEW

A. Does the proposed amendment result from changed circumstances or unforeseen conditions not understood or addressed at the time the plan was adopted?

The proposed amendment is a result of the changing circumstances that have occurred since the comprehensive plan was first written. At the time Horizon 2020 was written, there was a basic historic resources plan, Living With History: A Historic Preservation Plan for Lawrence, Kansas (1984, Dale Nimz). In 2004, the Horizon 2020 Historic Preservation Plan Element was adopted by the Historic Resources Commission (seven years after the City adopted Horizon 2020). However, the historic preservation plan cannot be adopted and fully implemented until the proposed amendment to Horizon 2020 takes place. The proposed amendment is derived from the executive summary of the Horizon 2020 Historic Preservation Plan Element and is intended to summarize the overall nature of that plan.
B. Does the proposed amendment advance a clear public purpose and is it consistent with the long-range goals and policies of the plan?

The proposed amendment is an advancement of a clear public purpose and is consistent with the long-range planning goals and policies of the community. Historic preservation is an important feature in any community. Often times it is used as an economic development tool to promote tourism or downtown/neighborhood revitalization or in a way that encourages community spirit, pride, and heritage. The proposed amendment helps further the goals and policies for historic preservation while staying consistent with the overall intent of Horizon 2020 and the goals and policies relating to economic development, parks and recreation, and the various other components of the comprehensive plan.

C. Is the proposed amendment a result of a clear change in public policy?

The proposed amendment to Horizon 2020 is a response to a change in public policy. As the City of Lawrence and unincorporated Douglas County continue to grow and expand, there is greater emphasis on the need to identify, preserve, and protect the community's significant historic resources. These efforts range from preserving downtown Lawrence and its surrounding neighborhoods to protecting remnant tallgrass prairie and pioneer wagon wheel ruts that still dot the rural landscape of the county. The advent of a stand alone historic preservation plan supports this shift in public policy from when Horizon 2020 was initially adopted in the late 1990s.

PROFESSIONAL STAFF RECOMMENDATION

Staff recommends approval of this comprehensive plan amendment to Horizon 2020, Chapter 11 (Historic Resources), for unincorporated Douglas County and the City of Lawrence and recommends forwarding this comprehensive plan amendment to the Lawrence City Commission and the Douglas County Board of County Commissioners with a recommendation for approval.
Historic Resources
Executive Summary

The *Horizon 2020 Historic Preservation Plan Element* provides Lawrence and unincorporated Douglas County with both a broad-based and inclusive preservation model. Its goal is to create opportunities to preserve, enhance and develop, through preservation activities and programs, livable, vital, and sustainable neighborhoods, commercial centers, cultural landscapes, and rural communities. The plan broadly focuses on the city’s and county’s cultural resources, including its buildings, neighborhoods and streetscapes, historic sites, trails, battlefields, open spaces, and prehistoric and historic archaeological sites. These are the assets that provide a unique “sense of place” in the region.

This historic preservation plan element presents goals, policies, and implementation strategies that integrate historic preservation into the city’s and the county’s planning and land use policies and processes. By capitalizing on historic preservation’s demonstrated strengths, reinforcing current programs, and initiating both short- and long-term new efforts, the city and the county can not only protect valuable resources, they can also coordinate the processes involved in this protection.

**PRESERVATION PLAN GOALS**

The City of Lawrence and Douglas County possess a unique legacy of built and natural resources that reflect its rich history. This legacy deserves to be protected and preserved. This plan capitalizes on the demonstrated success of historic preservation methodology as a tool for revitalization of older neighborhoods and commercial centers, the popularity of traditional urban environments, the fast-growing heritage and cultural tourism industry, and the strong public support for environmental stewardship and sustainability. It provides strategies that place preservation as an important component in the city and county’s planning and development programs. Six goals compose the key elements of the plan.

- Incorporate Historic Preservation as an Important Component of the City and County Planning Processes.
- Conserve the Rural Character of Unincorporated Douglas County in Strategic Areas.
- Incorporate Preservation Incentives into the City and County’s Economic Development Policies and Programs.
• Incorporate Heritage Tourism as an Economic Development Program.
• Establish Outreach and Educational Programs.
• Incorporate Historic Preservation into the City and County’s sustainability Policies and Programs.

WHY A HISTORIC PRESERVATION PLAN?

Historic preservation offers two distinct benefits. The preservation of historic resources has its own intrinsic value in celebrating the city and the county’s diverse cultural heritage, in honoring the craftsmanship of other eras, in instilling the values by which we live, and in understanding the relationships of the past, the present, and the future. Historic preservation also has proven practical value as a tool for economic development and environmental stewardship.

Economic Benefit

The most successful revitalization efforts in the country (cities, towns, or rural communities) utilize historic rehabilitation and preservation as the core of their revitalization strategies. Throughout the nation, there are successful models for preservation programs that demonstrate the positive economic impact that occurs when historic preservation is used as a tool for planned revitalization efforts in older neighborhoods and commercial centers.

Public policy that integrates historic preservation into the planning process and targets it to definable areas provides a level of stability that attracts both short- and long-term investment. Revitalized neighborhoods provide a stable population, a greater tax base, higher job retention, and less drain on city services.

Heritage Tourism Venues

Preserved neighborhoods and commercial centers attract visitors. Heritage tourism is big business. This plan provides initiatives that capitalize on existing historic resources and themes and presents approaches to developing new heritage tourism programs that promote local and regional synergy, allowing the city and county to capitalize on their historic resources. Lawrence and Douglas County can claim a role in the development of cultural, economic, and political forces of local, state, and national significance. Lawrence and Douglas County retain tangible ties to prehistoric and historic indigenous peoples, the era of European exploration and the fur trade, the Santa Fe commercial trade route, the establishment of the Indian Territory, the Oregon and California emigrant trails, the abolitionist movement, the Border War, the Civil War, the evolution
Historic preservation is an important component in environmental stewardship and sustainable development. The citizens of Lawrence and Douglas County increasingly support environmental conservation efforts. This growing awareness of how local conditions fit into larger environmental issues has led to the recognition of the importance of natural resources and of the embodied energy contained in the built environment. Historic preservation practices are tools for better stewardship of older buildings, neighborhoods, and rural landscapes. The conservation and improvement of our existing built resources, including the re-use and improvement of historic structures, is central to our community's overall plan for environmental stewardship and sustainable development.

The Federal, State, and Local Preservation Partnership

Many of the nation’s preservation programs are part of a partnership between federal, state, and local government. The National Historic Preservation Act of 1966 created the framework for the National Register of Historic Places, the Advisory Council on Historic Preservation, and authorized matching grants-in-aid to states. By October of 1966, the Secretary of the Interior asked the governor of each state to appoint an individual to help accomplish the directives of the National Historic Preservation Act including the review and allocation of matching grants-in-aid. In 1980 the National Park Service created the Certified Local Government program to formalize the partnership between the National Park Service, acting on behalf of the Federal Government, the State Historic Preservation Office (SHPO), acting on behalf of the state government, and local governments.

Federal laws affect preservation in a number of ways. They authorize federal support for national, state, and local preservation programs; define procedures for the identification, evaluation, and protection of cultural resources; provide incentives to protect resources; and mandate procedures to review the impact of federal undertakings on significant cultural resources.

Among the most successful preservation incentives are the 20 percent rehabilitation tax credit for income-producing properties listed individually or as contributing to a district in the National Register of Historic Places and the low-income housing credit that can be combined with the rehabilitation credit. Owners of properties that are listed in the National Register can donate a preservation easement to a not-for-profit entity and
receive a charitable contribution deduction. Easements may be donated for buildings, scenic or landscape elements, or for open space.

Each state administers federal preservation programs as well as programs established by the state. The Cultural Resources Division of the Kansas Historical Society provides technical assistance and administers a number of grant and incentive programs, as well as federal programs. The Kansas Legislature passed a 25 percent tax credit for rehabilitation of income-producing and residential properties listed individually or as contributing to a district in the National Register of Historic Places. The program uses the same criteria as the federal rehabilitation tax credit program and is designed to “piggy back” onto the federal tax credits.

By design, the strongest element of the federal, state and local government preservation partnership is at the local level. The City of Lawrence was designated as a Certified Local Government in 1989. This status indicates a partnership in compliance with federal guidelines for local government historic preservation programs. The Lawrence-Douglas County Metropolitan Planning Office administers the program assisted by the Lawrence Historic Resources Commission. The regulatory framework for preservation in the city is in place through the Conservation of Historic Resources (Chapter 22) Code of the City of Lawrence. The City of Lawrence also has an agreement with the State Historic Preservation Officer (SHPO) to conduct reviews required by the State Preservation Law.

Douglas County does not have a formal preservation program. Under federal guidelines, the county could establish a preservation program focusing on the preservation of resources within the unincorporated areas of Douglas County and become a Certified Local Government.

In addition to the various government preservation programs, there are a number of well-established private entities – neighborhood associations, professional groups, historical societies, and preservation organizations – that provide a variety of research, technical, educational, and advocacy roles in promoting the preservation of cultural resources.
HORIZON 2020 PRESERVATION PLAN ELEMENT

This plan for preservation outlines goals, policies, and implementation strategies designed to identify, evaluate, and protect the cultural resources in the City of Lawrence and in the unincorporated areas of Douglas County.

Mechanisms are needed to integrate historic preservation efforts in all city and county planning processes. In addition, new policies and processes need to be developed to protect the visual character of areas that include historic resources and to inaugurate particular preservation and conservation initiatives that:

- encourage appropriate new infill construction in older neighborhoods and commercial centers;
- retain and create appropriate transition areas and buffer zones between historic districts, institutions, downtown, and commercial corridors, such as alleyways, landscape features, etc.;
- establish notification area boundaries and design issues in environs review; and
- encourage property maintenance.

GOAL # 1: INCORPORATE PRESERVATION AS AN IMPORTANT COMPONENT OF THE CITY AND COUNTY PLANNING PROCESSES

POLICY 1.1: EXPAND HISTORIC PRESERVATION IDENTIFICATION, EVALUATION, AND PROTECTION PROGRAMS

The basis of an integrated, community-based preservation plan is an inventory of the City and County’s historic assets. Effective preservation planning takes place when there is sufficient knowledge of the number, location, and significance of both above ground and buried resources. An historic resource survey identifies what resources exist, records their condition, and evaluates their level of significance. This knowledge can be used in a variety of ways:

- to develop programs and policies to protect significant resources from destruction or unsympathetic alteration;
- to determine the location and distribution of resources to aid in planning, development and incentive programs; and
- to establish funding priorities for further evaluation and protection efforts.
Implementation Strategies

a. **Expand the cultural resource survey process to identify important resources to be considered in all city and county planning processes.** Considerable research and publication, most of which occurred since 1984, documents the City of Lawrence’s architectural heritage. While these efforts identified most of the significant themes in local history, much of the research was not systematic or comprehensive — limiting a balanced understanding of the city’s history. There are individual properties and neighborhoods not yet identified that could have important roles in defining historic contexts of the city and the surrounding region. Specifically, the multiple property documentation form that establishes the context for historic properties in Lawrence ends at the period identified as “Quiet University Town, 1900-1945.” Many properties have achieved historic significance from 1945 to 1961, the fifty year mark established by the National Park Service for historic.¹

Very little survey work has been conducted in the unincorporated areas of Douglas County. Surveys should be conducted on a township-by-township basis. Special care should be taken to work with rural property owners to ensure proper notification is secured prior to conducting a survey.

b. **Update the existing National Register of Historic Places Multiple Property Documentation Form for Lawrence to include properties that have achieved historic significance since 1945.**

c. **Work with the State Historic Preservation Office’s interactive online database, the Kansas Historic Resources Inventory (KHRI), to establish an up-to-date survey database.** To facilitate analysis of survey information in the planning process, the city needs to bring the cultural resource inventory database up-to-date. KHRI contains all of the SHPO’s survey records and is fully searchable and available to the public. All future surveys in Lawrence and Douglas County should require consultants to enter the survey information into the KHRI system.

d. **Launch an ongoing effort to create National Register and local historic districts in the city with design guidelines to maximize the potential to stabilize and increase property values while protecting resources.** Properties listed in the Lawrence Register of Historic Places represent a small percentage of the city’s significant structures, sites, buildings, streetscapes, commercial centers, and cultural landscapes. As of 2011, the Lawrence Register includes only thirty-six individual properties and the Oread historic residential district.

e. **In conjunction with property owners, develop and implement a National Register, and State Register nomination plan for significant historic properties within the unincorporated areas of the county.** A
Multiple Property Documentation Form should be developed for the County identifying development periods and associated property types. Because of the potential issues with environs review, any property listed in the unincorporated areas of the county should only be listed upon completion of an environs definition that clearly defines the environs boundaries and design considerations. The property owner and adjacent property owners shall be consulted in the development of the environs definition.

**f. Identify and evaluate, during the development review process, properties that are fifty years\(^1\) or older that will be affected by development proposals such as rezoning, platting, development plans, conditional use permits, and use permitted upon review permits.** When properties are identified as “historic”, an assessment of historic integrity should be completed. If the identified property is eligible for listing in the Lawrence, Kansas or National registers, protection measures should be evaluated.

**g. Working with property owners, develop a program to list as many eligible properties in the National Register and State Register as possible, enabling property owners to utilize the federal and state rehabilitation tax credits.**

**h. Reevaluate the city’s demolition ordinance and investigate streamlining the 30-day waiting period by developing a policy for properties which are potentially eligible for listing.** Currently, city ordinances provide protection of significant resources from demolition only for properties listed individually or as contributing to a designated historic district in the Lawrence Register. Current ordinance provisions require a thirty day arbitrary delay before demolition can occur. However, there is no process to evaluate the significance, work with the property owner, or to seek alternative solutions. As a convenience to property owners and from a preservation perspective, a demolition policy that by ordinance outlines a process for public participation and consideration of all issues affecting a proposed demolition will benefit the city. For example, some cities, due to the large amount of significant historic properties that have not been inventoried or locally designated, have amended their ordinances to provide for demolition review for all properties in the city that are over fifty years in age. In these models, city staff conducts a preliminary review to determine if the property has historical integrity and significance. If not, the demolition permit process proceeds. For properties that are significant or have the potential to be significant, the local historic preservation review commission (i.e. the Lawrence Historic Resources Commission) conducts a review. The review includes consideration of whether the property is economically viable, what will replace the demolished building/structure, and consideration of economic hardship based on a model developed by the American Planning Association.

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\(^1\) The National Park Service’s criteria for evaluation of historical significance exclude properties that achieved significance within the last fifty years unless they are of exceptional importance. Fifty years is the general estimate of time needed to develop the necessary historical perspective to evaluate significance.
i. Explore alternative protection mechanisms used in other communities for protection programs for identified significant rural resources. Lawrence and Douglas County should initiate successful programs for evaluation, prioritization, and preservation of selected significant rural resources. The county and the city should work directly with property owners to determine the most appropriate protection mechanisms.

**POLICY 1.2:** DEVELOP OR MODIFY APPROPRIATE ZONING, BUILDING CODE, AND FIRE CODE REGULATIONS TO FACILITATE THE PRESERVATION AND REHABILITATION OF HISTORIC PROPERTIES.

Zoning regulations are a key preservation tool as they contribute to patterns of neighborhood change and investment as well as disinvestment. Neighborhood preservation and revitalization efforts benefit from compatible land use regulations, including the existing zoning ordinances.

**Implementation Strategies**

a. **Investigate the possibility of creating additional conservation districts as an alternative protection mechanism and standard for environs review.** Conservation Districts established by overlay zoning can be a successful tool to creating buffer zones for historic districts. In particular, they can encompass and define the design issues related to environs review. They can strategically address design issues for new construction in areas that have a “sense of place” but do not meet the criteria for Local, State or National Register designation. Conservation Districts can also be implemented to protect potentially significant resources that are not yet fifty years of age and therefore ineligible for local, State or national designation. They can also be used to protect and stabilize areas that, with the use of incentive programs, may be upgraded to meet National Register, State Register, and local historic district designation criteria.

Design guidelines for Conservation Districts can be specifically tailored to promote the desired visual character and allowable special land uses of specific geographical areas. For example, in a Conservation District created to serve as a buffer to a historic district or as a transition zone between an older residential streetscape and a commercial area, limited design review of major changes – such as new construction and demolition – limits adverse changes to the character of the district. At the same time, it encourages property owners to make positive changes to their buildings or to erect new buildings that are compatible to the streetscape. Usually the scope of the review helps to maintain the appropriate size, scale, massing, materials, and building setbacks within the designated area.

In a Conservation District for properties that might in the future be eligible for local or National Register designation, guidelines might address avoiding irreversible loss of specific character-defining architectural elements as well as retention of the appropriate zoning.
The City of Lawrence established the Urban Conservation Overlay District to allow for the creation of conservation districts. One of the key elements in the creation of an Urban Conservation Overlay District is the development of design guidelines and the identification of contributing and non-contributing structures.

b. Review and update existing city zoning to be compatible with existing or desired land use that promotes preservation of intact residential neighborhoods and commercial centers that have historical, architectural, and physical integrity. Among the issues to be considered are:

1. consistency between overlay zoning and base land use zoning among contiguous properties;
2. flexible provisions for developing compatible new “infill” construction on vacant lots;
3. allowance of innovative preservation alternatives, such as additional or specialty uses including “bed and breakfast,” studios, and other professional uses;
4. appropriate design guidelines and site development controls to encourage quality rehabilitation and compatible new construction worthy of preservation in the future; and
5. effective procedures to discourage demolition of significant buildings and structures.

c. Require new development in established areas of the city to use designs complementary to the adjacent streetscape.

d. Create transition zones and flexible links within Lawrence by using setbacks, alleys, parks, and open space in a way that is consistent with established patterns.

e. Adopt a rehabilitation code to address building code and fire code requirements in historic structures for the City of Lawrence and Douglas County.

**Policy 1.3: Develop and Implement Formalized Procedures to Coordinate Preservation Efforts Among City and County Departments and Agencies**

Economic development, land use and property management issues are the purview of a number of different county and city departments and quasi-public agencies to which government bodies have delegated certain programmatic responsibilities. To integrate preservation methodologies in a manner that assures they become part of the day-to-day program administration, it is necessary to develop formalized policies and procedures. The result should guarantee that the public receives information on related
preservation policies, procedures, and ordinances when undergoing compliance with any department or public agency’s processes.

Implementation Strategies

a. Establish formalized procedures for the Lawrence Historic Resources Commission (HRC) or the Historic Resources Administrator to review and comment on City planning activities.

b. Facilitate the integration of the development review process and the building permitting process with the design review process. Consider alternative processes for project review.

c. Require historic preservation elements as part of comprehensive, watershed or sub-basin, sector, neighborhood, and special area plans.

d. Implement consistent and systematic building and maintenance code enforcement.

e. Enforce environmental code.

f. Explore a demolition by neglect ordinance.

g. Adopt a rehabilitation building and fire code for the city and the county.

h. When possible, historic preservation issues should be represented in appointed positions. Representatives of these entities should also be considered as appointed members on the HRC.

i. Working with property owners, target significant cultural landscapes for park/green space designation on the National, State or Local Register.

j. Working with property owners, target open space designation to areas with probability for the presence of a high level of archaeological artifacts. Given the limited amount of resources for archaeological investigations, consideration should be given to those sites which have been documented by creditable historical research.

k. Include a preservation element in the City of Lawrence’s Parks and Recreation Master Plan.

l. Require review of new ordinances for their impact on historic resources and historic preservation efforts.
**Policy 1.4: Improve Existing Local and State Law Design Review Process**

Successful and proactive design review must be “user friendly.” Review standards and processes must be clear, concise, and consistently administered.

**Implementation Strategies**

a. Conduct ongoing inspection of work after HRC review.

b. Develop review process that promotes more consistent and objective interpretation of environs law.

c. Provide legal enforcement of HRC decisions.

d. Reconcile the differences between state law environs review and City of Lawrence’s environs review standards.²

e. Establish a recording process with the Register of Deeds to record National Register, State Register, and Local Register properties.

f. Investigate ways to simplify the design review and the state law review process through the integration of building permit applications, design review applications, and development review applications.


In addition to the local city design review process for designated properties, there are a number of federal and State programs that require review to determine the impact of proposed work on significant cultural resources. Conflict over private and public institutional development needs and surrounding commercial and/or residential neighborhood needs, is most successfully addressed by establishment of processes that include a defined public participation component that establishes when, where, and what type of city or county jurisdiction is applicable. The city or county can play an important role in initiating establishment of such processes, particularly in the context of development of neighborhood, sector, or special area plans.

² There are a number of differences between the State law requirements and the local ordinance requirements. One of the main issues is that the standard of review required under the local ordinance places the burden of proof on the Historic Resources Commission in reviewing environs review cases while the state law places the burden of proof on the applicant. In cases that involve both local ordinance and state law review there is an inherent conflict.
Implementation Strategies

a. Develop and continue agreements regarding development policies for federal, state, public and private institutions such as the University of Kansas, Baker University, Haskell University, Lawrence Memorial Hospital, Lawrence School District, Townships, and Rural Water Districts, which are located near historic areas. Such agreements should include community expectations, a public participation process, and development requirements, including development of expansion boundaries.

b. Formulate Neighborhood, sector, and special area plans that establish clear boundaries for commercial areas as well as institutions.

c. Form stronger partnerships between the Campus Historic Preservation Board and the Lawrence Historic Preservation Commission.

Policy 1.6: Develop a Public Resources Policy that Values Historic Public Improvements.

Participants in neighborhood planning processes and in the Preservation Plan workshops as well as cultural resource surveys identified streetscape infrastructure elements such as alleys, curbs, sidewalks, brick streets, bridges, etc. as important elements that define historic neighborhoods. Residents in historic neighborhoods note that choice of arterial and collector streets have a profound impact on residential neighborhoods. In rural areas, the selection of major new routes encourages development. Thus, the city and county should consider historic resources and their defining elements when implementing infrastructure projects.

Implementation Strategies

a. Create a comprehensive approach to infrastructure improvements on a neighborhood-by-neighborhood basis.

b. Protect and maintain existing brick streets, brick sidewalks, and hitching posts in the City of Lawrence.

c. Restore brick streets and sidewalks in the City of Lawrence.

d. Implement appropriate traffic calming measures in residential neighborhoods in the City of Lawrence. Traffic calming measures should be compatible with the character of the residential neighborhood.

e. Investigate and implement initiatives to improve parking in Downtown with minimal impact of older buildings.

f. Improve bicycle and pedestrian routes and rural trails.
g. Target Parks and Recreation tax revenues when appropriate for cultural resource projects on public lands.

h. Improve flood control to protect historic properties.

i. Develop a formal review process for all public improvements to determine the effects on historic preservation and/or historic preservation planning efforts.

Historic resources in the unincorporated areas of Douglas County are integral in defining the character of the county and the region. The ongoing preservation of significant resources and cultural landscapes can yield an improved quality of life and a sense of place for future generations. Specific preservation programs and processes are needed to assist in providing considerations of these resources in land use decisions to protect significant resources and to allow a balance between commercial, residential, institutional, agricultural, industrial, and natural land uses.

GOAL # 2: CONSERVE THE RURAL CHARACTER OF UNINCORPORATED DOUGLAS COUNTY IN STRATEGIC AREAS

POLICY 2.1: DEVELOP A PRESERVATION PROGRAM FOR THE IDENTIFICATION AND EVALUATION OF CULTURAL RESOURCES IN THE UNINCORPORATED AREAS OF DOUGLAS COUNTY

The basis of an integrated preservation plan is an inventory and analysis of the county’s historic assets. Effective preservation planning takes place only when there is sufficient knowledge of the number, location, and significance of both above ground and buried resources. A historic resource survey identifies what resources exist, collects information about each resource, analyzes its continuity and change, assesses its integrity, determines its significance, and places it within the historic context of similar resources. This knowledge can be used in a variety of ways:

- to develop programs and policies to protect significant resources from destruction or unsympathetic alteration;
- to determine the location and distribution of resources to aid in planning, development, and incentive programs; and
- to establish funding priorities for further evaluation and protection efforts.

Implementation Strategies

a. Develop and implement a rural survey plan to identify and evaluate rural resources based on a systematic approach by township areas,
giving priority to areas with the highest rate of development. In 1997, preservation consultants noted that the rapid pace of development outward from the municipalities threatened rural and early suburban properties that may have potential significance. Available information suggests that rural residences, barns, and other agricultural outbuildings are increasingly rare significant property types, as well as rural churches, schools, and commercial buildings. To date, only limited survey of the historic architectural and cultural resources has occurred in rural Douglas County and includes:

1. A reconnaissance survey of Palmyra Township (1989) identified a number of properties in the community of Vinland and 207 properties with associated structures, and six rural cemeteries in rural Palmyra Township that appeared to be more than fifty years old. The farmstead is the most common rural property type in this township. However, examples with a complete intact set of early outbuildings are uncommon.

2. “Commons on the Prairie,” (1990), an unpublished master’s thesis by Dennis Domer, discussed the historic architecture and cultural landscape of Willow Springs Township; and


b. Working with rural property owners, develop a cultural landscape component for the identification and evaluation of cultural resources. Rural Douglas County is a landscape that evolved through human activities, which, in turn, shaped its appearance. Like historic buildings and districts, cultural landscapes "reveal aspects of our country's origins and development through their form and features and the ways they were used." Therefore, a significant cultural landscape is a geographical area, "... including both cultural and natural resources, and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values." There are four recognized types of cultural landscapes: historic sites that include man-made and natural features, historic designed landscapes, historic vernacular landscapes that include man-made and natural features and ethnographic landscapes that reflect specific cultural and racial groups.

Vinland, for example, is a rural village situated in the Coal Creek Valley, Palmyra Township. It has a cultural landscape that includes buildings, structures, cultivated and uncultivated fields, and natural features. Farther west in Marion Township, the churches and farms of the Church of the Brethren community on Washington Creek represent a potentially significant cultural landscape. The Brethren community moved to Hickory Point, Douglas County, in 1856. They established two churches, Pleasant Grove in Willow Springs Township and Washington Creek Church to the west in Marion Township.

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4 Ibid.
c. **Develop an archaeological survey plan for the County that:**

1. includes an archaeological predictive model for Douglas County that identifies areas of high medium and low probability and
2. prioritizes archaeological survey to focus on areas in which development is ongoing and in which resources would most likely be expected.

The extent of potentially significant archaeological sites in Douglas County is not fully known. However, research and investigations indicate the potential for the presence of important sites throughout the county. In Douglas County, archaeological survey usually occurred only when triggered by federal law. As a result, little historical archaeological investigation has been conducted in the county.

In addition to the more obvious benefits of preserving information about past cultures, knowledge about the location of archaeological sites is crucial to facilitating both public and private development projects. Knowledge of the location or even the ability to predict the possible occurrence of archaeological sites provides developers and government agencies with the ability to investigate during project planning and avoid expensive last minute delays in project development.

Section 106 of the National Historic Preservation Act requires any public or private entity utilizing federal funds, loans, or permits to identify, evaluate, and mitigate damage to archaeological resources affected by the project. This affects agencies such as the General Services Administration, the Army Corps of Engineers, the Kansas Highway and Transportation Department, and County programs receiving federal funding.

One of the key issues to creating a successful archaeological survey plan for the County is working with rural property owners. Only by creating partnerships with existing land owners can sites be identified and evaluated. Successful examples such as the Blanton’s Crossing project should be used as models. No survey or evaluation should take place on private property without the consent of the property owner.

d. **Work with the State Historic Preservation Office’s interactive online database, the Kansas Historic Resources Inventory (KHRI), to establish an up-to-date survey database.** To facilitate analysis of survey information in the planning process, the county needs to bring the cultural resource inventory database up-to-date. KHRI contains all of the SHPO’s survey records and is fully searchable and available to the public. All future surveys in Douglas County should require consultants to enter the survey information into the KHRI system.
**Policy 2.2: Develop a Preservation Program for the Protection of Cultural Resources in the Unincorporated Areas of Douglas County to be Integrated into County Planning Policies and Processes.**

Only after the identification, evaluation, and subsequent “mapping” of significant cultural resources through survey, can the county begin to target and prioritize preservation of significant resources. Rural preservation presents different challenges to integrating preservation strategies into the land use and development decision-making processes. To be effective, preservation issues need to be considered early in the planning stages and in the context of other development and land use issues. Because of the many changes in agribusiness occurring as a result of international, national and local economic forces, farming and livestock enterprises that reflect nineteenth and twentieth century practices are vanishing. Preserving the physical reminders of these eras will require the cooperative, proactive efforts of property owners, private preservation and conservation organizations, and county planners. To assure a successful rural preservation program, the county should only initiate a detailed rural preservation plan, after the successful identification of significant resources. A detailed rural preservation plan must create a number of strategies or tools to be used in combination with other county, state, and federal programs to target the preservation of specific resources that have been identified as significant.

**Implementation Strategies**

- **a. Develop and establish by ordinance a rural preservation program for the unincorporated areas of the county.** Given all issues in developing such a program, the development will take the cooperation of property owners, county administrators, and preservationists. Public meetings must be held in all parts of the county and adequate time should be allowed for all parties to voice their opinions.

- **b. Explore the benefits and liabilities of establishing Douglas County as a separate Local Certified Government (CLG).** Establishing Douglas County as a separate CLG will allow the local community to conduct state law reviews at the local level. This will ensure that reviews are conducted in a timely manner and allow for greater community control. The CLG program will also allow the county to apply for the 10% pass through Historic Preservation Fund grants.

- **c. Investigate successful protection strategies used in other areas of the nation and develop a plan to implement those that are applicable to Douglas County, such as conservation easements and incentives to encourage private stewardship.** Because of growth, Lawrence and Douglas County should initiate successful programs for evaluation, prioritization, and preservation of selected significant rural resources.

- **d. Develop and implement a National Register and State Register nomination plan for significant historic properties within the unincorporated area of the County.** Only twelve properties in the unincorporated area that are listed in the National Register and one on the Kansas Register. The lack of listed properties can be contributed partly to the
lack of surveyed properties and the environs require requirements. To resolve these issues, a process should be developed to identify environs review issues prior to the listing of properties. Property owners shall provide permission for listing and shall help develop and environs definition for their property.

e. Target and prioritize sites such as the natural areas – unplowed prairie and woodlands – identified in Horizon 2020 for preservation.

f. Target significant cultural landscapes for park/green space designation.

g. Target open space to areas with a predictive model for the presence of a high level of archaeological artifacts.

h. Investigate the use of funding mechanisms to retain open space around historic sites.

**POLICY 2.3: ELIMINATE DISINCENTIVES TO ORDERLY PLANNED DEVELOPMENT**

Zoning is a key strategy for protecting cultural resources. Current zoning and land use policies act as a disincentive for orderly planned development that incorporates preservation planning strategies.

**Implementation Strategies**

a. Require annex plans and urban growth boundaries from all municipalities within Douglas County. This will help to eliminate some of the development pressures for undeveloped land and maintain the rural character of unincorporated areas.

b. Develop policies that encourage development in the urban growth boundaries of associated municipalities.

**POLICY 2.4: CONSERVE THE VISUAL DISTINCTION BETWEEN CITY AND RURAL AREAS**

As a matter of policy and practicality, the preservation of cultural landscapes requires an approach that first distinguishes and promotes distinction between developed land and farmland/natural terrain. The city and county currently have defined projected growth areas that allow orderly perimeter development outward from the City of Lawrence and other communities. Such a plan for orderly growth allows preservation of scattered significant historic resources and cultural landscapes to occur as part of planned orderly growth. In areas with significant resources or landscapes, it is important that the distinction between rural and city be maintained in the future.

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5 “Horizon 2020”.
Implementation Strategies

a. Create transition zones between rural areas and the city using wetlands, open spaces, parks, golf courses, "rails to trails," small farm transition areas, and commercial/rural transition areas, i.e., businesses that require open space. Maintaining the distinction between urban and rural areas through the establishment of greenhouses and other agricultural related uses maintains the distinction while allowing for orderly growth.

b. Continue to investigate and create limits on development outside the urban growth areas or boundaries.

c. Promote retention of agricultural land use through programs such as the transfer of development rights and conservation easements.

The city and county need to capitalize on the use of incentive programs to facilitate retention of past investment in infrastructure and built environment and to reap the benefits of historic preservation. The city has not actively implemented or funded economic incentives for preservation. Public incentives should reward and utilize preservation as a tool for economic revitalization. Priority should be given to areas with significant historic resources, capitalizing on existing assets and previous public investment.

GOAL # 3: INCORPORATE PRESERVATION INCENTIVES INTO THE CITY AND COUNTY’S ECONOMIC DEVELOPMENT POLICIES AND PROGRAMS

To fully utilize and promote the economic advantages of historic preservation, Lawrence and Douglas County must develop programs that assist property owners in the use of preservation incentive programs. In addition, the city and county need to reprioritize how they use existing incentive programs. These programs encourage a range of activities targeted to create certain types of results. Some, such as publicly supported transportation and parking incentives, seek to spur development on a broad level; others, such as tax abatement or tax credits, both by legal constraints and/or habit, address specific types of projects and activities. All must be seen as tools to be used in various combinations to encourage revitalization in older commercial and residential neighborhoods or in selected rural areas.

POLICY 3.1: ENCOURAGE THE UTILIZATION AND LINKAGE OF EXISTING INCENTIVES

In addition to the federal and state rehabilitation tax credits, many available incentive programs have “blight” or related conditions as criteria for participation. Others focus on development of businesses. None specifically address the reuse of older buildings; they are usually targeted to new construction and attracting new residents and businesses. The following public incentive programs, are among available programs that, when targeted individually or in combinations, have a demonstrated track record in
stimulating stabilization and revitalization of blighted or declining neighborhoods.

- Property Tax Exemptions
- Heritage Trust Fund (State Grant Program)
- Kansas Neighborhood Revitalization Act
- Low Income Housing Tax Credit Program
- Kansas Main Street Program
- Federal Charitable Deduction Easements
- KSA 12-1740 Revenue Bonds
- Kansas Technology Enterprise Programs

**Implementation Strategies**

a. **Develop a program to list as many eligible properties in the National and State Registers as possible, enabling property owners to utilize the federal and state rehabilitation tax credits.** Properties listed in the National Register of Historic Places are eligible for significant tax credits. The 20 percent federal rehabilitation tax credit applies to owners and some renters of income-producing National Register properties. The law also permits depreciation of such improvements over 27½ years for a rental residential property and over 31½ years for a nonresidential property. The rehabilitated building must be subject to depreciation.

All of the state’s National Register properties (commercial and residential) are eligible for a 25 percent rehabilitation tax credit. The federal and state tax credits can be used together.

The state tax credits can be sold, and while federal tax credits cannot be sold directly, a project can involve an equity partner, such as a bank, who participates in the project by contributing funds toward the rehabilitation in exchange for some or all of the tax credits.

Certain types of buildings that contribute to the significance of a historic district may also be eligible for rehabilitation tax credits. Within a district contributing buildings that are income-producing properties are eligible for both credits; non-income-producing residential properties are eligible for the state rehabilitation tax credit.

b. **Maximize the use of incentives by combining them into preservation “tool kits” — different combinations of incentives targeted for specific areas and tailored to certain needs — to provide flexible and lasting strategies to address stabilization and revitalization of older residential and commercial centers.**

c. **Target public incentives to projects in areas with existing public infrastructure and significant historic resources.**
d. Notify owners of eligible properties and assist them in providing access to applicable rehabilitation incentives and grants.

e. Investigate the use of Community Development Block Grant funds to foster historic preservation efforts.

f. Establish and fund the Historic Preservation Fund as described in city’s Conservation of Historic Resources Code.

**POLICY 3.2: DEVELOP INCENTIVES TO ENCOURAGE THE REHABILITATION AND OCCUPANCY OF HISTORIC PROPERTIES**

In addition to existing preservation incentives, many communities develop specific incentive programs to encourage rehabilitation and occupancy of historic properties in specific locations, both rural and urban. For example, many communities encourage façade improvements using preservation guidelines through funding grants and/or technical assistance.

**Implementation Strategies**

a. Attach appropriate design guidelines to incentive programs.

b. Create taxing incentives by using such tools as the Neighborhood Revitalization Act.

c. Create incentives to increase critical mass development in Downtown.

d. Create and target incentives to historic commercial areas such as façade improvement grants and economic incentives to owners or businesses that occupy or lease space in historic buildings.

e. Develop and implement policies and programs that eliminate parking issues as a disincentive to rehabilitation of buildings, including review of use permits and accompanying parking requirements and implementation of public/private shared use of parking structures.

f. Create incentives to maintain and preserve historically significant farming areas.

g. Provide design and/or technical assistance to property owners undertaking preservation projects, such as schematic architectural design assistance for renovation/restoration of residences, businesses, and rural structures.

h. Develop incentives to retain and strengthen small neighborhood commercial areas.
i. Utilize or create incentive programs for abatement of environmental hazards in significant historic buildings.

j. Provide incentives to reduce the number of multi-family units in houses originally designed as single-family residences that are located in historic and conservation districts.

**POLICY 3.3: ELIMINATE DISINCENTIVES TO PRESERVATION EFFORTS**

While incentives play an important role in promoting preservation, it is important to review current city and county policies that may discourage preservation. Removal of these obstacles may be as effective as implementation of incentives.

**Implementation Strategies**

a. Tax properties that are listed in the National Register, State Register or Local Register at a lower rate.

b. Abolish or develop a lower fee schedule for rehabilitation building permits.

The city and county need to develop a significant historic destination that establishes Lawrence and Douglas County as a gateway entity to the interpretation of regional history, linking historic preservation to a significant economic growth industry.

**GOAL # 4: INCORPORATE HERITAGE TOURISM AS AN ECONOMIC DEVELOPMENT PROGRAM**

**POLICY 4.1: DEVELOP A COMPREHENSIVE HERITAGE TOURISM PROGRAM THAT INTEGRATES HISTORIC RESOURCES AND VENDORS INTO PROGRAM PLANNING AND IMPLEMENTATION**

Tourism is big business and Heritage Tourism is a significant component of the tourism industry. Lawrence and Douglas County have a rich legacy of historic landmarks, sites, cultural landscapes, neighborhoods, buildings, structures, and archaeological resources that can bring knowledge and understanding of past cultures and events. These are assets that can be capitalized upon.

These assets have associations with national, state, and local events. They are tangible ties to prehistoric and historic native peoples, the era of European exploration, the Santa Fe, California and Oregon trails, the Border and Civil Wars, the development of regional agricultural industries, and the founding and development of a major state educational institution and multi-national Native American educational institution.

To capitalize on this legacy, Lawrence and Douglas County need to develop and
implement strategies to provide for the quality interpretation of the past, to preserve and protect historic and cultural resources, and to encourage collaboration and linkages within the city and county and throughout the region in developing a unified approach to capitalize on the Heritage Tourism market.

**Implementation Strategies**

a. **Support the Freedom’s Frontier National Heritage Area**  A National Heritage Area is an area or corridor designated by the United States Congress “... where natural, cultural, historic and recreational resources combine to form a cohesive, nationally distinctive landscape arising from patterns of human activity shaped by geography. These patterns make National Heritage Areas representative of the national experience through the physical features that remain and the traditions that have evolved in them.” National Heritage Areas are local partnerships with the National Park Service that:

1. protect historic, environmental, scenic, and cultural resources;
2. increase sustainable tourism and economic development;
3. educate residents and visitors about community history, traditions, and the environment;
4. create new outdoor recreation opportunities, and
5. build partnerships among federal, State, and local governments.

b. **Encourage and enter into cooperative regional efforts in programming and networking in public relations and marking efforts.**

c. **Revitalize the Watkins Community Museum.**

d. **Through the National Trust for Historic Preservation Heritage Tourism Program, the city/county should enlist the participation of all communities in Douglas County, sites, and museums to conduct a comprehensive management and interpretive assessment and to develop cooperative interpretive, marketing and programming plans.**

1. Inventory of current and potential attractions.
2. Assess current attractions, visitor services, organizational capabilities, preservation resources, and marketing programs.
3. Establish priorities and measurable goals through organizing human and financial resources.
4. Prepare for visitors through development of long-term management goals that protect historic resources.
5. Market for success through development of a multi-year, multiple-tier targeted marketing plan involving local, regional, State, and national partners.
6. Develop cooperative efforts between the Lawrence/Douglas County Chamber of Commerce and local preservation groups.
Policy 4.2: Encourage the Development of Black Jack Battlefield as a Significant Site in the History of the United States.

As part of the public participation in the adoption of this plan, the Lawrence-Douglas County Planning Commission identified Black Jack Battlefield as a resource worthy of specific identification, evaluation, documentation and preservation. The majority of the battle site is listed in the National Register of Historic Places and the structure known as the Pearson House is listed in the Register of Historic Kansas Places. The national importance of this site should be recognized and celebrated.

Implementation Strategies

a. Support the efforts of the Black Jack Battlefield & Nature Park to document the history of this site.
b. Support the efforts of the Black Jack Battlefield & Nature Park to encourage the development of this site as part of the Freedom’s Frontier National Heritage Area.
c. Encourage and enter into cooperative regional efforts in programming and networking in public relations and marking efforts that promote this significant historic site.

Public awareness of historic resources is needed to develop public/private partnerships in promoting and implementing historic preservation.

Goal # 5: Establish Outreach and Educational Programs

Policy 5.1: Develop a Government Sponsored Public Information Outreach Program

The city and county have a number of vehicles that could be used to disseminate information about historic preservation to the larger community. Among the most effective of these tools are the use of the city/county website to provide information about city/county efforts and links to other governmental and private entities in the federal, state, and local preservation network. Another important governmental tool is the publication and/or distribution of information brochures.

Implementation Strategies

a. Make public aware of available funding sources.
b. Develop or provide hands-on materials that provide information on how to repair and preserve historic buildings according to the Secretary of the Interior’s Guidelines for the Rehabilitation of Historic Buildings.
c. Provide information on historic neighborhoods (i.e. promote walking tours).

d. Provide notification each spring, prior to the construction season, to property owners in local districts, National Register properties, and State Register properties of the design guidelines and procedures to obtain a Certificate of Appropriateness and/or State Law Review.

e. Develop in-house materials for other city/county department staff about preservation processes and issues in order to assist in building consensus in applying preservation procedures.

f. Provide on-going preservation education sessions for members of appointed bodies including the Historic Resources Commission, City Commission, and Planning Commission.

g. Expand the city’s webpage to include additional information regarding National Register listing, survey information, how-to materials, etc.

h. Work with existing hardware and home improvement stores to provide hands on materials regarding historic preservation issues.

**POLICY 5.2: IN PARTNERSHIP WITH AN APPROPRIATE LOCAL ORGANIZATION, ASSIST IN DEVELOPING AND CONDUCTING A SERIES OF PUBLIC WORKSHOPS TO EDUCATE THE PUBLIC ABOUT PRESERVATION**

The city and the county can play a crucial role in convening and initial coordination of educational efforts. Although both governmental entities should develop in-house and public programs that communicate information about city and county preservation programs, the larger role of education and advocacy must be undertaken by private organizations.

**Implementation Strategies:**

a. Establish forums for realtors, rural lenders, developers, contractors, preservationists, business community leaders, and neighborhood groups to acquaint them with preservation benefits, issues and procedures.

**POLICY 5.3: DEVELOP MEDIA RELATIONS TO BE AN ADVOCATE FOR PRESERVATION**

A crucial component of public education is the support of the media in coverage of events and issues. This involves both the city and county as well as private organizations. The city can play a role in assembling information and preparing press releases about its programs and related activities. However, a private organization should be designated to coordinate media relations and to respond to preservation issues related to advocacy of a particular course of action that the city/county cannot address.
Implementation Strategy

a. **Promote preservation news in local press through press releases during National Preservation Week** that focus on the economic impact of preservation, as well as local newsworthy events, and recent local, state or national designations, etc.

**POLICY 5.4: DEVELOP PROACTIVE RECOGNITION PROGRAMS**

Existing and new programs that recognize preservation efforts (particularly when timed to coincide with National Preservation Week) can have a positive and on-going impact on public awareness. Such programs should be part of larger media and promotions strategy promoting and understanding and support for historic preservation.

Implementation Strategy

a. **Develop a county-wide Heritage Farm honorific program.**

b. **Develop historic signage.**

c. **Encourage the nomination of projects for local, state and national awards programs.**

**POLICY 5.5: COORDINATE PRESERVATION PROGRAMS IN THE COUNTY AND CITY WITH OTHER LOCAL, STATE, AND FEDERAL GOVERNMENTS AND ORGANIZATIONS**

Coordinating preservation activities and programs with other local municipalities, state, and federal government organizations is a very difficult task. Preservation efforts will be more successful by facilitating cooperation between the various entities. Both the city and the county can play an important convening and facilitating role in coordinating private and public preservation efforts.

Implementation Strategy

a. **Establish a countywide coordinating entity that includes private and public organizations and agencies. Primary goals should be:**

1. Development of an outreach program to unincorporated areas of the county to involve property owners in historic preservation initiatives; and

2. Joining rural and city constituencies in cooperative efforts.
Historic preservation is an important component in environmental stewardship and sustainable development. Sustainable development includes environmental sustainability, economic sustainability and cultural sustainability.

**GOAL # 6: INCORPORATE SUSTAINABLE PRESERVATION INTO THE CITY AND COUNTY’S SUSTAINABILITY POLICIES AND PROGRAMS**

The citizens of Lawrence and Douglas County increasingly support environmental conservation efforts. This growing awareness of how local conditions fit into larger environmental issues has led to the recognition of the importance of natural resources and of the embodied energy contained in the built environment. Historic preservation practices are tools for better stewardship of older buildings, neighborhoods, and rural landscapes. The conservation and improvement of our existing built resources, including the re-use and improvement of historic structures, is central to our community’s overall plan for environmental stewardship and sustainable development.

**POLICY 6.1: ENCOURAGE AND INCORPORATE HISTORIC PRESERVATION IN SUSTAINABLE PLANNING AND BUILDING PRACTICES**

To maximize the inherent sustainable qualities of historic preservation, long range planning and building practices should encourage the reuse of the existing built environment.

**Implementation Strategies:**

- **a. Foster a culture of reuse of existing structures by maximizing the life cycle of existing buildings.**
  -   1. Explore and adopt building codes that give a discount on the overall permit fee for the reuse of historic structures.
  -   2. Identify and promote programs that identify historic building materials, like first growth wood and historic lath and plaster, and the values they bring to structures.

- **b. Encourage reinvestment in the existing built environment.**
  -   1. Explore and adopt building codes that give a discount on the overall permit fee for the reuse of historic structures.
  -   2. Identify and promote programs that identify historic building materials, like first growth wood and historic lath and plaster, and the values they bring to structures.

- **c. Explore the use of outcome-based codes.**
  Building energy codes that focus on energy saving and consumption give existing structures proper credit for embodied energy and discourage teardowns.

- **d. Explore the adoption of building codes that create sustainable communities.** Building codes can address issues associated with
  -   1. Optimizing site potential
  -   2. Minimizing energy consumption
  -   3. Protecting and preserving water
  -   4. Use of environmentally sound products
  -   5. Enhancing indoor environmental quality
  -   6. Optimizing operational and maintenance practices
e. Explore the adoption of demolition codes that require sustainable practices like
   1. A percentage of demolition debris to be recycled and reused
   2. Demolition permit fees that reflect the values of historic resources.

**POLICY 6.2: DEVELOP PROGRAMS THAT ENCOURAGE PRESERVATION AS PART OF CREATING A SUSTAINABLE COMMUNITY.**

The City and County have taken the lead in beginning to identify goals and programs that will help create a sustainable community. New goals and programs are needed to incorporate the maintenance, reuse/repurpose, and recycling of our significant historic resources.

**Implementation Strategy**

a. Develop and adopt sustainability design guidelines for historic districts.

b. Develop and implement programs for City and County buildings that maintain historic fabric and reduce natural resource consumption.

c. Encourage and support the development of energy strategies. Energy strategies for energy conservation and generation should include
   1. Energy audits
   2. Evaluations of existing systems
   3. Establishing goals for energy savings.

d. Encourage and support the development of sustainable energy systems that can provide energy for multiple historic properties that cannot achieve sustainable energy goals individually. Many historic structures do not have the land or roof capacity to install sustainable energy systems such as solar, geothermal, and wind for the individual structure. Energy districts can combine areas to create sustainable systems for multiple historic properties that do not have the requirements necessary to achieve this goal individually.

e. Capitalize on the potential of the Green Economy and develop programs to encourage the manufacture and use of local products that are environmentally sound.

f. Utilize increased permit fees for the demolition of historic structures to fund a preservation fund to create low interest loans or grants that facilitate the rehabilitation of historic structures.

**POLICY 6.3: DEVELOP AN EDUCATION PROGRAM TO INCORPORATE SUSTAINABLE PRESERVATION INTO PUBLIC INFORMATION OUTREACH PROGRAMS ON SUSTAINABILITY**

Historic preservation is an important component of any effort to promote sustainable development. The conservation and improvement of our existing built resources, including re-use of historic and older buildings, greening the existing building stock, and reinvestment in older and historic communities, is crucial to lowering our carbon footprint and reducing energy leakage.
Implementation Strategies

a. Develop City and County Sponsored Public Information Outreach Programs that promote sustainability through preservation and rehabilitation of historic structures.
   1. Establish forums for realtors, developers, contractors, and preservationists to inform them about sustainable preservation benefits, issues and procedures.

b. Align Historic Preservation Policies with sustainability policies.
   1. Assist the Sustainability Advisory Board with the development of goals and priorities for future cultural resource conservation efforts.
   2. Work with the Sustainability Coordinator to identify practical methods and programs to reach the City’s goals for sustainability.
   3. Identify and encourage the adoption of Preservation goals, policies, and programs that incorporate sustainable community ideals.

c. Work with the Sustainability Coordinator to identify education programs and opportunities to promote preservation and sustainability.

d. Promote educational programs that identify sustainable development and how it differs from sustainable design.
   1. Sustainable Development is not limited to environmental sustainability.
   2. Sustainable Development is also economic sustainability and cultural sustainability.
HORIZON 2020

Historic Preservation Plan Element

The Comprehensive Historic Preservation Plan for Lawrence and Unincorporated Douglas County

May 19, 2011
HORIZON 2020
Historic Preservation Plan Element

The Comprehensive Historic Preservation Plan for Lawrence and Unincorporated Douglas County

Lawrence-Douglas County Metropolitan Planning Office

May 19, 2011

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Dr. Terry Riordan
Shawn Pine

LAWRENCE-DOUGLAS COUNTY METROPOLITAN PLANNING OFFICE
Scott McCullough, Director
Lynne Braddock Zollner, Historic Resources Administrator

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Executive Summary
Executive Summary

The Horizon 2020 Historic Preservation Plan Element provides Lawrence and unincorporated Douglas County with both a broad-based and inclusive preservation model. Its goal is to create opportunities to preserve, enhance and develop, through preservation activities and programs, livable, vital, and sustainable neighborhoods, commercial centers, cultural landscapes, and rural communities. The plan broadly focuses on the city's and county's cultural resources, including its buildings, neighborhoods and streetscapes, historic sites, trails, battlefields, open spaces, and prehistoric and historic archaeological sites. These are the assets that provide a unique “sense of place” in the region.

This historic preservation plan element presents goals, policies, and implementation strategies that integrate historic preservation into the city's and the county's planning and land use policies and processes. By capitalizing on historic preservation’s demonstrated strengths, reinforcing current programs, and initiating both short- and long-term new efforts, the city and the county can not only protect valuable resources, they can also coordinate the processes involved in this protection.

PRESERVATION PLAN GOALS

The City of Lawrence and Douglas County possess a unique legacy of built and natural resources that reflect its rich history. This legacy deserves to be protected and preserved. This plan capitalizes on the demonstrated success of historic preservation methodology as a tool for revitalization of older neighborhoods and commercial centers, the popularity of traditional urban environments, the fast-growing heritage and cultural tourism industry, and the strong public support for environmental stewardship and sustainability. It provides strategies that place preservation as an important component in the city and county's planning and development programs. Six goals compose the key elements of the plan.

- Incorporate Historic Preservation as an Important Component of the City and County Planning Processes.
- Conserve the Rural Character of Unincorporated Douglas County in Strategic Areas.
- Incorporate Preservation Incentives into the City and County's Economic Development Policies and Programs.
• Incorporate Heritage Tourism as an Economic Development Program.

• Establish Outreach and Educational Programs.

• Incorporate Historic Preservation into the City and County's sustainability Policies and Programs.

WHY A HISTORIC PRESERVATION PLAN?

Historic preservation offers two distinct benefits. The preservation of historic resources has its own intrinsic value in celebrating the city and the county's diverse cultural heritage, in honoring the craftsmanship of other eras, in instilling the values by which we live, and in understanding the relationships of the past, the present, and the future. Historic preservation also has proven practical value as a tool for economic development and environmental stewardship.

Economic Benefit

The most successful revitalization efforts in the country (cities, towns, or rural communities) utilize historic rehabilitation and preservation as the core of their revitalization strategies. Throughout the nation, there are successful models for preservation programs that demonstrate the positive economic impact that occurs when historic preservation is used as a tool for planned revitalization efforts in older neighborhoods and commercial centers.

Public policy that integrates historic preservation into the planning process and targets it to definable areas provides a level of stability that attracts both short- and long-term investment. Revitalized neighborhoods provide a stable population, a greater tax base, higher job retention, and less drain on city services.

Heritage Tourism Venues

Preserved neighborhoods and commercial centers attract visitors. Heritage tourism is big business. This plan provides initiatives that capitalize on existing historic resources and themes and presents approaches to developing new heritage tourism programs that promote local and regional synergy, allowing the city and county to capitalize on their historic resources. Lawrence and Douglas County can claim a role in the development of cultural, economic, and political forces of local, state, and national significance. Lawrence and Douglas County retain tangible ties to prehistoric and historic indigenous peoples, the era of European exploration and the fur trade, the Santa Fe commercial trade route, the establishment of the Indian Territory, the Oregon and California
emigrant trails, the abolitionist movement, the Border War, the Civil War, the evolution of regional livestock and agricultural industries and an acclaimed State university.

Environmental Stewardship and Sustainability

Historic preservation is an important component in environmental stewardship and sustainable development. The citizens of Lawrence and Douglas County increasingly support environmental conservation efforts. This growing awareness of how local conditions fit into larger environmental issues has led to the recognition of the importance of natural resources and of the embodied energy contained in the built environment. Historic preservation practices are tools for better stewardship of older buildings, neighborhoods, and rural landscapes. The conservation and improvement of our existing built resources, including the re-use and improvement of historic structures, is central to our community's overall plan for environmental stewardship and sustainable development.

The Federal, State, and Local Preservation Partnership

Many of the nation's preservation programs are part of a partnership between federal, state, and local government. The National Historic Preservation Act of 1966 created the framework for the National Register of Historic Places, the Advisory Council on Historic Preservation, and authorized matching grants-in-aid to states. By October of 1966, the Secretary of the Interior asked the governor of each state to appoint an individual to help accomplish the directives of the National Historic Preservation Act including the review and allocation of matching grants-in-aid. In 1980 the National Park Service created the Certified Local Government program to formalize the partnership between the National Park Service, acting on behalf of the Federal Government, the State Historic Preservation Office (SHPO), acting on behalf of the state government, and local governments.

Federal laws affect preservation in a number of ways. They authorize federal support for national, state, and local preservation programs; define procedures for the identification, evaluation, and protection of cultural resources; provide incentives to protect resources; and mandate procedures to review the impact of federal undertakings on significant cultural resources.

Among the most successful preservation incentives are the 20 percent rehabilitation tax credit for income-producing properties listed individually or as contributing to a district in
the National Register of Historic Places and the low-income housing credit that can be combined with the rehabilitation credit. Owners of properties that are listed in the National Register can donate a preservation easement to a not-for-profit entity and receive a charitable contribution deduction. Easements may be donated for buildings, scenic or landscape elements, or for open space.

Each state administers federal preservation programs as well as programs established by the state. The Cultural Resources Division of the Kansas Historical Society provides technical assistance and administers a number of grant and incentive programs, as well as federal programs. The Kansas Legislature passed a 25 percent tax credit for rehabilitation of income-producing and residential properties listed individually or as contributing to a district in the National Register of Historic Places. The program uses the same criteria as the federal rehabilitation tax credit program and is designed to “piggy back” onto the federal tax credits.

By design, the strongest element of the federal, state and local government preservation partnership is at the local level. The City of Lawrence was designated as a Certified Local Government in 1989. This status indicates a partnership in compliance with federal guidelines for local government historic preservation programs. The Lawrence-Douglas County Metropolitan Planning Office administers the program assisted by the Lawrence Historic Resources Commission. The regulatory framework for preservation in the city is in place through the Conservation of Historic Resources (Chapter 22) Code of the City of Lawrence. The City of Lawrence also has an agreement with the State Historic Preservation Officer (SHPO) to conduct reviews required by the State Preservation Law.

Douglas County does not have a formal preservation program. Under federal guidelines, the county could establish a preservation program focusing on the preservation of resources within the unincorporated areas of Douglas County and become a Certified Local Government.

In addition to the various government preservation programs, there are a number of well-established private entities – neighborhood associations, professional groups, historical societies, and preservation organizations – that provide a variety of research, technical, educational, and advocacy roles in promoting the preservation of cultural resources.
HORIZON 2020 PRESERVATION PLAN ELEMENT

This plan for preservation outlines goals, policies, and implementation strategies designed to identify, evaluate, and protect the cultural resources in the City of Lawrence and in the unincorporated areas of Douglas County. A summary outline of these elements is provided below. Chapter Five provides a narrative elaboration to provide a clear understanding of their intent.

GOAL # 1: INCORPORATE PRESERVATION AS AN IMPORTANT COMPONENT OF THE CITY AND COUNTY PLANNING PROCESSES

POLICY 1.1: EXPAND HISTORIC PRESERVATION IDENTIFICATION, EVALUATION, AND PROTECTION PROGRAMS

Implementation Strategies

a. Expand the cultural resource survey process to identify important resources to be considered in all city and county planning processes.

b. Update the existing National Register of Historic Places Multiple Property Documentation Form for Lawrence to include properties that have achieved historic significance since 1945.

c. Work with the State Historic Preservation Office’s interactive online database, the Kansas Historic Resources Inventory (KHRI), to establish an up-to-date survey database.

d. Launch an ongoing effort to create National Register and local historic districts in the city with design guidelines to maximize the potential to stabilize and increase property values while protecting resources.

e. In conjunction with property owners, develop and implement a National Register, and State Register nomination plan for significant historic properties within the unincorporated areas of the county.

f. Identify and evaluate, during the development review process, properties that are fifty years or older that will be affected by development proposals such as rezoning, platting, development plans, conditional use permits, and use permitted upon review permits.

g. Working with property owners, develop a program to list as many eligible properties in the National Register and State Register as possible, enabling property owners to utilize the federal and state rehabilitation tax credits.

h. Reevaluate the city’s demolition ordinance and investigate streamlining the 30-day waiting period by developing a policy for properties which are potentially eligible for listing.

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1 The National Park Service’s criteria for evaluation of historical significance exclude properties that achieved significance within the last fifty years unless they are of exceptional importance. Fifty years is the general estimate of time needed to develop the necessary historical perspective to evaluate significance.
i. Explore alternative protection mechanisms used in other communities for protection programs for identified significant rural resources.

POLICY 1.2: DEVELOP OR MODIFY APPROPRIATE ZONING, BUILDING CODE, AND FIRE CODE REGULATIONS TO FACILITATE THE PRESERVATION AND REHABILITATION OF HISTORIC PROPERTIES.

Implementation Strategies

a. Investigate the possibility of creating additional conservation districts as an alternative protection mechanism and standard for environs review.

b. Review and update existing city zoning to be compatible with existing or desired land use that promotes preservation of intact residential neighborhoods and commercial centers that have historical, architectural, and physical integrity. Among the issues to be considered are:

1. consistency between overlay zoning and base land use zoning among contiguous properties;
2. flexible provisions for developing compatible new “infill” construction on vacant lots;
3. allowance of innovative preservation alternatives, such as additional or specialty uses including “bed and breakfast,” studios, and other professional uses;
4. appropriate design guidelines and site development controls to encourage quality rehabilitation and compatible new construction worthy of preservation in the future; and
5. effective procedures to discourage demolition of significant buildings and structures.

c. Require new development in established areas of the city to use designs complementary to the adjacent streetscape.

d. Create transition zones and flexible links in Lawrence by using setbacks, alleys, parks, and open space in a way that is consistent with established patterns.

e. Adopt a rehabilitation code to address building code and fire code requirements in historic structures for the City of Lawrence and Douglas County.

POLICY 1.3: DEVELOP AND IMPLEMENT FORMALIZED PROCEDURES TO COORDINATE PRESERVATION EFFORTS AMONG CITY AND COUNTY DEPARTMENTS AND AGENCIES

HORIZON 2020 Preservation Plan Element 1-7

Introduction
Implementation Strategies

a. Establish formalized procedures for the Lawrence Historic Resources Commission (HRC) or the Historic Resources Administrator to review and comment on City planning activities.

b. Facilitate the integration of the development review process and the building permitting process with the design review process. Consider alternative processes for project review.

c. Require historic preservation elements as part of comprehensive, watershed or sub-basin, sector, neighborhood, and special area plans.

d. Implement consistent and systematic building and maintenance code enforcement.

e. Enforce environmental code.

f. Explore a demolition by neglect ordinance.

g. Adopt a rehabilitation building and fire code for the city and the county.

h. When possible, historic preservation issues should be represented in appointed positions. Representatives of these entities should also be considered as appointed members on the HRC.

i. Working with property owners, target significant cultural landscapes for park/green space designation on the National, State or Local Register.

j. Working with property owners, target open space designation to areas with probability for the presence of a high level of archaeological artifacts. Given the limited amount of resources for archaeological investigations, consideration should be given to those sites which have been documented by credible historical research.

k. Include a preservation element in the City of Lawrence’s Parks and Recreation Master Plan.

l. Require review of new ordinances for their impact on historic resources and historic preservation efforts.

POLICY 1.4: IMPROVE EXISTING LOCAL AND STATE LAW DESIGN REVIEW PROCESS
Implementation Strategies

a. Conduct ongoing inspection of work after HRC review.

b. Develop review process that promotes more consistent and objective interpretation of environs law.

c. Provide legal enforcement of HRC decisions.

d. Reconcile the differences between state law environs review and City of Lawrence’s environs review standards.²

e. Establish a recording process with the Register of Deeds to record National Register, State Register, and Local Register properties.

f. Investigate ways to simplify the design review and the state law review process through the integration of building permit applications, design review applications, and development review applications.

POLICY 1.5: ESTABLISH CLEAR, WORKING DEVELOPMENT AND DESIGN REVIEW PROCESSES WITH FEDERAL, STATE, COUNTY, PUBLIC, AND PRIVATE INSTITUTIONS LOCATED NEAR HISTORIC RESOURCES.

Implementation Strategies

a. Develop and continue agreements regarding development policies for federal, state, public and private institutions such as the University of Kansas, Baker University, Haskell University, Lawrence Memorial Hospital, Lawrence School District, Townships, and Rural Water Districts, which are located near historic areas. Such agreements should include community expectations, a public participation process, and development requirements, including development of expansion boundaries.

b. Formulate Neighborhood, sector, and special area plans that establish clear boundaries for commercial areas as well as institutions.

c. Form stronger partnerships between the Campus Historic Preservation Board and the Lawrence Historic Preservation Commission.

POLICY 1.6: DEVELOP A PUBLIC RESOURCES POLICY THAT VALUES HISTORIC PUBLIC IMPROVEMENTS.

² There are a number of differences between the State law requirements and the local ordinance requirements. One of the main issues is that the standard of review required under the local ordinance places the burden of proof on the Historic Resources Commission in reviewing environs review cases while the state law places the burden of proof on the applicant. In cases that involve both local ordinance and state law review there is an inherent conflict.
Implementation Strategies

a. Create a comprehensive approach to infrastructure improvements on a neighborhood-by-neighborhood basis.

b. Protect and maintain existing brick streets, brick sidewalks, and hitching posts in the City of Lawrence.

c. Restore brick streets and sidewalks in the City of Lawrence.

d. Implement appropriate traffic calming measures in residential neighborhoods in the City of Lawrence.

e. Investigate and implement initiatives to improve parking in Downtown with minimal impact of older buildings.

f. Improve bicycle and pedestrian routes and rural trails.

g. Target Parks and Recreation tax revenues when appropriate for cultural resource projects on public lands.

h. Improve flood control to protect historic properties.

i. Develop a formal review process for all public improvements to determine the effects on historic preservation and/or historic preservation planning efforts.

GOAL # 2: CONSERVE THE RURAL CHARACTER OF UNINCORPORATED DOUGLAS COUNTY IN STRATEGIC AREAS

POLICY 2.1: DEVELOP A PRESERVATION PROGRAM FOR THE IDENTIFICATION AND EVALUATION OF CULTURAL RESOURCES IN THE UNINCORPORATED AREAS OF DOUGLAS COUNTY

Implementation Strategies

a. Develop and implement a rural survey plan to identify and evaluate rural resources based on a systematic approach by township areas, giving priority to areas with the highest rate of development.

   1. A reconnaissance survey of Palmyra Township (1989) identified a number of properties in the community of Vinland and 207 properties with associated structures, and six rural cemeteries in rural Palmyra Township that appeared to be more than fifty years old. The farmstead is the most common rural property type in this township. However, examples with a complete intact set of early outbuildings are uncommon.
2. “Commons on the Prairie,” (1990), an unpublished master's thesis by Dennis Domer, discussed the historic architecture and cultural landscape of Willow Springs Township; and

b. **Working with rural property owners, develop a cultural landscape component for the identification and evaluation of cultural resources.**

   Develop an archaeological survey plan for the County that:

   1. includes an archaeological predictive model for Douglas County that identifies areas of high medium and low probability and
   2. prioritizes archaeological survey to focus on areas in which development is ongoing and in which resources would most likely be expected.

c. **Work with the State Historic Preservation Office’s interactive online database, the Kansas Historic Resources Inventory (KHRI), to establish an up-to-date survey database.**

**POLICY 2.2: DEVELOP A PRESERVATION PROGRAM FOR THE PROTECTION OF CULTURAL RESOURCES IN THE UNINCORPORATED AREAS OF DOUGLAS COUNTY TO BE INTEGRATED INTO COUNTY PLANNING POLICIES AND PROCESSES.**

**Implementation Strategies**

a. Develop and establish by ordinance a rural preservation program for the unincorporated areas of the county.

b. Explore the benefits and liabilities of establishing Douglas County as a separate Local Certified Government (CLG).

c. Investigate successful protection strategies used in other areas of the nation and develop a plan to implement those that are applicable to Douglas County, such as conservation easements and incentives to encourage private stewardship.

d. Develop and implement a National Register and State Register nomination plan for significant historic properties within the unincorporated area of the County.

e. Target and prioritize sites such as the natural areas – unplowed prairie and woodlands – identified in Horizon 2020 for preservation.

f. Target significant cultural landscapes for park/green space designation.

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3 “Horizon 2020”.
g. Target open space to areas with a predictive model for the presence of a high level of archaeological artifacts.

h. Investigate the use of funding mechanisms to retain open space around historic sites.

POLICY 2.3: ELIMINATE DISINCENTIVES TO ORDERLY PLANNED DEVELOPMENT

Implementation Strategies

a. Require annex plans and urban growth boundaries from all municipalities within Douglas County.

b. Develop policies that encourage development in the urban growth boundaries of associated municipalities.

POLICY 2.4: CONSERVE THE VISUAL DISTINCTION BETWEEN CITY AND RURAL AREAS

Implementation Strategies

a. Create transition zones between rural areas and the city using wetlands, open spaces, parks, golf courses, "rails to trails," small farm transition areas, and commercial/rural transition areas, i.e., businesses that require open space.

b. Continue to investigate and create limits on development outside the urban growth areas or boundaries.

c. Promote retention of agricultural land use through programs such as the transfer of development rights and conservation easements.

GOAL # 3: INCORPORATE PRESERVATION INCENTIVES INTO THE CITY AND COUNTY’S ECONOMIC DEVELOPMENT POLICIES AND PROGRAMS

POLICY 3.1: ENCOURAGE THE UTILIZATION AND LINKAGE OF EXISTING INCENTIVES

Implementation Strategies

a. Develop a program to list as many eligible properties in the National and State Registers as possible, enabling property owners to utilize the federal and state rehabilitation tax credits.

b. Maximize the use of incentives by combining them into preservation “tool kits”—different combinations of incentives targeted for specific areas and tailored to certain needs— to provide flexible and lasting g
strategies to address stabilization and revitalization of older residential and commercial centers.

c. Target public incentives to projects in areas with existing public infrastructure and significant historic resources.

d. Notify owners of eligible properties and assist them in providing access to applicable rehabilitation incentives and grants.

e. Investigate the use of Community Development Block Grant funds to foster historic preservation efforts.

f. Establish and fund the Historic Preservation Fund as described in city’s Conservation of Historic Resources Code.

POLICY 3.2: DEVELOP INCENTIVES TO ENCOURAGE THE REHABILITATION AND OCCUPANCY OF HISTORIC PROPERTIES

Implementation Strategies

a. Attach appropriate design guidelines to incentive programs.

b. Create taxing incentives by using such tools as the Neighborhood Revitalization Act.

c. Create incentives to increase critical mass development in Downtown.

d. Create and target incentives to historic commercial areas such as façade improvement grants and economic incentives to owners or businesses that occupy or lease space in historic buildings.

e. Develop and implement policies and programs that eliminate parking issues as a disincentive to rehabilitation of buildings, including review of use permits and accompanying parking requirements and implementation of public/private shared use of parking structures.

f. Create incentives to maintain and preserve historically significant farming areas.

g. Provide design and/or technical assistance to property owners undertaking preservation projects, such as schematic architectural design assistance for renovation/restoration of residences, businesses, and rural structures.

h. Develop incentives to retain and strengthen small neighborhood commercial areas.
i. Utilize or create incentive programs for abatement of environmental hazards in significant historic buildings.

j. Provide incentives to reduce the number of multi-family units in houses originally designed as single-family residences that are located in historic and conservation districts.

**POLICY 3.3: ELIMINATE DISINCENTIVES TO PRESERVATION EFFORTS**

**Implementation Strategies**

a. Tax properties that are listed in the National Register, State Register or Local Register at a lower rate.

b. Abolish or develop a lower fee schedule for rehabilitation building permits.

**GOAL # 4: INCORPORATE HERITAGE TOURISM AS AN ECONOMIC DEVELOPMENT PROGRAM**

**POLICY 4.1: DEVELOP A COMPREHENSIVE HERITAGE TOURISM PROGRAM THAT INTEGRATES HISTORIC RESOURCES AND VENDORS INTO PROGRAM PLANNING AND IMPLEMENTATION**

**Implementation Strategies**

a. Support the Freedom’s Frontier National Heritage Area

b. Encourage and enter into cooperative regional efforts in programming and networking in public relations and marking efforts.

c. Revitalize the Watkins Community Museum.

d. Through the National Trust for Historic Preservation Heritage Tourism Program, the city/county should enlist the participation of all communities in Douglas County, sites, and museums to conduct a comprehensive management and interpretive assessment and to develop cooperative interpretive, marketing and programming plans.

1. Inventory of current and potential attractions.
2. Assess current attractions, visitor services, organizational capabilities, preservation resources, and marketing programs.
3. Establish priorities and measurable goals through organizing human and financial resources.
4. Prepare for visitors through development of long-term management goals that protect historic resources.
5. Market for success through development of a multi-year, multiple-tier targeted marketing plan involving local, regional, State, and national partners.

6. Develop cooperative efforts between the Lawrence/Douglas County Chamber of Commerce and local preservation groups.

**POLICY 4.2: ENCOURAGE THE DEVELOPMENT OF BLACK JACK BATTLEFIELD AS A SIGNIFICANT SITE IN THE HISTORY OF THE UNITED STATES.**

**Implementation Strategies**

a. Support the efforts of the Black Jack Battlefield & Nature Park to document the history of this site.

b. Support the efforts of the Black Jack Battlefield & Nature Park to encourage the development of this site as part of the Freedom’s Frontier National Heritage Area.

c. Encourage and enter into cooperative regional efforts in programming and networking in public relations and marketing efforts that promote this significant historic site.

**GOAL # 5: ESTABLISH OUTREACH AND EDUCATIONAL PROGRAMS**

**POLICY 5.1: DEVELOP A GOVERNMENT SPONSORED PUBLIC INFORMATION OUTREACH PROGRAM**

**Implementation Strategies**

a. Make public aware of available funding sources.

b. Develop or provide hands-on materials that provide information on how to repair and preserve historic buildings according to the Secretary of the Interior’s Guidelines for the Rehabilitation of Historic Buildings.

c. Provide information on historic neighborhoods (i.e. promote walking tours).

d. Provide notification each spring, prior to the construction season, to property owners in local districts, National Register properties, and State Register properties of the design guidelines and procedures to obtain a Certificate of Appropriateness and/or State Law Review.

e. Develop in-house materials for other city/county department staff about preservation processes and issues in order to assist in building consensus in applying preservation procedures.
f. Provide on-going preservation education sessions for members of appointed bodies including the Historic Resources Commission, City Commission, and Planning Commission.

g. Expand the city’s webpage to include additional information regarding National Register listing, survey information, how-to materials, etc.

h. Work with existing hardware and home improvement stores to provide hands on materials regarding historic preservation issues.

**POLICY 5.2: IN PARTNERSHIP WITH AN APPROPRIATE LOCAL ORGANIZATION, ASSIST IN DEVELOPING AND CONDUCTING A SERIES OF PUBLIC WORKSHOPS TO EDUCATE THE PUBLIC ABOUT PRESERVATION**

Implementation Strategies:

a. Establish forums for realtors, rural lenders, developers, contractors, preservationists, business community leaders, and neighborhood groups to acquaint them with preservation benefits, issues and procedures.

**POLICY 5.3: DEVELOP MEDIA RELATIONS TO BE AN ADVOCATE FOR PRESERVATION**

Implementation Strategy

a. Promote preservation news in local press through press releases during National Preservation Week that focus on the economic impact of preservation, as well as local newsworthy events, and recent local, state or national designations, etc.

**POLICY 5.4: DEVELOP PROACTIVE RECOGNITION PROGRAMS**

Implementation Strategy

a. Develop a county-wide Heritage Farm honorific program.

b. Develop historic signage.

c. Encourage the nomination of projects for local, state and national awards programs.

**POLICY 5.5: COORDINATE PRESERVATION PROGRAMS IN THE COUNTY AND CITY WITH OTHER LOCAL, STATE, AND FEDERAL GOVERNMENTS AND ORGANIZATIONS**

Implementation Strategy
a. Establish a countywide coordinating entity that includes private and public organizations and agencies. Primary goals should be:

1. development of an outreach program to unincorporated areas of the county to involve property owners in historic preservation initiatives; and

2. joining rural and city constituencies in cooperative efforts.

GOAL # 6: INCORPORATE SUSTAINABLE PRESERVATION INTO THE CITY AND COUNTY’S SUSTAINABILITY POLICIES AND PROGRAMS

POLICY 6.1: ENCOURAGE AND INCORPORATE HISTORIC PRESERVATION IN SUSTAINABLE PLANNING AND BUILDING PRACTICES

Implementation Strategies:

a. Foster a culture of reuse of existing structures by maximizing the life cycle of existing buildings.

b. Encourage reinvestment in the existing built environment.
   1. Explore and adopt building codes that give a discount on the overall permit fee for the reuse of historic structures.
   2. Identify and promote programs that identify historic building materials, like first growth wood and historic lath and plaster, and the values they bring to structures.

c. Explore the use of outcome-based codes.

d. Explore the adoption of building codes that create sustainable communities.

e. Explore the adoption of demolition codes that require sustainable practices like
   1. A percentage of demolition debris to be recycled and reused
   2. Demolition permit fees that reflect the values of historic resources.

POLICY 6.2: DEVELOP PROGRAMS THAT ENCOURAGE PRESERVATION AS PART OF CREATING A SUSTAINABLE COMMUNITY.

Implementation Strategy

a. Develop and adopt sustainability design guidelines for historic districts.

b. Develop and implement programs for City and County buildings that maintain historic fabric and reduce natural resource consumption.

c. Encourage and support the development of energy strategies.

d. Encourage and support the development of sustainable energy systems that can provide energy for multiple historic properties that cannot achieve sustainable energy goals individually.
e. Capitalize on the potential of the Green Economy and develop programs to encourage the manufacture and use of local products that are environmentally sound.

f. Utilize increased permit fees for the demolition of historic structures to fund a preservation fund to create low interest loans or grants that facilitate the rehabilitation of historic structures.

POLICY 6.3: DEVELOP AN EDUCATION PROGRAM TO INCORPORATE SUSTAINABLE PRESERVATION INTO PUBLIC INFORMATION OUTREACH PROGRAMS ON SUSTAINABILITY

Implementation Strategies

a. Develop City and County Sponsored Public Information Outreach Programs that promote sustainability through preservation and rehabilitation of historic structures.

1. Establish forums for realtors, developers, contractors, and preservationists to inform them about sustainable preservation benefits, issues and procedures.

b. Align Historic Preservation Policies with sustainability policies.

1. Assist the Sustainability Advisory Board with the development of goals and priorities for future cultural resource conservation efforts.
2. Work with the Sustainability Coordinator to identify practical methods and programs to reach the City’s goals for sustainability.
3. Identify and encourage the adoption of Preservation goals, policies, and programs that incorporate sustainable community ideals.

c. Work with the Sustainability Coordinator to identify education programs and opportunities to promote preservation and sustainability.

d. Promote educational programs that identify sustainable development and how it differs from sustainable design.

1. Sustainable Development is not limited to environmental sustainability.
2. Sustainable Development is also economic sustainability and cultural sustainability.
Introduction

Why a Preservation Plan?
What is a Preservation Plan?
How is the Preservation Plan Used?
Horizon 2020 Preservation Planning Process
Overall Horizon 2020 Preservation Planning Goals
Chapter One
Introduction

WHAT IS A PRESERVATION PLAN?

This preservation plan for Lawrence and the unincorporated areas of Douglas County reflects the desire to shape the future image of the community and provides the foundation and framework for making physical development and policy decisions in the future.

- It is a policy plan stating the community's desires for directing city and county preservation activities through identified goals and policies.

- It is both short- and long-range, considering Lawrence and Douglas County's expected growth in the future.

- It is comprehensive, considering urban and rural land use, property maintenance, economic development, and education and outreach needs that will continue to influence preservation planning.

The preservation plan component provides a vision for the community. It is used as a policy guide that identifies the community's goals for directing planning decisions and preservation activities. It is designed to be integrated into city and county planning, land use, and economic development programs. It also provides property owners and residents with an understanding of how the city and county plan to protect cultural resources, particularly in the evaluation of new development, the design and adoption of area and neighborhood plans, and in the design and implementation of economic development strategies. Most importantly, this plan not only integrates preservation goals, policies, and strategies into city and county processes, it allows decision makers to look at preservation issues within the context of other land use and development issues.

WHY A PRESERVATION PLAN?

Like many communities and rural areas nationwide, Lawrence and Douglas County experienced significant growth during the last decade. New development is evident along the roads leading into the City's historic core and in previously rural farmland in the county. Arising from this growth are new land use and economic development issues. In particular, a preservation plan addresses the issues arising from new commercial and residential development and the consequent decline and disappearance
of older neighborhoods, commercial centers, farmsteads, and villages.

The historic development of Lawrence and Douglas County is a unique and important story. It defines the culture of the community and provides tangible reminders of its past, creating a unique “sense of place.” The story of the County and its communities is intrinsically entwined with the story of the development of the United States — an evolution over 200 years of ethnic and cultural interaction and amalgamation. It is an experience of diversity both in natural environment and cultural heritage. The inhabitants of Douglas County witnessed and participated in events that significantly contributed to that national experience. Few communities or counties can boast of intimate associations with the era of European exploration, the westering movement, the Santa Fe commercial route, the California and Oregon overland emigrant trails, the Border and Civil wars, the establishment of a regional livestock and agriculture industry, and associations with an acclaimed state university and a notable Native American university. Thus, Lawrence and Douglas County are important not only for their own unique history; they are also significant for their associations with the history of the trans-Mississippi West.

The physical impact of rapidly developing suburban enclaves already obscures much of that past. As new housing and commercial developments spring up on previously unexcavated prairie pasture, the physical destruction of former farmland reduces an understanding of the historical development of Douglas County. Less obvious is the random destruction of buildings, structures, and sites that have associations to the unique history of Douglas County and, in particular, of Lawrence as a “free state” settlement, educational center, railroad market town, and county seat that developed in the late nineteenth and early twentieth centuries. The loss of these physical elements that historically defined the core of the community significantly impacts its identity — its unique attributes that distinguishes it from other communities in the region.

Lawrence and Douglas County will continue to change. Change, however, provides the opportunity to strengthen and enrich the city’s and county’s visual character and to enhance the quality of life already appreciated by many residents and visitors. The goal of this preservation plan is to move toward change in a positive manner, as a catalyst for capitalizing on the synergy of the old and new. To achieve this goal, it is necessary first to recognize and understand the assets that contribute to the city’s and county’s unique physical and cultural character; then to forge a consensus regarding their preservation; and after that to develop goals, policies and initiatives to assist elected officials and citizens in supporting future identification, interpretation, evaluation and protection of Lawrence’s and Douglas County’s remaining cultural resources.

**BENEFITS OF PRESERVATION**

**HORIZON 2020 Preservation Plan Element 1-22**

**Introduction**
While preservation of cultural resources has its own intrinsic value, the most compelling argument for protecting historic resources is that people like them! People seek historic settings because they reflect quality design, craftsmanship, and materials. They appreciate physical reminders of the past that reflect the depth and diversity of our culture. Preservation also has practical value as a tool for economic development and environmental stewardship.

**Economic Benefits**

As noted by real estate expert, Donovan D. Rypkema, “. . . the history of the preservation movement has been one that was largely the preservation of historic structures as an end in itself. Today the cutting edge of preservation isn’t as an end itself but as a vehicle for economic development.”4 He notes in his book, *The Economics of Historic Preservation*, that preservation may be one of the most effective acts of fiscal responsibility governmental entities can undertake. Older neighborhoods and commercial centers represent a considerable taxpayer investment in infrastructure and building stock. Moreover, it is expensive to continue the random extension of public services to outlying areas. The lifetime cost of low-density suburban development is 40 to 400 percent greater than more compact development.5 Thus, conservation of buildings, neighborhoods, and sites of historic and aesthetic value is one of the best tools for recovering the worth of past investments while fueling new economic activity.6

The most successful revitalization efforts in the country utilize historic rehabilitation as the core of their economic development strategies. The creative combination of preservation, adaptive reuse, and new construction, capitalizes on the aesthetics and craftsmanship of other eras, provides opportunities for architectural innovation, and promotes problem solving, thereby enhancing the community’s character and fabric.7 Thus, as noted by Carolyn Douthat in *Economic Incentives for Historic Preservation*, “Clear public policy favoring historic preservation, particularly when targeted at identifiable districts, provides a level of certainty and stability necessary to [attract] investment.”8

Lawrence has a strong cultural identity. Its cultural and historic resources are among

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5 Ibid., 38
7 Ibid.
8 Ibid., 40, quoting Cathy Douthat, *Economic Incentives for Historic Preservation*. 

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the community’s strongest assets in attracting tourists. Heritage Tourism is a national growth industry that supports preservation, builds on the convention and travel business, attracts hundreds of thousands of new visitors, and generates millions of dollars in new spending. It creates jobs and new businesses, and promotes higher property values.

Historic preservation can also be an effective rural economic development strategy. Many rural areas lack the ingredients important to industries they imagine they can attract, but they are not without assets. Beauty is, first and foremost, our “money crop.” And that beauty includes old stone barns, backwater rivers and streams, upland ridges, woodlands, small hamlets, rural churches and cemeteries, and even fields of crops ready for harvest. The wise and strategic use of these resources through historic preservation techniques can lead to economic rewards. By putting these assets to work, rural residents, in cooperation with each other and Douglas County planning entities, can generate new prosperity to attract other forms of economic development along with tourism.

**Environmental Stewardship**

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9 Ibid., 20, citing Robert Becker in *Enhancing Rural Economics through Amenity Resources.*
Natural resources and energy are valuable assets that should be used judiciously and managed wisely for the benefit of present and future generations. Using preservation as a tool for conservation of resources provides a rational and effective environmental strategy for the future. There is a strong and growing accord among the citizens of Lawrence and Douglas County in support of environmental conservation efforts.

This consensus includes the recognition of the important embodied energy contained in built resources and efforts to encourage better stewardship of older buildings and structures. Rehabilitating historic buildings saves energy costs. This energy is measured not just by the amount required to tear down and build anew, it is also measured by the “embodied energy” existing in the building itself. “Embodied energy” is the amount of energy invested in a building’s construction and improvement — energy that has already been expended, materials previously mined or harvested, manufactured, shipped, and assembled. For example, the shell of a two-story brick house contains over one billion BTUs of energy in construction materials. This is equivalent to about eight thousand gallons of gasoline. The replacement of a building results in the loss of that “embodied energy” plus the added energy cost to demolish the building, remove and dispose of the debris, and manufacture, deliver, and install new material for a new building.\footnote{Ibid., 52, citing “The Benefits of Cultural Resource Conservation,” U.S. Department of Defense.} Moreover, the life expectancy of rehabilitated historic buildings may well be longer than that of the new structures that replace them.
During the later decades of the twentieth century, we as a society began to understand the environmental imperatives of proper disposal of our solid waste. Small towns, cities, and undeveloped rural areas all share the consequences of the growing volume of waste materials. And, while disposable diapers and Styrofoam containers receive public attention, few know that up to 40 percent of solid waste comes from demolition and new construction debris.

Random, low-density development in rural areas has environmental costs as well. Among them are environmental pollution, loss of greenbelts and open space and obliteration of community life.

**HORIZON 2020 PRESERVATION PLAN ELEMENT PLANNING PROCESS**

The City of Lawrence contracted the firm of Historic Preservation Services LLC (HPS) to complete a comprehensive historic preservation plan for the City and the unincorporated areas of Douglas County. The Kansas State Historical Society Cultural Resources Division allocated and administered grant funding from the United States Department of the Interior, National Park Service Historic Preservation Fund. The Lawrence Historic Resources Administrator, Dennis J. Enslinger, facilitated the development of the plan.

The goal of the preservation plan is the identification and development of specific goals, policies, and implementation strategies that will guide historic preservation efforts in the community. Historic Preservation Services conducted research, consulted with City staff, and conducted public workshops between August 2001 and June 2002. HPS partner, Sally Schwenk served as project lead. Workshop facilitation included the services of HPS partner, Elizabeth Rosin and associate staff member, Dale Nimz. Dale Nimz researched and prepared the Preservation Activity Overview and the Historic Overview sections.

Historic Preservation Services, in conjunction with the Historic Resources Administrator, assumed responsibility for providing the following three work products associated with development of the Comprehensive Historic Preservation Plan for Lawrence/Douglas County:

- A detailed outline of the process to be used in the development of the Comprehensive Historic Preservation Plan for Lawrence/Douglas County.

- A draft of the Comprehensive Historic Preservation Plan for Lawrence/Douglas County.

- A final draft of the Comprehensive Historic Preservation Plan for Lawrence/Douglas County in publishable form.
The Comprehensive Plan contains the following elements:

- An Executive Summary providing an overview of the main elements within the plan;
- An Introduction providing information on the merits of historic preservation and the development of a historic preservation plan;
- Background information relating to the physical character of the environment, its history, historic contexts and themes, historic/cultural resources, and past and current preservation activities;
- Preservation issues identified by the general public, steering committee, and government officials during the public meeting process;
- Preservation opportunities/resources available to individuals, organizations, and government agencies to further the goals and policies identified in the plan;
- Historic preservation vision statement and community preservation goals;
- Implementation strategies for preservation goals; and
- Provisions for periodic review and update.

**Preliminary Research and Investigation**

Historic Preservation Services initiated and participated in pre-planning organizational meetings between the consultant team and city staff to design a public participation process, identify participants, establish a schedule and identify various planning studies and policies affecting the plan.

In preparation for developing visual aids and agendas for the public participation process and information to be included in the preservation plan, Dale Nimz performed the following tasks:

- Developed a summary overview of past and current preservation activities, including an overview of survey results, consultant management recommendations, and protection efforts.
- Developed a historic overview of the project area including pre-history, native culture, historical development, historic contexts and themes, and historic and cultural resources including cultural landscapes, buildings, structures and sites, historic architecture and property types.

Sally Schwenk with the assistance of staff:
• Reviewed local land use ordinances to determine the existing relationship between preservation, zoning, codes, and other related land use and property management ordinances; and incorporated the information into the public participation process and the final preservation plan document.

• Developed a list of incentives to be considered as preservation strategies during the public participation process and incorporated into the preservation plan.

Public Participation

After consultation with city staff, HPS developed and conducted a series of public workshops designed for the general public, special interest groups, city staff, and appointed members of planning and preservation commissions. City staff assisted in arranging for and conducting the workshop presentations. Staff also arranged for newspaper notices, flyers, and direct mailings to ensure participation by local residents and interest groups.

Workshops I and II:

The consultants conducted two sessions of the first workshop — one at the Carnegie Library in Lawrence and one at the Vinland School in Douglas County. This initial workshop focused on developing a unified vision for preservation activities in the city/county. At these meetings, HPS conducted an introductory overview of the federal, state, and local government preservation network, the role of historic preservation in community planning and economic development, the current local historic preservation programs in Lawrence/Douglas County, and data on identified cultural resources in the project area. After this orientation, participatory exercises focused on identification of the following:

• general conditions and visual characteristics that currently exist in the city's older neighborhoods and commercial centers and in the county's rural unincorporated areas;

• character-defining features — landmarks, paths, activity centers, areas, and places;

• man-made and natural physical assets that add value to the city's historic core and rural areas (a physical place, building, street, public fixture, landscape feature, etc.); and
man-made and natural physical features, buildings, structures (man-made or natural) that distract from the city's historic neighborhoods and commercial centers and the county's rural areas.

After these sessions, HPS and city staff developed a set of preliminary goals and implementation strategies.

Workshop III
Exercises in this workshop focused on the refinement and prioritization of a base set of goals and implementation strategies. The city staff and HPS Consultant Dale Nimz met with the project steering committee to review the previous workshop results and to incorporate the findings into this workshop.

After the public participation, HPS and planning staff met to determine the final draft goals, policies, and implementation strategies. In addition, staff provided comments on the information gathered, the draft historic context, and the preservation activities to-date sections of the final plan. From this information, HPS developed a draft report for review by the staff and steering committee in preparation for presenting the draft plan at the final workshop. The steering committee and staff at this point suggested organizations, government agencies, and public/private partnerships that could be assigned responsibility for initiating implementation strategies as well as suggested time frames for the initiation of activities.

Five action goals comprise the key elements required to achieve this vision. They form the cornerstones for integrating preservation into the city’s planning programs.

Goal # 1: Incorporate Preservation as an Important Component of City and County Planning Processes.

Goal # 2: Conserve the Rural Character of Unincorporated Douglas County in Strategic Areas.

Goal # 3: Incorporate Preservation Incentives into the City and County’s Economic Development Policies and Programs.

Goal # 4: Incorporate Heritage Tourism as an Economic Development Program.

Goal # 5: Establish Outreach and Educational Programs.

Workshop IV - Public Hearing Review Process
This final workshop was also a public hearing venue to receive comment upon the final goals, policies, and strategies developed in the workshops and steering committee meetings. Discussion focused extensively on issues relating to rural preservation.
Participants also prioritized the goals, policies, and strategies, by ranking the top ten with the highest priority and the ten with the lowest priority.

**Historic Resources Commission Adoption of Plan**
The draft Preservation Plan Element was distributed for public comment in April 2003. The draft and the public comment were submitted to the Historic Resources Commission for review in October 2003. The Historic Resources Commission held a study session on the plan in November 2003 and requested planning staff make some corrections to the document. On May 20, 2004, the Lawrence Historic Resources Commission approved the Preservation Plan Element and forwarded the complete document to the Lawrence Douglas County Planning Commission for review. The Executive Summary of the complete document was to replace the existing Chapter 11 of *Horizon 2020*.

**Planning Commission Recommendation**
On July 20, 2004, the Lawrence City Commission received the Preservation Plan Element and referred it to the Lawrence Douglas County Planning Commission for review. The Lawrence Douglas County Planning Commission received the document and referred it to the Comprehensive Plans Committee. On May 25, 2005 the Lawrence Douglas County Planning Commission held a public hearing on the Preservation Plan Element and the proposed Chapter 11 revision. The Commission voted 8-1 to forward the Preservation Plan Element and Chapter 11 revision to the Lawrence City Commission and the Douglas County Board of County Commissioners with a recommendation for approval. The Douglas County Board of County Commissioners received the Preservation Plan Element on February 27, 2006 and tabled the item.

**2010 Historic Resources Commission**
In January of 2010, the Lawrence Historic Resources Commission directed planning staff to bring the Preservation Plan Element and the revisions to Chapter 11 of *Horizon 2020* back to the Commission for review. Public hearings were held on the document during February, March, June and December. The Historic Resources Commission directed planning staff to incorporate the comments the Commission had received on sustainability into the document by adding a sixth goal: Incorporate sustainable preservation into the City and County’s sustainability Policies and Programs.
Plan Area
Summary of Background Studies*

PLANNING AREA

The land use component of the plan includes Lawrence and the unincorporated areas of Douglas County; the economic development component of the Plan has a countywide focus that also includes the incorporated cities of Eudora, Baldwin and Lecompton. The planning area is illustrated in Map 2-1, HORIZON 2020 Planning Area.

The area expected to become urbanized in the next 20 years is illustrated in Map 2-2, Urban Area Boundary. This urban area boundary is based on development trends and other factors, including physical constraints (e.g., floodplains) and the projected availability of urban services such as sewer and water. As with any plan, the urban area boundary is subject to change as conditions change. The Lawrence/Douglas County Metropolitan Planning Commission designated the current urban area boundary with the concurrence of the Kansas Department of Transportation (KDOT), in 2003. The urban area, as defined by KDOT standards, encompasses approximately 40 square miles and includes the proposed alignment of the South Lawrence Trafficway (SLT). Changes in the assumed alignment of this circumferential route could affect the urban area boundary and assumptions in the Plan.

In addition to this urbanized area, the Plan identifies the Urban Growth Areas (UGA's) for the incorporated cities within the county. The UGA encompasses more area than the delineated urbanized area, so that 'an area of influence' is identified in which additional standards for development are established because of the area's proximity to an urban area and the impacts development along the fringe may have on future development.

*This information is taken directly from Horizon 2020 The Comprehensive Plan for Lawrence and Unincorporated Douglas County.
Page purposely left blank.
Land Use Recommendations in the Planning Area do not apply to the incorporated cities of Baldwin, Eudora, and Lecompton.
Map 2-2 - Urban Area Boundary
Lawrence and Douglas County have experienced substantial growth since 1950, as shown in Table 2-1.

- Lawrence experienced a 243 percent increase in population between 1950 and 2000, and the unincorporated areas of Douglas County had an increase of almost 48 percent in this 50-year period.

- The unincorporated areas of Douglas County experienced an 8 percent decrease in population from 1950 to 1960. From 1960 to 2000 the same area experienced a 61 percent increase in population.

- Lawrence has consistently increased its population each decade, with an increase of 41 percent occurring from 1950 to 1960. Lawrence grew at a rate of 15 percent from 1970 to 1980.

### Table 2-1: Population Growth, 1950 - 2000

<table>
<thead>
<tr>
<th>Year</th>
<th>Lawrence</th>
<th>Eudora</th>
<th>Baldwin</th>
<th>Lecompton</th>
<th>Balance of County</th>
<th>Douglas County</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>23,351</td>
<td>929</td>
<td>1,741</td>
<td>263</td>
<td>7,802</td>
<td>34,086</td>
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<tr>
<td>1960</td>
<td>32,858</td>
<td>1,526</td>
<td>8,304</td>
<td>16</td>
<td>7,155</td>
<td>43,720</td>
</tr>
<tr>
<td>1970</td>
<td>45,698</td>
<td>2,071</td>
<td>4,320</td>
<td>43</td>
<td>7,209</td>
<td>57,932</td>
</tr>
<tr>
<td>1980</td>
<td>52,738</td>
<td>2,934</td>
<td>9,531</td>
<td>19</td>
<td>8,573</td>
<td>67,640</td>
</tr>
<tr>
<td>1990</td>
<td>65,608</td>
<td>3,006</td>
<td>12,520</td>
<td>21</td>
<td>9,604</td>
<td>81,798</td>
</tr>
<tr>
<td>2000</td>
<td>80,098</td>
<td>4,307</td>
<td>15,400</td>
<td>22</td>
<td>11,549</td>
<td>99,962</td>
</tr>
</tbody>
</table>

Source: US Census and Lawrence/Douglas County Planning Department

- Since 1970, the population distribution has been consistent, with Lawrence containing 78 to 80 percent of the county’s population.

### Table 2-2: Percentage as a Total of Douglas County Population

<table>
<thead>
<tr>
<th>Year</th>
<th>Lawrence</th>
<th>Eudora</th>
<th>Baldwin</th>
<th>Lecompton</th>
<th>Balance of County</th>
<th>Douglas County</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>69%</td>
<td>3%</td>
<td>5%</td>
<td>1%</td>
<td>23%</td>
<td>100%</td>
</tr>
<tr>
<td>1960</td>
<td>75</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>16</td>
<td>100</td>
</tr>
<tr>
<td>1970</td>
<td>79</td>
<td>4</td>
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<td>1</td>
<td>12</td>
<td>100</td>
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<tr>
<td>1980</td>
<td>78</td>
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<td>1</td>
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<tr>
<td>1990</td>
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<td>2000</td>
<td>80</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>12</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: US Census and Lawrence/Douglas County Planning Department
POPULATION PROJECTIONS

In making population projections the community must look back to analyze past trends in population growth, while also looking forward to assess factors that may limit the community's future population growth. Projecting the future population growth of a community is an inexact science and the population projections in this Plan are presented as ranges for Lawrence and Douglas County to reflect the possibility of variation in that growth rate.

Tables 2-3 and 2-4 and Figures 2-3 and 2-4 are the population projections for Lawrence and Douglas County. Both tables have High, Middle, and Low population projections for the years 2010, 2020, and 2030. A range of population projections was created to reflect the difficulty in predicting an exact population for a specific point in the future. Using a population projection range gives the plan flexibility address different growth scenarios over time, for example the provision of sewage treatment. If the city grows at the slower projected rate, increased sewage treatment capacity may not be required for a number of years. However, if the city grows at the faster rate, sewage treatment capacity may need to be increased in the very near future.

Lawrence and Douglas County have experienced a stable population growth rate since 1960 making the creation of population projections somewhat simpler. However, the most important component of any population projection model is the establishment of the basic assumptions that will be used in building a projection. In making the projections for both Lawrence and Douglas County the following assumptions were made:

- Lawrence and Douglas County will continue to be a desirable place for new businesses to locate and existing businesses to expand.
- This area will continue to experience a positive net in-migration.
- Lawrence and Douglas County will continue to extend and expand the necessary infrastructure (water treatment, sewer treatment, water and sewer lines, roads, fire, medical, and police protection, etc.) to support the projected population growth. If the necessary infrastructure is not built, the population growth for Lawrence will slow.
- The area's rate of population growth for the next three decades will be similar to the population growth rate the area has experienced in the last five decades.

The same method was use to create both Lawrence and Douglas County population projections. The Low projection model uses a simple linear regression with decennial census data from 1950 to 2000. The Middle projection model uses a simple linear regression with data from the Census estimates for the years 1990 to 1999. The High estimate model uses the average decade growth rate from 1950-2000 of 24 percent.

- For 2020 the Middle range population projection for Lawrence is 110,406, an increase of 38 percent from year 2000.
- The previous population projection in this plan for Lawrence for the year 2020 was 87,479, which is 22,927 less than the new projections for the year 2020.
All of Lawrence and Douglas County Master Plans should be reviewed and, if necessary, revised to reflect these new population projections.

As the population in Douglas County increases, the rural areas will become more suburbanized.

**Figure 2-1**

**City of Lawrence Population Projections**

<table>
<thead>
<tr>
<th>Year</th>
<th>LOW</th>
<th>MIDDLE</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>80,098</td>
<td>88,961</td>
<td>95,178</td>
</tr>
<tr>
<td>2010</td>
<td>88,961</td>
<td>100,076</td>
<td>110,406</td>
</tr>
<tr>
<td>2020</td>
<td>100,076</td>
<td>111,191</td>
<td>122,394</td>
</tr>
<tr>
<td>2030</td>
<td>111,191</td>
<td>125,635</td>
<td>151,296</td>
</tr>
</tbody>
</table>

*Census 2000 figures
Source: US Census Bureau and Lawrence/Douglas County Planning Department
Figure 2-2

Douglas County Population Projections

Table 2-4: Douglas County Population Projections

<table>
<thead>
<tr>
<th>Year</th>
<th>2000*</th>
<th>2010</th>
<th>2020</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>99,962</td>
<td>109,522</td>
<td>122,474</td>
<td>135,426</td>
</tr>
<tr>
<td>Middle</td>
<td>99,962</td>
<td>118,501</td>
<td>136,826</td>
<td>155,152</td>
</tr>
<tr>
<td>High</td>
<td>99,962</td>
<td>120,065</td>
<td>144,212</td>
<td>173,214</td>
</tr>
</tbody>
</table>

*Census 2000 figures
Source: US Census Bureau and Lawrence/Douglas County Planning Department
The projections in Table 2-5 for Eudora, Baldwin City and Lecompton were generated with a simple linear regression, using data from 1970 to 2000. These projections are based on the assumption these cities will continue to grow at the same pace that they have for the past 30 years.

The projections for the Unincorporated Area were generated by a simple linear regression, using US Census population estimates for 1990 to 1999.

### Table 2-5: Population Projections for Unincorporated Douglas County and Incorporated Areas

<table>
<thead>
<tr>
<th>Year</th>
<th>2000*</th>
<th>2010</th>
<th>2020</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eudora</td>
<td>4,307</td>
<td>4,775</td>
<td>5,507</td>
<td>6,239</td>
</tr>
<tr>
<td>Baldwin City</td>
<td>3,400</td>
<td>3,621</td>
<td>3,898</td>
<td>4,175</td>
</tr>
<tr>
<td>Lecompton</td>
<td>608</td>
<td>701</td>
<td>758</td>
<td>816</td>
</tr>
<tr>
<td>Unincorporated Area</td>
<td>11,549</td>
<td>13,407</td>
<td>15,148</td>
<td>16,889</td>
</tr>
</tbody>
</table>

*Census 2000 figures
Source: US Census Bureau and Lawrence Douglas/County Planning Department

### HOUSEHOLDS AND HOUSING UNITS

Substantial growth in households, as illustrated in Table 2-6, has also occurred within Lawrence and Douglas County since 1970.

- Lawrence experienced an approximately 68% increase in households between 1970 and 1990. The unincorporated areas of Douglas County had an increase of about 14% in the 10-year period between 1980 and 1990 [individual counts were not available from the 1970 census].
- Household projections for Lawrence anticipate an increase of 49% between 1990 and 2020. Projections for the unincorporated areas indicate an increase of approximately 39% by 2020.

### Table 2-6: Household Growth, 1970 - 2020

<table>
<thead>
<tr>
<th>Year</th>
<th>Lawrence</th>
<th>Eudora</th>
<th>Baldwin</th>
<th>Lecompton</th>
<th>Balance of County</th>
<th>Douglas County</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>1970</td>
<td>13615</td>
<td>68.1</td>
<td>681</td>
<td>43.7</td>
<td>675</td>
<td>27.1</td>
</tr>
<tr>
<td>1980</td>
<td>18818</td>
<td>38.2</td>
<td>979</td>
<td>43.7</td>
<td>858</td>
<td>27.1</td>
</tr>
<tr>
<td>1990</td>
<td>24513</td>
<td>30.2</td>
<td>1083</td>
<td>10.6</td>
<td>902</td>
<td>5.1</td>
</tr>
<tr>
<td>2000*</td>
<td>28362</td>
<td>15.7</td>
<td>1322</td>
<td>22.1</td>
<td>974</td>
<td>8.0</td>
</tr>
<tr>
<td>2010*</td>
<td>33048</td>
<td>16.5</td>
<td>1618</td>
<td>22.4</td>
<td>1052</td>
<td>7.9</td>
</tr>
<tr>
<td>2020*</td>
<td>36190</td>
<td>9.5</td>
<td>1871</td>
<td>15.6</td>
<td>1069</td>
<td>1.6</td>
</tr>
</tbody>
</table>

* Projections prepared by TPAP and the University of Kansas Institute for Public Policy and
Business Research as part of the HORIZON 2020, Phase I Report.

- The number of building permits issued by Lawrence has been influenced over the years by national economic trends. The number of new single-family residences has been constant over the past 40 years, while the number of new multi-family units has varied greatly from year to year. Only recently has the rate of single-family building permit activity increased in both Lawrence and in unincorporated parts of Douglas County. Figures 2-3 and 2-4 illustrate past building trends in the city and county. Figure 2-7, Residential Growth by Township, illustrates the distribution of new residential growth within the unincorporated areas of Douglas County over the past 25 years.

- Households, as counted through the census process, typically equate to the number of occupied housing units within a community. The average household size (measured in the 1990 census as 2.35 for Lawrence and 2.42 for the entire county) is projected to decrease over time. As population within the community grows and the average household size decreases, more housing units will be needed to accommodate growth.
EMPELOYMENT TRENDS

Employment growth has also increased substantially between 1970 and 1990 and it is anticipated to continue to grow throughout the planning period.

- In 1990, over 32,600 Lawrence residents were employed, an increase of nearly 82% over 1970. This was nearly 50% of all those living in the city. The fastest growing sectors were finance/insurance/real estate, retail trade and transportation/communications/public utilities.

- Within Douglas County as a whole, the number of employed residents rose by 82.6% during this 20 year period. These 40,186 workers represented approximately 49% of all those living in the County in 1990.

- The area's job growth rate is anticipated to outpace the local population and household growth rate. Table 2-7 indicates employment growth projections prepared by Trkla, Pettigrew, Allen & Payne (TPAP) [Phase I Report, Part II, Page 74]. Projections were prepared for Lawrence and Douglas County as a whole; employment projections for the cities of Eudora, Baldwin and Lecompton were not included in the Phase I Report (as indicated by --- in the following table). These forecasts will be exceeded if the economic development goal of adding over 20,000 new jobs in the County by the year 2020 is met.

<table>
<thead>
<tr>
<th>Year</th>
<th>Lawrence No.</th>
<th>% Δ</th>
<th>Eudora No.</th>
<th>% Δ</th>
<th>Baldwin No.</th>
<th>% Δ</th>
<th>Lecompton No.</th>
<th>% Δ</th>
<th>Balance of County No.</th>
<th>% Δ</th>
<th>Douglas County No.</th>
<th>% Δ</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>17942</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>942</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>22008</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1980</td>
<td>25279</td>
<td>40.9</td>
<td>1203</td>
<td>NA</td>
<td>1307</td>
<td>38.7</td>
<td>281</td>
<td>NA</td>
<td>3514</td>
<td>NA</td>
<td>31584</td>
<td>43.5</td>
</tr>
<tr>
<td>1990</td>
<td>32603</td>
<td>28.9</td>
<td>1402</td>
<td>16.5</td>
<td>1413</td>
<td>7.5</td>
<td>276</td>
<td>-1.8</td>
<td>4492</td>
<td>21.8</td>
<td>40186</td>
<td>27.2</td>
</tr>
<tr>
<td>2000*</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>**45450</td>
<td>13.1</td>
</tr>
<tr>
<td>2010*</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>**49314</td>
<td>8.5</td>
</tr>
<tr>
<td>2020*</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>**52272</td>
<td>6.0</td>
</tr>
</tbody>
</table>

** Projections prepared by TPAP and the University of Kansas Institute for Public Policy and Business Research as part of the HORIZON 2020, Phase I Report.
• 20% of the Lawrence area's employment base works at the University of Kansas, while about 16% work in Downtown Lawrence. Combined, these two employment centers represent over one-third of the urban area's total work force.

• According to the 1990 US Census, about 18% of the county work force is employed outside Douglas County. This percentage is presented to address the perceived threat that the Lawrence area is becoming a bedroom community for workers in the Kansas City and Topeka areas. The census also indicated that an approximately equal number of the county's workers lived outside Douglas County and commuted to work.
LAND USE

Existing land use development [as surveyed in 1992] within Lawrence and the unincorporated areas of Douglas County is illustrated in Figure 2-7 below:

- Single-family residential uses account for approximately 24% of the city and 5% of the unincorporated area of the county.
- Substantial land area is devoted to public/semi-public uses [16%] and right-of-way [17%] within the city; approximately 14% is vacant.
- Multiple-family, commercial and industrial uses account for nearly equal land areas within the city.
- The majority of the unincorporated area, approximately 43%, is devoted to nonresidential agricultural uses, followed closely at 38% by Farm Ranch uses with residential dwellings.

Figure 2-7 - Existing Land Use (1992)

Existing Land Use – Lawrence (1992 Study)

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-Family Residential</td>
<td>24%</td>
</tr>
<tr>
<td>Multi-Family Residential</td>
<td>6%</td>
</tr>
<tr>
<td>Commercial</td>
<td>6%</td>
</tr>
<tr>
<td>Industrial</td>
<td>4%</td>
</tr>
<tr>
<td>Public/Semi-Public</td>
<td>16%</td>
</tr>
<tr>
<td>Right-of-Way</td>
<td>17%</td>
</tr>
<tr>
<td>Vacant Land</td>
<td>14%</td>
</tr>
<tr>
<td>Parks/Open Space</td>
<td>9%</td>
</tr>
<tr>
<td>Agricultural</td>
<td>4%</td>
</tr>
</tbody>
</table>

Existing Land Use – Unincorporated DG Co

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm Ranch w/Residence</td>
<td>38.0%</td>
</tr>
<tr>
<td>Single-Family Residential</td>
<td>5.0%</td>
</tr>
<tr>
<td>Commercial</td>
<td>0.1%</td>
</tr>
<tr>
<td>Industrial</td>
<td>0.2%</td>
</tr>
<tr>
<td>Public/Semi-Public</td>
<td>0.3%</td>
</tr>
<tr>
<td>Right-of-Way</td>
<td>1.7%</td>
</tr>
<tr>
<td>Vacant Land</td>
<td>2.3%</td>
</tr>
<tr>
<td>Parks/Open Space</td>
<td>9.2%</td>
</tr>
<tr>
<td>Extraction</td>
<td>0.2%</td>
</tr>
<tr>
<td>Agricultural</td>
<td>43.0%</td>
</tr>
</tbody>
</table>
LAND FORMS

Physical development and transportation facilities in Lawrence and Douglas County have been influenced by several geographic features:

- Mt. Oread and the University of Kansas campus are located in the middle of the Lawrence urban area, and form a physical barrier to continuous street patterns. The area has significant slopes (15% or greater in some areas). As a result, 23rd Street/Clinton Parkway is the only east-west street that extends completely from one side of the city to the other.

- The Kansas and Wakarusa Rivers and their floodplains form barriers to development on the north, south and northeast sides of the city, and inhibit north-south street extensions.

- The Kansas River, the larger of the two rivers, has a particularly limiting effect on access from east Lawrence to North Lawrence and Grant Township.

- Clinton Lake and the area below the dam limit urban development and the extension of east-west streets in the area west of Wakarusa Drive, south of 27th Street.

DEVELOPMENT PATTERNS

Historically, the majority of development within Douglas County has occurred within Lawrence. The "core area" of Lawrence, which was mostly developed before 1960, is characterized by higher density land uses, a grid street pattern, and a concentration of several employment centers. The core area of Lawrence is generally south of the Kansas River and north of 23rd Street, between Iowa Street and Haskell Avenue. Although this area represents only one percent of the land area of Douglas County, the core area includes more than one-third of the County's household total, and over half of Douglas County's total workforce. These patterns are illustrated in Table 2-8 and Figure 2-8, Land Area, Households and Employment.

<table>
<thead>
<tr>
<th></th>
<th>Land Area [Sq. Miles]</th>
<th>Households</th>
<th>Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Douglas County (total)</td>
<td>458.0</td>
<td>30,138</td>
<td>37,318</td>
</tr>
<tr>
<td>City of Lawrence</td>
<td>24.0</td>
<td>24,513</td>
<td>34,809</td>
</tr>
<tr>
<td>Core Area</td>
<td>4.7</td>
<td>10,374</td>
<td>19,460</td>
</tr>
</tbody>
</table>

Table information based upon 1990 US Census counts and the Lawrence/Douglas County Planning Office Database.
Figure 2-8 - Land Area, Households, and Employment Distribution

Land Area

- Balance of Lawrence: 7%
- Core Area: 1%
- Balance of Douglas Co: 92%

Households

- Balance of Douglas Co: 19%
- Balance of Lawrence: 47%
- Core Area: 34%

Employment

- Balance of Douglas Co: 7%
- Balance of Lawrence: 41%
- Core Area: 52%
Streets in Lawrence can be divided into two distinct patterns, based upon the time in which development of the area occurred. These different patterns present different problems for the community and often require different solutions.

- A "grid" street pattern, in which streets are oriented in straight lines, typifies the older "core area" of the city, which was developed between the late 1800s and the 1960s. The core area is dissected by numerous streets, with approximately 8-10 east-west streets and 10-12 north-south streets in each mile. The straight streets encourage higher traffic speeds.

- Curvilinear and cul-de-sac residential streets, which discourage through traffic, typify the newer development areas of the city. In some areas where only a portion of a section has been developed, the street system is discontinuous.

Roads within the unincorporated areas of the county are laid out on a rectilinear grid pattern primarily on section lines. Roadway separations generally occur every half-mile or mile on a north-south and east-west axis.

Gateways are transportation facilities that serve as entrances, or transitions between land uses and transportation corridors. Major gateways are entrances to the county and city from other transportation facilities, and often form a visitor's first impression of the community. Gateways to the county are subtle; major entrances occur along the major highways: I-70 from the east and west; K-10 from the east; US-40 from the west; US-56 from the east and west; US-59/24/40 from the north and US-59 from the south.

Gateways to the city are more distinct. Major gateways include:

- N. 2nd/3rd Street - US 59/24/40 from the north and east via the east toll plaza of the Kansas Turnpike;
- McDonald Drive via the west toll plaza of the Kansas Turnpike from the north;
- Iowa Street/US-59 from the south;
- W. 6th Street/US-40 from the west, including new access via the Lecompton interchange at the Kansas Turnpike and the SLT;
- 23rd Street/K-10 from the east; and
- Clinton Parkway from the west

Minor gateways into the city include:

- 15th Street from the east and west;
- Haskell Avenue from the south; and
- Louisiana Street from the south.
ENVIROMENTAL FEATURES

Douglas County is characterized by a variety of environmental and natural conditions that will influence physical development and preservation potentials. These include soils, hydrologic conditions, slopes, and natural areas.

Soils

Soil types within Douglas County are directly related to the underlying geology and natural climatic conditions of the region. The USDA Soil Conservation Service 1976 Soil Survey of Douglas County identifies five basic soil associations that incorporate classes or series of soils throughout the County. Most of these soils have some limitations for construction due either to unstable slopes or shrink-swell characteristics. Soil conditions on steep slopes, most often found near major water bodies and drainage tributaries, may be severe enough to preclude development. Major portions of Douglas County also contain soils that are productive for pasture, range and agricultural uses.

Drainage Basins

A long-range Wastewater Master Plan for the Lawrence area was completed in the summer of 1995 by Black & Veatch. The study area for this report is generally bounded by the Kansas River and the North Lawrence area on the north, County Route 1057 on the east, the Wakarusa River on the south as far west as Clinton Dam, and north from the Clinton Lake along the western ridgeline of the study area to the Kansas River. The study area contains approximately 61 square miles and is divided into two distinct watersheds. The northern half of the study area is located in the Kansas River Watershed and drains north to the Kansas River. The southern half of the study area is located in the Wakarusa River Watershed and drains south to the Wakarusa River. The two watersheds are further divided into eight drainage basins for wastewater planning purposes: Kansas River, North Lawrence, Central, East Lawrence, Wakarusa River, Yankee Tank Creek, Baldwin Creek, and Lake View Lake. These basins, established for wastewater planning purposes, are illustrated in the 1995 Black & Veatch study.

A long-range Stormwater Management Master Plan was also developed during 1995 by Burns & McDonnell Engineers. The study included 17 principal drainage basins, covering approximately 26 square miles of Kansas and Wakarusa River tributaries. Map 2-3, Lawrence Area Drainage Basins illustrates the following drainage basins: Yankee Tank West [756 acres/1.18 sq. mi.]; Hidden Valley [1,788 acres/2.79 sq. mi.]; Quail Creek [1,028 acres]; Yankee Tank East [1,747 acres]; Naismith [1,036 acres]; KLWN [486 acres]; Belle Haven [260 acres]; Broken Arrow [235 acres]; Haskell [824 acres]; Deerfield [898 acres]; Riverside [337 acres]; Country Club [1,217 acres]; Downtown [1,095 acres]; East Lawrence [830 acres]; Brook Street [397 acres]; Sunflower [189 acres]; and North Lawrence [934 acres].

UTILITIES

Existing utility provision systems are described in the HORIZON 2020 Background Studies. Water treatment and distribution facilities owned and operated by Lawrence provide water service from Clinton Lake and the Kansas River to water users within the city. The city also maintains contracts for treatment services for Baldwin City and several Rural Water Districts that provide service to unincorporated areas of Douglas County. A long-range Water Master Plan Update for Lawrence has recently been completed by Black and Veatch that outlines system improvements to serve Lawrence and growth areas through the year 2010.

Wastewater treatment facilities are operated by Lawrence by a treatment facility located along
the south side of the Kansas River at Eighth Street. Services are provided to properties within the city limits and an area west of the city located within a county sewer benefit district. As noted above, Black and Veatch has recently completed a long-range Wastewater Master Plan Update for Lawrence that identifies system improvements to serve the city and growth areas through the year 2020. The update of the Wastewater Master Plan utilized the original population projections contained in HORIZON 2020. These projections were underestimated, so it is advisable that the Wastewater Master Plan, and all other relevant city master plans that relied on the original HORIZON 2020 population projections, be updated based on the new population growth information.

Wastewater treatment for property located in the majority of the unincorporated areas of the county is provided by on-site septic disposal systems that are regulated by the Douglas County Health Department. As the county becomes more urbanized, the county may wish to reassess the widespread use of individual septic disposal systems in the county.
Map 2-3 - Lawrence Area Drainage Basins

Source: Stormwater Management Master Plan; Burns & McDonnell eng
Preservation Partnerships
Chapter Three -- Preservation Partnerships

A variety of federal, State and local laws and incentive programs protect thousands of historic properties in the United States. The State of Kansas’ laws provide protection of properties listed in the National Register of Historic Places and the Register of Historic Kansas Places. In general, local preservation laws provide the most substantive protection for historic properties.

Federal Framework

A large number of federal laws affect historic preservation in various ways:

- by establishing preservation programs for federal, state, and local government agencies;
- by establishing procedures for different kinds of preservation activities; and
- by creating opportunities for preservation of different kinds of resources.

The National Historic Preservation Act of 1966, as amended, is the centerpiece of historic preservation programs in the United States. The Act’s primary mandates

- authorize the Department of the Interior, National Park Service to expand and maintain the National Register of Historic Places;
- provide for the establishment of State Historic Preservation Officers to administer federal preservation programs;
- specify how local governments can be certified for participation in federal programs;
- authorize preservation grants-in-aid to states and local governments;
- provide a process for federal agencies to consider and mitigate adverse impacts on historic properties that are within their control; and
- establish a rehabilitation tax credit program for private property owners that is also part of the Internal Revenue Code. The tax codes also allow charitable contributions through façade and scenic easements.

Many of the programs established as a result of the mandates of the National Historic Preservation Act of 1966 are cooperative programs between the National Park Service, acting as a Federal partner, and the State Historic Preservation Office (SHPO), acting as the State partner. In addition to the U.S. Department of the Interior/National Park Service, other federal partners for historic preservation activities include the Advisory Council on Historic Preservation, the U.S. Departments of Defense, U.S. Department of Transportation, and the U.S. Department of Housing and Urban Development.
**National Register**

The National Register of Historic Places is the country's official list of historically significant properties. Properties eligible for the register generally retain their historic appearance, are at least fifty years old, and have the potential to be documented as historically or architecturally significant at either the local, state, or national level. The quality of significance in American history, architecture, archeology, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association. The National Register is administered by the National Park Service. The SHPO, also known as the Cultural Resources Division of the Kansas Historical Society, administers the nomination procedures for the National Register of Historic Places in Kansas.

**Federal Preservation Tax Incentives**

Federal legislation provides for tax incentives to encourage the preservation and rehabilitation of historic properties. In 1976, the 20% Rehabilitation Tax Credit Program began and has since become one of the federal government’s most successful and cost-effective community revitalization programs. The Internal Revenue Code and the Department of the Treasury Regulations provide for income and estate tax deductions for charitable contributions of partial interest in historic property, principally in the form of preservation/conservation easements.

Preservation tax incentives are available for qualified projects that the National Park Service designates as a certified rehabilitation of a certified historic structure. A certified historic structure is any building that is listed individually in the National Register of Historic Places or located in a National Register historic district and identified as contributing to the district.

The 20 percent federal rehabilitation tax credit applies to owners and some lessees of income-producing National Register properties. The law also permits depreciation of such improvements over 27½ years for a rental residential property and over 31½ years for a nonresidential property. The rehabilitated building must be subject to depreciation.

In exchange for the tax credits, the rehabilitation work must comply with the Secretary of the Interior’s Standards for Rehabilitation. The SHPO functions as the intermediary between the project sponsors and the National Park Service, as well as processing applications for the State Rehabilitation Tax Credit. The SHPO provides applicants with technical information and recommends appropriate preservation treatments and methods.
Preservation Tax Incentives reward private investment in rehabilitating historic properties such as offices, rental housing, and retail stores. Abandoned or under-used schools, warehouses, factories, churches, retail stores, apartments, hotels, houses, and offices in many cities have been restored to life in a manner that retains their historic character. The Preservation Tax Incentives have also helped to create moderate and low-income housing in historic buildings. Since the 20% tax credit—began in 1976, the National Park Service (NPS) has administered it in partnership with the Internal Revenue Service (IRS) and with State Historic Preservation Offices (SHPOs). To date tens of thousands of rehabilitation projects have been approved, representing billions of dollars in private investment.

Certified Local Government Program

The Certified Local Government Program is a preservation partnership between local, state and national governments focused on promoting historic preservation at the grass roots level. The program is jointly administered by the National Park Service (NPS) and the State Historic Preservation Offices (SHPOs) in each state, with each local community working through a certification process to become recognized as a Certified Local Government (CLG). CLGs then become an active partner in the Federal Historic Preservation Program and the opportunities it provides.

Through the CLG process, the local government can assume a leadership role in the preservation of its historic resources, have a formal role in the National Register nomination process, participate in the establishment of state historic preservation objectives, and receive technical and advisory services from the SHPO. Assistance includes development of a preservation ordinance and a qualified preservation commission, as well as establishment of a survey and inventory system, which are all prerequisites for participation. One of the most significant benefits of being a Certified Local Government (CLGs) is the ability to compete annually for 10 percent of the State's federal historic preservation funds to carry out preservation functions in the CLG community.

Project Review and Compliance

Section 106 of the National Historic Preservation Act requires Federal undertakings be reviewed for their impact on historic and cultural resources. The SHPO staff review approximately two thousand projects a year in accordance with the Secretary of the Interior’s Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings for potential effects on the State's historic and cultural resources. This includes all federal or federally funded, licensed, permitted, or approved undertakings that may have an effect on properties listed in or eligible for listing in the National Register of Historic Places.
Save America’s Treasures
Save America's Treasures (SAT) is a federal program created in 1998 to award grants to Federal agencies, non-profits, government entities, and Indian tribes to "contribute to the preservation of [...] prehistoric and historic resources and give maximum encouragement to organizations and individuals undertaking preservation by private means." This program is administered by the National Park Service in partnership with the President's Committee on the Arts and the Humanities, the National Endowment for the Arts, the National Endowment for the Humanities, and the Institute of Museum and Library Services.

Preserve America
Preserve America is a federal program that encourages and supports community efforts to preserve and enjoy our cultural and natural heritage. Goals of the program include a greater shared knowledge about the nation’s past, strengthened regional identities and local pride, increased local participation in preserving our heritage assets, and support for the economic vitality of our communities. The program includes community and volunteer recognition, grants, and awards, as well as policy direction to federal agencies.
STATE FRAMEWORK

Each state has a State Historic Preservation Officer (SHPO) usually appointed by the Governor to administer federal preservation programs. The Cultural Resources Division of the Kansas Historical Society (KSHS) fosters the preservation of the archeological, architectural, and cultural heritage of Kansas. The Cultural Resources Division, also referred to as the State Historic Preservation Office (SHPO), administers the State as well as the federal preservation program within Kansas.

Kansas Historical Society Cultural Resources Division Programs

Public Education / Outreach

An extensive public education program provides information to Kansas citizens on general preservation issues. *Kansas Preservation* is a free quarterly newsletter in magazine format that features articles on historic resources, historic preservation and archeology. Staff members of the Cultural Resources Division participate in workshops, seminars, and conferences as lecturers or advisors; speak to university classes, local historical societies, preservation groups, downtown organizations, local governments, etc.; respond to written and telephone requests for information; distribute technical leaflets and information; and inspect buildings to offer advice on preservation treatments. The program provides special assistance to compatible programs like the Kansas Main Street Program, the Certified Local Government Program, and their participants to insure that they are implemented in a manner conducive to proper preservation practices. *Preserving Kansas* is a free listserv and discussion forum for individuals interested in current topics specific to the preservation of cultural resources in Kansas.

Register of Historic Kansas Places

The National Register of Historic Places and the Register of Historic Kansas Places are the official lists of the cultural resources worthy of preservation in Kansas. The quality of significance in American history, architecture, archeology, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association. The Cultural Resources Division of the Kansas Historical Society administers the nomination procedures for both the National Register of Historic Places and the Register of Historic Kansas Places.
Grants

Heritage Trust Fund
The Heritage Trust Fund program, enacted in 1990, awards state grants for the preservation of properties listed in the National Register of Historic Places or the Register of Historic Kansas Places. All registered properties except for those owned by the State or federal governments are eligible for these annual grants. This program finances activities often referred to as “brick and mortar” grants because they can be used for construction costs associated with the rehabilitation or preservation of historic buildings and structures. Professional fees may also be qualifying expenses for this grant program.

Historic Preservation Fund Grants

The Historic Preservation Fund (HPF) is a grant program administered by the National Park Service (NPS). Funds for the HPF program are derived from Outer Continental Shelf mineral receipts. Each year the NPS provides the SHPO with funds that finance its operations, salaries and grants. The SHPO awards grants to cities, counties, universities, Certified Local Governments (CLGs) and other eligible organizations, to help support local historic preservation activities. Ten percent of the grant funds available to the SHPO must be dedicated to CLGs.

Historic Preservation Fund grants provide financial support for local preservation activities that will contribute to planning for the preservation of the built environment and archeological resources. Up to sixty percent of the cost of eligible activities can be funded through this program. Through property identification and evaluation, communities may assess their historic properties and develop plans for their recognition and preservation. Eligible activities include historic resources surveys, nominations to the National Register of Historic Places, design review guidelines, historic preservation plans and educational activities that inform the public about local historic resources and historic preservation issues and techniques.

State Preservation Tax Incentives

State legislation establishes a tax incentive program similar to the Federal Rehabilitation Tax Credit Program. The State Rehabilitation Tax Credit program provides for tax incentives to encourage the rehabilitation of historic properties. Preservation tax incentives are available for qualified projects that the Cultural Resources Division of the Kansas Historical Society designates as a certified rehabilitation of a certified historic structure. A certified historic structure for the Kansas program is any building that is listed individually in the National Register of Historic Places or the Register of Kansas Historic Places or is located in a
National Register historic district or Register of Kansas historic district and is identified as contributing to the district. Rehabilitation projects for certified historic structures may receive a 25% Kansas tax credit for the overall cost of the rehabilitation. The Kansas tax incentive program is not restricted to income producing property and may be used by individuals to rehabilitate private residences. The State program also offers the advantage of the tax credits being transferable. The State Rehabilitation Tax Credit program can be combined with the Federal Tax Credit Program for income producing projects. When used together, the federal and state tax credits can help recapture a significant amount of eligible rehabilitation costs in tax credits.

In exchange for the tax credits, the rehabilitation work must comply with the Secretary of the Interior's Standards for Rehabilitation. The SHPO functions as the intermediary between the project sponsors and the Kansas Department of Revenue, as well as processing applications for the State Rehabilitation Tax Credit. The SHPO provides applicants with technical information and recommends appropriate preservation treatments and methods.

**Project Review and Compliance**

In addition to the role of the SHPO staff to review federally funded, licensed, permitted, or approved undertakings that may have an effect on properties listed in or eligible for listing in the National Register of Historic Places, SHPO staff is also responsible for reviewing projects for compliance with the State Preservation Law. K.S.A. 75-2715—75-2725, as amended, titled “Protective Measures of the Kansas Historical Preservation Act,” identifies that any project undertaken, licensed, or permitted by the state or its political subdivisions (such as a city, county, township, school district, etc.) that will affect a historic property listed in the State or National Registers or the environs of a listed historic property must be reviewed in accordance with the state preservation laws. The environs are the context of the listed property and are typically identified as a measured five hundred foot notification area. For projects that involve properties listed in the National or Kansas Registers, the SHPO must use the *Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings*. For projects located in the environs, the SHPO must use the *Standards and Guidelines for Evaluating the Effect of Projects on Environ*.

The State Preservation Law allows the State Historic Preservation Officer to enter into agreements authorizing a city or county to make recommendations or to perform any or all responsibilities of the state historic preservation officer under the State Preservation Law if the City or County has enacted a comprehensive local historic preservation ordinance, established a local historic preservation board or commission and is actively engaged in a local historic preservation program.
Certified Local Government Program

The Certified Local Government (CLG) program is a partnership between the National Park Service, acting as the Federal Partner, the State Historic Preservation Office (SHPO), acting as the state partner, and local government municipalities. The SHPO administers the CLG program in Kansas and works with local governments to take advantage of a leadership role in the preservation of its historic resources, have a formal role in the National Register nomination process, participate in the establishment of state historic preservation objectives, and receive technical and advisory services from the SHPO. The SHPO also administers the yearly Historic Preservation Fund grant program funded by the State's federal historic preservation funds and CLGs are eligible to compete annually for 10 percent of this fund to carry out preservation functions in their communities.

Cultural Resource Survey

The SHPO maintains historic property inventories for identified historic and archeological resources in Kansas. Local organizations, agencies, or individuals are encouraged (often through matching grants) to perform surveys in their own communities or regions. The office performs limited specialized inventories, trains local surveyors, provides guidance to local survey projects, and evaluates the results of survey projects. Survey and inventory activities provide information for register nomination and protection of historic and cultural resources.

The Kansas SHPO has recently transitioned from a paper-based survey form to an interactive online database, the Kansas Historic Resources Inventory (KHRI). KHRI contains all of the SHPO’s survey records and is fully searchable and available to the public. Users interested in submitting new surveys or updating existing survey forms can become registered and, once approved by SHPO staff, log into KHRI. There is an online tutorial for instructions on searching, becoming a registered user, and providing new information for the database. This new survey system allows for the information in the database to be updated as new information is collected.

Preservation Planning

The SHPO has responsibility for developing and implementing a statewide strategic management plan that addresses key critical issues in preservation. The plan assists in predicting trends affecting and impacting historic and archeological properties and guides resource management decisions and operations for the SHPO and other preservation stakeholders. The SHPO involves many organizations, agencies, and individuals in the
statewide preservation planning process. The plan is updated and revised every five years to adequately address the preservation needs of the state. The current approved plan for 2011-2016 includes the following goals:

- Broaden public knowledge
- Strengthen advocacy
- Develop a statewide preservation network
- Integrate historic preservation practices into community planning
- Fund Historic Preservation Initiatives

**Preservation Programs Administered by other State Agencies**

**Main Street Program**
The Kansas Main Street program uses a common-sense approach to tackle the complex issues of revitalizing a community's central business district, capitalizing on the downtown's history and identifying the resources of the community itself. The state program, which started in 1985, provides management training, consultation visits, local program evaluation, design assistance, business enhancement strategies, incentive dollars, and ongoing training in the National Main Street Center's four-point approach — organization, promotion, design, and economic restructuring. The Kansas Department of Commerce Rural Development Division manages the Kansas Main Street program.

**Kansas Neighborhood Revitalization Act**
The Kansas Neighborhood Revitalization Act allows the governing body of any municipality or county to pass an ordinance designating an area within that municipality as a "Neighborhood Revitalization Area" if it finds that "the rehabilitation, conservation or redevelopment of the area is necessary to protect the public health, safety or welfare of the residents of the municipality."

Kansas also has constitutional and legislative provisions that allow state and local governments to enact preservation legislation. The state and federal supreme courts have upheld these powers.
LOCAL FRAMEWORK
Lawrence’s historic preservation programs include the study, identification, protection, restoration, and rehabilitation of buildings, structures, objects, districts, areas, and sites significant in the history, architecture, archeology, or culture of Lawrence, the State of Kansas, or the nation. On November 15, 1988 the Lawrence City Commission unanimously approved the “Historic Preservation Ordinance” in order to help protect and restore its historical and architectural assets. (An earlier attempt to write and pass a historic preservation ordinance for Lawrence failed in 1983.) Many local citizens consider the ordinance to be a direct response to the protest aroused by the dramatic demolition of eight historic houses on June 27, 1987. Those structures were in the 800 block of Kentucky Street on lots acquired by the Douglas County State Bank for a parking lot to support their new bank building. The ordinance, now identified as Chapter 22 of the Code of the City of Lawrence – Conservation of Historic Resources Code, calls for the establishment of local historic districts and local landmarks, the Lawrence Historic Resources Commission and the requirement of maintaining a preservation specialist on staff. The principal goals of the ordinance are to encourage the preservation of Lawrence's historic and architectural resources.

The Lawrence/Douglas County Metropolitan Planning Office administers Lawrence’s preservation programs. One of the strongest protections the city’s preservation ordinance offers for historic buildings and archaeological remains is the power to designate and regulate changes to historic properties. In doing so, the city joins more than 8,000 local jurisdictions nationwide that have historic preservation ordinances.

The City of Lawrence is a Certified Local Government (CLG). As such, its historic preservation program meets federal and state guidelines. The designation also allows the city to compete for a pool of grant funds available each year to CLGs in the state.

Lawrence Historic Resources Commission
Established as part of the city's Historic Preservation Ordinance, the Lawrence Historic Resources Commission is the only entity specifically created and mandated to identify and conserve the distinctive historic and architectural resources of the city of Lawrence.

The city established the Lawrence Historic Resources Commission in response to rising public concern for the irreplaceable loss to the community of significant historic structures and sites. The City of Lawrence’s Historic Resources Commission (HRC) is a seven-member, city-appointed advisory board to the City Commission. Three of the members on the commission are required to come from preservation-related backgrounds (architecture, architectural history, history, landscape architecture, and planning). Four of the members on the commission are required to come from a diversity of professions or be lay persons.
with demonstrated interest, knowledge, and training in fields closely related to historic preservation (history, architecture, landscape architecture, architectural history, archeology, planning, real estate, law, finance, building trades, urban design, and geography.)

The Lawrence Historic Resources Commission is responsible for:

- identifying distinctive architectural characteristics and historic resources of the city that are representative of the city and that are representative of elements of the city's cultural, social, economic, political, and architectural history;

- fostering civic pride in the past accomplishments of the city;

- conserving and improving the value of property in and around designated historic landmarks and historic districts;

- fostering and encouraging preservation, restoration, and rehabilitation of structures, areas, and neighborhoods; and

- educating the public as to what is historic and how the preservation of these resources can benefit the individual property owners and the community at large.

**Figure 2. Preservation Partners**
<table>
<thead>
<tr>
<th>PRESERVATION NETWORK</th>
<th>PUBLIC</th>
<th>PRIVATE</th>
</tr>
</thead>
</table>
| **FEDERAL / NATIONAL** | National Park Service  
Advisory Council on Historic Preservation | National Trust for Historic Preservation  
Preservation Action  
National Alliance of Statewide Organizations  
American Association for State and Local History  
Association for Preservation Technology  
Society for American Archaeology |
| **STATE** | State Historic Preservation Offices (SHPO)  
Regional Offices for the National Park Service | Kansas Preservation Alliance  
Regional Offices for the National Trust for Historic Preservation |
| **LOCAL GOVERNMENT** | Certified Local Government /Lawrence’s Historic Resources Commission | Local Preservation and History Organizations and Neighborhood Associations  
Lawrence Preservation Alliance  
Douglas County Historical Society  
Lawrence Association of Neighborhoods (LAN) |
PRESERVATION ACTIVITY OVERVIEW

“Living with History,” the title of the 1984 historic preservation plan referred to the fact that residents of Lawrence and visitors acknowledged the town's historic character while enjoying the prosperity of dynamic economic growth at the same time. That earlier theme is more relevant today. In 2011, the historic preservation movement in Lawrence and Douglas County clearly demonstrates the principle that successful communities recognize, protect, and benefit from their history as manifested in historic architectural resources, urban plans, and cultural landscapes.

Prosperity has threatened historic buildings, districts, and landscapes. Inappropriate rehabilitation and demolition threaten historic buildings. Economic pressure to intensify land use threatens historic districts. In the unincorporated areas of Douglas County, urban sprawl and a decline in agricultural land use threaten rural historic resources.

Preservation Organizations

Several organizations in Lawrence and rural Douglas County have direct or indirect interests in historic preservation. Established in 1933, the Douglas County Historical Society is the oldest and most broadly representative historical organization in the county. Similar organizations include the Clinton Lake Historical Society, Eudora Historical Society, Lecompton Historical Society, and the Santa Fe Trail Historical Society. These organizations have broad interests in community history, maintain archival and artifact collections, and own historic properties.

The Lawrence Preservation Alliance (LPA) was formed in May 1984 to buy a dilapidated house in the Oread neighborhood that was threatened by demolition. Three months later, the LPA sold the house to a new buyer who rehabilitated the building as a personal residence. Beginning in January 1985, the organization announced its goals of establishing a revolving fund to purchase threatened buildings, promoting survey and nomination of significant buildings, sponsoring walking tours, and assisting in finding a new use for the threatened Union Pacific Railroad Depot in North Lawrence. (Contrasting with the success and stability of the Lawrence Preservation Alliance, the Douglas County Preservation Alliance, founded in April 1991 to undertake preservation activities in rural areas of the County, disbanded in 2001.) LPA preservation activities include:

- 1984 purchase and resale of a threatened house at 947 Louisiana.
- 1985 purchase and resale of the Wiggins house at 840 West 21st with eventual listing of the property on the Kansas State Register.
- 1986 - Purchase of the Priestly house at 1505 Kentucky to save it from
demolition and nomination of the property to the National Register
  o 1987 purchase of the threatened Benedict house at 923 Tennessee, nomination of the property to the National Register, and rehabilitation of the building
  o 1997 purchase of the property at 1113 Pennsylvania and sale three years later
  o 2000 provision of a loan to move a threatened house at 2201 Louisiana into the country
  o 2009-2010 1120 Rhode Island Street Partnership with Tenants to Homeowners and Douglas County for rehabilitation of the structure.

Historic preservation is also important to neighborhood associations in Lawrence. These associations organized as the Lawrence Association of Neighborhoods (LAN) to assist in the development of new neighborhood associations, encourage cooperation among neighborhoods, and identify more efficient ways to evaluate the effects of city policies, services, and programs on neighborhoods. Generally, LAN has strongly supported historic preservation and has incorporated a policy statement on Historic Preservation into their Policy Document.

Other organizations have objectives related to historic preservation but extend their programs beyond Douglas County.

The Kansas Preservation Alliance (KPA) was founded in 1979 and is a statewide, not-for-profit corporation dedicated to supporting the preservation of Kansas’ heritage through education, advocacy, cooperation with like-minded individuals and groups, and participation in the preservation of historic structures and places. KPA works with the SHPO to plan and implement the yearly State Historic Preservation Conference, publishes a quarterly newsletter, and promotes preservation education through an awards program and a yearly endangered places list.

Established in 1989, the Kansas Land Trust is a non-profit organization that protects and preserves lands of ecological, historical, scenic, agricultural, and recreational significance. The Trust works with landowners, other organizations, and individuals to preserve natural features in Kansas. Although many of the founding members lived in or near Douglas County, the organization's mission extends throughout Kansas. As a land trust, the organization uses a variety of conservation techniques but primarily accepts conservation easements from willing landowners.

The Professional Archaeologists of Kansas (PAK) goal is to encourage and facilitate communication about the historic and prehistoric cultural heritage of Kansas and the importance of protecting and preserving archaeological resources for future generations. The organization maintains a website, administers a listserv, and sponsors Kansas
Archaeology Month. This event offers varied programming in April of each year, including speakers, site visits, artifact identification days, and museum exhibits across the state.

The Kansas Anthropological Association (KAA) has a long tradition of preservation work in the state. Its primary goal is the involvement and education of avocational archeologists in the preservation process.

The Kansas Archeology Training Program hosts a field school that is a multi-activity program providing avocational archeologists with professional advice on the location, recording, interpretation, preservation, and publication of information on archeological sites. The primary activity is an annual two-week field school carried out in partnership with the KSHS. The KATP also administers a certification program that allows individuals to receive training and earn certification in areas such as site survey, excavation, laboratory work, and public outreach.

The Kansas Barn Alliance is committed to researching and preserving barns throughout the state. The Alliance hosts workshops throughout the state to raise awareness about this threatened property type, to promote the National Register of Historic Places and rehabilitation tax credits and grants, and to provide networking and educational opportunities to rural advocates.

The Kansas Sampler Foundation is a public non-profit 501(C)(3) organization committed to preserving, sustaining, and growing rural culture by educating Kansans about Kansas and by networking and supporting rural communities. The organization educates Kansans through the annual Kansas Sampler Festival and a variety of programs including the Kansas Explorers Club, the 8 Wonders of Kansas contests, the “Get Kansas!” blog, and the We Kan! network.
Preservation Activities

Recent historic preservation activities in Lawrence and Douglas County can be summarized in terms of education and promotion, survey and nomination, planning and zoning, and economic development. However, as preservation activity has become more diverse and extended into new areas, issues and conflicts have also developed.

Education

The 2001 Kansas Preservation Plan stated that, "...enhanced public knowledge of practices and techniques..." is the key to successful historic and cultural preservation efforts. Making information accessible to the general public through workshops and publications encourages public involvement in historic preservation. The 2011 State Preservation Plan reiterates this sentiment by identifying the first goal of the plan as "Broaden public knowledge."

The School of Architecture, Design and Planning, University of Kansas offers formal education in historic preservation. Classes for students in architecture and planning include preservation planning, preservation economics, American architectural history and American vernacular architecture, as well as special studies guided by faculty members.

Since the mid-1980s, the Lawrence Preservation Alliance has provided educational programs including walking tours and educational lectures for the general public. In 2009, the LPA initiated a new awards program to recognize individuals and groups who have made a significant contribution to historic preservation in Lawrence.

The Lawrence Convention and Visitors Bureau (CVB) promotes heritage tourism and historic preservation through various driving and walking tour brochures. The CVB provides brochures directing visitors to historic sites in Lawrence and Douglas County including a "In Plain View, A Self Guided Tour of Old East Lawrence;" "Quantrill's Raid: The Lawrence Massacre;" "House Styles of Old West Lawrence;" "Historic Cemeteries Tour of Lawrence;" "Historic Trails of Douglas County;" and "Downtown Lawrence." Many of these walking tours are now available as iTours.

In December 2001, the Douglas County and Lawrence City Commissions jointly appointed the Lawrence/Douglas County Heritage Area Commission to study the possibility of seeking National Heritage Area designation. A National Heritage Area is a defined cultural landscape designated by Congress where natural, cultural, historic, and scenic resources combine to form a nationally distinctive landscape arising from patterns of human activity shaped by

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geography. These patterns make Heritage Areas representative of the national experience. The National Park Service supports National Heritage Areas with funding, training, technical assistance, and recognition for community efforts.\(^2\) In 2003, a Heritage Summit Meeting was held in Lawrence and included representation from twenty Kansas and Missouri communities. Freedom’s Frontier National Heritage Area was established as a National Heritage Area on October 12, 2006. In February 2008, citizens began working together to create a management plan for the area. The management plan was approved by the National Park Service in June 2009. Freedom’s Frontier National Heritage Area consists of 42 counties in western Missouri and eastern Kansas.

**Archaeological Investigations**

Archaeological investigations provide practically the only data about the pre-history of humans in the area of Lawrence and Douglas County. The county’s two major drainage systems, the Kansas and Wakarusa rivers, created a topography that was well suited for human habitation. There is considerable evidence of past human use of many of the stream valleys of Douglas County. As archaeologists Lauren Ritterbush and India Hesse pointed out in their 1996 study, "The high archaeological potential of Douglas County is exciting, yet with it comes the need to actively evaluate and manage the finite and fragile resources that provide us with one of the very few sets of data about our human past."\(^3\)

Formal reports of archaeological sites in the county began in 1965. This work related to planning for construction of Clinton Reservoir by the U.S. Army Corps of Engineers. Additional investigations occurred in the project area between 1966 and 1987.

For preservation planning purposes, the most instructive archaeology project was the 1996 survey completed by Ritterbush and Hesse. The archaeologists recommended the continuation of efforts to identify archaeological remains in Douglas County. They conducted an intensive archaeological survey of selected parcels of land in Douglas County to identify and record archaeological sites. The goal of the project was to inventory cultural resources on a "... sample of lands having high potential for development." Investigators emphasized prehistoric (rather than historic) archaeological resources because "... in most cases prehistoric archaeological sites offer our only source of information about more than ten thousand years of human occupation of North America." The work completed represented a relatively small sample of potentially significant resources. Landowner concerns limited access to some properties. The archaeologists gave preference to survey tracts with good ground visibility and high potential for archaeological sites — stream

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\(^3\) Lauren Ritterbush and India Hesse, “Douglas County (Kansas) Archaeological Survey” (Lawrence; Museum of Anthropology, University of Kansas, May 1996), 6.
terraces and areas reported by landowners, farmers, or collectors to be associated with artifacts. As the investigators reported, they inspected ". . . approximately 1,056 acres of land within thirty-five survey tracts. The effort recorded fifteen new sites and revisited seventeen previously recorded sites. Twenty-four of these sites contain one or more prehistoric components. Nine contain historic components." Development projects destroyed four previously recorded prehistoric sites; destruction of one site occurred during the survey.4

The archaeologists recommended testing through excavation of twelve prehistoric sites. At least five of these had high potential for listing in the National Register of Historic Places. In addition, the archaeologists recommended continued survey of priority areas, evaluation of potentially significant sites, and designation of significant sites in the National Register of Historic Places. The survey project included a public education component — a presentation describing archaeology in Douglas County prehistoric cultures in Kansas entitled "Archaeology in Our Own Backyard."

Presently, there are over 200 archaeological sites in Douglas County formally recorded with the Kansas State Historical Society and the Museum of Anthropology at the University of Kansas. Currently, the identification of archaeological sites continues to be conducted on a project-by-project basis. Information from past surveys and any subsequent surveys must be considered in the comprehensive planning and development process. When warranted, the survey information should be evaluated through further investigation involving excavation of selected sites that are most likely to yield significant information.

**Survey and Nomination**


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4 Ibid., 1-6.
Preservation Plan Comprehensive Plan element, National Register of Historic Places District nominations (Lawrence’s Downtown Historic District, North Rhode Island Street Historic District, South Rhode Island and New Hampshire Streets Historic District, Pinckney I Historic District, Pinckney II Historic District, Breezedale Historic District, and Oread Historic District), the Downtown Design Guidelines, the survey of South Massachusetts Street, the employment of a Design Review Intern, the employment of a Historic Preservation Planning intern, preservation education projects, and a Historic Resources Survey of the area North of the Stadium.

**Planning and Zoning**

Historic preservation was an element in the "Horizon 2020" comprehensive plan approved in 1997. Of the twelve key goals in the plan, two are most relevant for historic preservation. The plan “. . . encourages the identification, protection, and adaptive reuse of the wide diversity of historic buildings, structures, sites, and archaeological sites that can be found in Lawrence and Douglas County. Considering historic preservation issues in combination with other land use decisions assures the preservation of historic resources but also fosters the image, identity, and economic development goals in the Comprehensive Plan." Secondly, the Horizon 2020 comprehensive plan promotes the maintenance of a strong and clear distinction between the urban and rural character of Lawrence-Douglas County. To further this goal, the plan also defined areas anticipated to receive new urban growth near existing urban areas and established parameters for non-agricultural development in Douglas County.\(^5\)

**Economic Activity**

In 1985 the Downtown Lawrence Association sponsored the Lawrence application to participate in the National Trust for Historic Preservation Main Street program. This program integrated business associations, coordinated marketing and historic preservation to stimulate economic development. Main Street cities make a commitment to hire a full-time downtown coordinator of these activities for one to three years. Lawrence participated in the Main Street program for several years.

Downtown Lawrence, Inc (DLI) is a not-for-profit membership organization created to promote the interests of the Downtown business district. DLI has over 100 members including individually-owned specialty stores, national retail chains, restaurants, bars, hair salons, and professional businesses. The mission of DLI is...“to preserve, protect, and promote Downtown Lawrence as the retail, service and professional, governmental, entertainment, and social center of our community.”

\(^5\) “Horizon 2020".
In May 1997 the owners of the Ludington-Thacher house, a National Register property and one of the landmark residences in Lawrence, received a $60,000 grant from the Kansas Heritage Trust Fund for brick restoration. This was the first grant in Lawrence to a private property owner.

Two other important economic events for historic preservation in Lawrence were set in the preservation of the English Lutheran Church building in downtown Lawrence and the Union Pacific Railroad Depot building in North Lawrence. In 1991, attorneys for the Kansas State Historical Society and the LPA presented arguments to the State Court of Appeals on behalf of preservation of the church building. They argued that the property owner, Allen Press, had not considered reasonable and prudent alternatives to the planned demolition. Eventually, Allen Press sold the building and the new owner rehabilitated it as an office building. Litigation over the church established important precedents for due process in considering demolition and the community interest in significant historic buildings.

A prominent preservation success occurred in February 1990 when the Union Pacific Railroad presented the key to the historic depot to the Mayor of Lawrence. This symbolized the donation of the building to the city so that fundraising for renovation could begin. The issue of community interest in the depot versus railroad policy arose when the Union Pacific announced plans in 1984 to demolish the depot within sixty days. In response, a "Save the Depot Task Force" organized. After years of negotiations and planning (including the possibility of moving the masonry building), the task force convinced the community and the railroad company to preserve, rehabilitate, and re-use this landmark building.

2004 was an exceptional year for preservation in Lawrence with six historic districts listed in the National Register of Historic Places and the Register of Historic Kansas Places. All of the contributing properties in these districts became eligible for the State Rehabilitation Tax Credit Program and the income producing properties became eligible for the Federal Rehabilitation Tax Credit Program.
Figure 3. Chronology of Historic Preservation Activities

1984  Lawrence Preservation Alliance incorporated.
1984  "Living With History," Lawrence Historic Preservation Plan recommends survey plan, nominations to the State and National registers, and historic preservation ordinance.

Union Pacific Depot threatened with demolition.

1987  Houses demolished in 800 block Kentucky Street.
1987  "Heart of Oread Survey" completed.
1988  Lawrence Historic Preservation Ordinance approved.
1989  Kansas Land Trust organized.
1990  City of Lawrence accepts Union Pacific Depot property.

City of Lawrence initiates Old West Lawrence re-survey, survey program.

1991  Lawsuit leads to sale and rehabilitation of old English Lutheran Church.
1995  Kaw Valley Heritage Association organized.
1996  Kansas Historic Preservation Conference, Lawrence.
2001  Douglas County Preservation Alliance disbanded.

National Heritage Area Commission appointed.

2003  Heritage Summit Meeting was held in Lawrence

2004  Six historic districts listed in the National Register of Historic Places

2006  Freedom's Frontier National Heritage Area established

2009  The management plan for Freedom's Frontier National Heritage Area approved by the National Park Service in June.
THE IMPORTANCE OF LOCAL PROGRAMS FOR PRESERVATION AND PLANNING

The development of economic incentives and strategies - making money through historic preservation - is the most important new direction in the evolution of historic preservation programs. In the past decade, the use of historic preservation as an economic development strategy had a dramatic impact on the economies of America's cities and towns. As the leading expert in this field, Donovan Rypkema, notes, "... the commitment to downtown revitalization and reuse of downtown's historic buildings may be the most effective single act of fiscal responsibility a local government can take."6

Consider these facts. Many more historic buildings merit being saved than can possibly be museums. There are not nearly enough tax dollars to save all the buildings that ought to be preserved. Finally, most historic buildings are not owned by historic preservationists.7 Consequently, the future of historic resources requires an economic justification. For most historic buildings, preservation has to pay for itself and it can.

If we want to attract capital and investment in our community, we must differentiate it from anywhere else. As Rypkema notes, "... it is our built environment that expresses, perhaps better than anything else, our diversity, our identity, our individuality, our differentiation."8 In the twenty-first century, historic preservation is a valuable economic development strategy for successful communities.

City of Lawrence Programs

While state and federal programs provide targeted assistance, historic preservation is basically a local activity. In Lawrence, the most immediate opportunity to use economic incentives is provided by Article 10 of the Historic Preservation Ordinance. To make the preservation of historically significant structures more economically feasible, the ordinance provides for special use permits, preservation easements, exceptions to the city building code, a preservation fund, and the Historic Conservation Award program.

For example, to encourage adaptive re-use of historic buildings, the Historic Resources Commission may recommend to the Lawrence-Douglas County Planning Commission that a special use permit be granted to the landmark property or listed property to allow other uses which are not allowed in the existing zoning category. This allows for appropriate functions such as bed and breakfast accommodations, house museums, art galleries, and other special uses. Preservation façade easements on buildings designated as landmarks

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7 Rypkema, The Economics of Historic Preservation, 1.
8 Ibid., 44.
may be acquired by the city or other groups through purchase, donation, or condemnation. A preservation easement would include any easement, covenant, or condition running with the land designed to preserve or maintain the significant features of such landmarks. An easement gives a partial interest in the historic property to the city or a qualifying organization. The owner retains use of the entire property but agrees to give up part of the rights inherent in property ownership (the right to change the façade, for example) in return for favorable tax treatment. An additional incentive to encourage the rehabilitation of historic buildings – exceptions to the building code – may be available to owners of landmarks and buildings within historic districts.

One of the most important incentives mentioned in the ordinance, which has not been utilized, is the establishment of a Preservation Fund. The City Commission determines how the fund is administered. The city may apply for, receive, and place in the fund any federal, state, local, or private gifts, grants, fees, or bequests. Also, the City Commission may budget and incorporate City revenues into the fund. The Preservation Fund could be used to purchase landmarks or properties located in a historic district. It could be used to accept preservation easements, to make grants or loans for preservation and rehabilitation of landmarks or properties in a historic district, as well as to make grants or loans to organizations to achieve one or more of the purposes of the Historic Preservation Ordinance. The fund could be used for the maintenance of landmarks or properties in a historic district. Finally, the preservation fund could be used for reasonable costs associated with the purchase of property, the purchase and enforcement of easements, and the sale of property.

The city code authorizes the Historic Resources Commission to recognize outstanding projects and individual contributions to historic preservation in Lawrence through the annual Paul Wilson Awards program. While the awards program does not provide direct financial assistance, it does honor projects that are valuable to the community, and that publicity may attract additional investment in historic preservation.

**Neighborhood Planning and Community Development**

In Lawrence, the Community Development Division administers several programs that can assist in the rehabilitation of historic properties. These are intended to benefit low-to-moderate-income homeowners. The Comprehensive Rehabilitation Program provides loans up to $25,000 to bring the property up to rehabilitation standards. A maximum of 50 percent of the loan may be forgiven over a seven-year period if the owner continues to occupy the home. Emergency loans, furnace loans, and weatherization programs are also available. The Home Owners Out of Tenants (HOOT) program provides an opportunity for low- and moderate-income, first-time homeowner families to purchase a home.
The Kansas Neighborhood Revitalization Act is an additional tool available to the city for the promotion of neighborhood revitalization. The act is specifically aimed at the preservation of historic or architecturally significant areas, the elimination of abandoned houses and properties through rehabilitation, and/or the construction of new improvements. It provides a tax rebate incentive program based on the increased valuation of improvements.

This act requires participation by other taxing jurisdictions. In Lawrence, the city would receive 24 percent of the total levy; Unified School District 497, 52 percent; and Douglas County, 24 percent. The City Commission must approve and implement a plan for any neighborhood revitalization area by designating areas, adopting a plan for each area, and determining the criteria, standards, and eligibilities for rebate of the tax increments. The goal is the rehabilitation, conservation, or redevelopment of an area as necessary to protect the public health, safety, or welfare of the residents of the city. Revitalization plans and the rebates can apply to commercial or residential property. Douglas County would serve as administrator of the Neighborhood Revitalization Trust Fund, which would hold increased revenues for the rebates. While the Revitalization Act is useful, implementation would require negotiation and agreement about the program among the City Commission, County Commission, and School Board.

The “East Lawrence Neighborhood Revitalization Plan” outlined other economic incentives for neighborhood conservation. Important goals in the plan that could apply to almost any older neighborhood or district were to preserve existing physical landmarks, support neighborhood institutions and activity centers, and protect and strengthen neighborhood businesses. Incentives related to residential property rehabilitation included property tax abatement, revolving loan funds for housing code improvement, rehabilitation, and emergency stabilization, as well as design assistance. For commercial properties, enterprise zones, issuance of revenue bonds, tax increment financing, rehabilitation loans, parking benefit districts, and façade improvement programs could help strengthen neighborhood businesses.9

One of the supporting components of the East Lawrence Plan is a design guidelines study. Design guidelines are a technique to protect the character defining qualities of a given area. The guidelines are a set of uniform criteria used to evaluate the appropriateness of proposed changes to existing buildings and new construction in a defined area or "district." Guidelines do not prevent property owners from making changes, but they ensure that

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those changes maintain the unique architectural qualities of a neighborhood. Design guidelines for the Old West Lawrence National Register district are now being used to protect that notable neighborhood.

One of the most important set of design guidelines in current use is the "Downtown Lawrence Design Guidelines." Downtown Lawrence has distinct physical attributes that contribute to its overall character. One of these attributes is "... the diversity of structures that have been constructed over an extended period of time." Many of these structures stand as historical reminders of the development patterns of Lawrence. Therefore, the focus of the downtown design guidelines is on new construction that complements the established character of downtown Lawrence. More than half of the goals of the Downtown Design Guidelines incorporate historic preservation methodology. These include regulation of the exterior scale, massing, design, arrangement, and materials to promote compatibility with the existing character of downtown Lawrence; development of an aesthetic appearance which complements the existing character; and the protection of the historic and architectural value of buildings or structures listed in the National, Kansas, or Lawrence registers. Finally, a central goal of the guidelines is to build upon historical character and foster diversity while meeting the goals of Horizon 2020 to increase the density of the downtown area.

Downtown design guidelines, like all design guidelines, are important because they inform property owners and developers about the community expectations for new construction and renovations of existing buildings. They provide detailed information and direction to property owners, developers, and interested citizens. This direction safeguards the considerable investment represented in existing buildings and new investment in a highly competitive business and/or development environment. The guidelines not only help owners and developers make decisions, but city staff uses the guidelines to review proposed projects in a consistent, fair, and equitable manner.

The success of the downtown design guidelines can be measured by the growing interest in designating a major portion of downtown Lawrence as a National Register historic district. Such a designation would qualify contributing properties to receive both the federal and state tax credits to offset the cost of rehabilitation of historic buildings. Presently, the members of Downtown Lawrence, Inc. are considering these incentives as an important vehicle to assist property owners in maintaining or restoring their historic buildings.

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10 Ibid., Appendix D, 1.
12 Ibid. 7-8.
Other Economic Incentive Programs

As noted previously, the Kansas Historic Preservation Office, Kansas Historical Society, provides the most direct economic assistance. Economic programs of the office include the implementation of a statewide tax incentive program, as well as more use of the federal investment tax credit program and the Neighborhood Revitalization Act.\textsuperscript{14}

In the United States, the foundation of economic incentives for historic preservation has been the federal rehabilitation tax credit implemented in 1977. During the past decade, property owners have spent more than $30 million on rehabilitation of historic Kansas buildings through the federal tax credit program. This provides a credit equal to 20 percent of qualifying rehabilitation expenses on income-producing properties that are listed in or eligible for listing in the National Register of Historic Places. Project work must conform to the Secretary of the Interior's Standards for Rehabilitation. Conforming to the standards contributes to the long-term preservation of a property's significance through the preservation of historic materials and features.

In Kansas, the newest economic incentive and one of the most important for its potential is the state credit for rehabilitation of historic buildings. This program complements the federal tax credit and is modeled after programs in surrounding states such as Missouri and Colorado. It provides for a state income tax credit equal to 25 percent of qualifying rehabilitation expenses on certified historic structures. Project work must exceed $5,000. Unlike the federal tax credit program – for which only income-producing properties qualify - rehabilitation of non-income-producing properties (such as personal residences) will qualify for the state tax credit. In 2010, the Kansas Preservation Alliance (KPA) contracted with the Center for Urban Policy and Research at Rutgers University to produce an economic impact study of the Kansas State Historic Rehabilitation Tax Credit program. The study was partially funded by a Historic Preservation Fund (HPF) grant from the Kansas Historical Society. The study concluded that a $69 million state tax credit has encouraged a four times greater amount of historic rehabilitation ($271 million). See the full report at http://www.kshs.org/p/kansas-state-tax-credit/14666#Economic%20Impact%20Study.

One of the most successful programs administered by the Historic Preservation Office is the Kansas Heritage Trust Fund. This fund provides grants up to $90,000 and technical assistance for rehabilitation of properties listed in the National or Kansas registers. Individual grant awards must be matched by the recipient. A 50/50 match is required in for-profit organizations, but not-for-profit organizations or government entities must only provide a 20/80 match. Properties owned by the state and federal governments are not eligible. Since 1990, the Heritage Trust Fund has provided more than $4 million to support

\textsuperscript{14} The Kansas Preservation Plan, 5.
the preservation of a variety of historic properties located in communities across the state.

Many factors affected the economic success and activity in downtown Lawrence, including strong community interest, the city's commitment to infrastructure development and planning, and participation in the Main Street program in the 1980s.

Established in Kansas in 1985, the Community Development Division of the Kansas Department of Commerce and Housing administers the Main Street program. It provides technical assistance – not direct funding – to Main Street cities and focuses on cities with a population under fifty thousand. An interested city must apply for designation, hire a manager, establish an advisory board, and develop a comprehensive program to bring about revitalization of the commercial core area.

The Main Street program encourages the integration of sound economic development and historic preservation principles. Successful programs coordinate improvements to create a positive, distinctive image for downtown. The four-point Main Street program consists of the organization of public-private partnerships to create a revitalization program; the promotion of downtown as an attractive place for business, investors, and visitors; appropriate design of the physical environment; and economic restructuring that strengthens existing businesses while diversifying the town's economic base of businesses. For example, the "Downtown Lawrence Guidelines" specify appropriate design guidelines to create a distinctive physical environment for downtown Lawrence.

At least three programs offered by the National Trust for Historic Preservation might be useful for preservation projects in Lawrence and rural Douglas County. The Trust provides a Preservation Services Fund that makes grants of $500 to $5,000 to non-profit organizations to initiate preservation projects. Secondly, the Barn Again program recognizes and promotes successful examples to encourage the adaptive re-use of historic barns for contemporary purposes. Finally, the Trust’s Heritage Tourism program provides a multi-disciplinary approach to attracting visitors. For Kansas, these programs are administered by the NTHP Mountain/Plains regional office in Denver, Colorado.
Historic Overview
Chapter Four—Historic Overview

PREHISTORY

Historians and anthropologists organize the study of human occupation in the Central Plains according to a cultural chronology that spans the period from about 10,000 years B.C.E. to the present. Paleo-Indian hunters who roamed the area were the earliest inhabitants during the period from 10,000 to 6000 B.C.E. The Archaic people were the next major cultural group; they predominated during the period 6000 B.C.E. to A.D. 300. Later cultures included the Plains Woodland people who lived from A.D. 1 to 1000, the Plains Woodland Village Farmers who lived from A.D. 1000 to 1450, and the Proto-Historic people A.D. 1450 to 1700. A westward advance of Woodland people into this area during the late Archaic period also provided evidence of a parallel Early Ceramic culture, A.D. 1 to 1000; a Middle Ceramic culture, A.D. 1000 to 1500 (Kansas City Hopewellian); and a Late Ceramic culture, A.D. 1500 to 1800. When European explorers and traders began to travel regularly through what is now Kansas, the documentation of this cultural interaction defined the Historic Period from about A.D. 1700 to the present.26

HISTORIC NATIVE AMERICAN CULTURE

The historic period of Native American culture began with the arrival of European-American traders on the Missouri River, which established an era of relatively regular contact with the native populations of northeastern Kansas. What is now Douglas County was part of the Kansa Indian Territory during the early historic period. The Kansa first lived along the Missouri River in the St. Joseph-Kansas City area. They later moved to the Big Blue River along the upper Kansas River near present-day Manhattan, and then to lower Mission Creek and the middle reaches of the Kansas River. Generally, the Kansa territory was the northeast corner of Kansas from the Missouri River to the Big Blue River and from the Nebraska line south to the Kansas River. In their last years in Kansas, the Kansa lived around Council Grove. In 1873, they moved to Indian Territory in present day Oklahoma. Investigations have not identified any Kansa camps or special activity sites in Douglas County, although they may be present.

In an effort to open more land to settlement, the United States government implemented a policy of "Indian Removal" of Native American nations from the Great Lakes region and Ohio River Valley to "vacant" lands west of the Missouri River and the Missouri and Arkansas

borders. Through a series of treaties initiated in 1825, the federal government promised reserved land as a permanent home for the emigrant tribes. As a result of these treaties, the Kansa accepted a much diminished reservation west of Douglas County and the so-called "emigrant Indians" from the East received land reserves that extended into what is now Douglas County.

Both the Delaware and Shawnee nations lived along the Kansas River, hunted buffalo to the west, developed farms, and raised livestock. The Delaware reservation extended along the north side of the Kansas River while the Shawnee reservation extended along the south side, including most of present-day Johnson and Douglas counties. The Delaware settled in present-day Wyandotte County in 1830. A Baptist mission established there for the Delaware continued to serve the Wyandotte nation until 1867. Shawnee tribes began arriving in the area in 1828 and more arrived in later years. Euro-Americans established a trading post for the Shawnee in Johnson County as well as Methodist Episcopal, Baptist, and Quaker missions. In 1848, missionaries established a Methodist Episcopal mission near the mouth of the Wakarusa River, possibly in extreme northeastern Douglas County.

To those accustomed to exploitation and appropriation of the public lands for their own purposes, "Indian Country" offered unusual opportunities. Productive soil, potentially valuable town sites, and railroad right-of-way became more important than treaty promises. As one reporter observed when Kansas Territory opened in 1854, "It required no spirit of divination to foresee that, in opening the territory to a white population, the semi-barbarous occupancy of the finest lands by the Indians would inevitably terminate in some manner."

One of the steps to dispossession was the federal statute of July 22, 1854, which allowed all Indian lands to which title had been or should be extinguished to come under the very liberal provisions of the Preemption Law of 1841. Preemption meant that the actual settler on unclaimed public land had the first right to buy it from the federal government. White settlers argued that - without preemption - the new country would be in the hands of monopolists and not the small yeoman farmer. Besides, the land-hungry settlers insisted that the federal government could hardly expect strict compliance with the rules governing land when federal policies toward Native Americans were filled with deception. The Delaware and Shawnee treaties of 1854 also stated that the emigrant tribes must allow rights-of-way for railroad development through their land.

During the conflicts of the territorial period and particularly after the outbreak of the Civil

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28 Ibid., 113.
29 Ibid., 14, 27.
War, white settlers challenged Indian land claims. The emigrant tribes came under continual harassment. By 1858, reports of squatters resorting to force became increasingly common. They physically abused Indian agents and forced some to abandon their agencies. As late as 1863, Native American nations still held almost four million acres in the State. Euro-American settlers complained that the government should extinguish the Indian titles completely, not just to negotiated concessions for traders, land speculators, and railroad men.30

The demand for public land eventually led to the removal of more than ten thousand Kickapoo, Delaware, Sac and Fox, Shawnee, Potawatomi, Kansa, Ottawa, Wyandot, Miami, and Osage, in addition to a number of smaller nations, from the State. After 1866, many Native Americans ceded their Kansas lands to the federal government and most moved to Indian Territory in what is now Oklahoma. By 1875, fewer than one thousand – the Prairie Band of the Potawatomis, a few Kickapoos, and even fewer Sacs and Foxes – remained.31

HISTORIC DEVELOPMENT, 1820-1854

From the early to the mid-nineteenth century, many Euro-American travelers and emigrants moved through the Kansas River valley along several commercial and overland emigrant trails. Both the Oregon-California and Santa Fe trails ran through what is now Douglas County.

As early as the late eighteenth century, French and Spanish explorers traveled between Santa Fe and St. Louis. Eventually, the Santa Fe Trail took its name from its destination, the capital of Mexico's northernmost province. Before 1821, Spain prohibited overland trade with the United States, but after Mexican independence, trade flourished between Mexico and merchants from the United States.

In March 1825, Congress authorized a survey of a road from Missouri to New Mexico and negotiations with Indian nations for safe passage across the plains. The survey party signed treaties with the Osage and Kansa for permission to mark the road and use it freely. At first, traders left from Franklin, then Fort Osage, and, later, Independence and Westport in Missouri and Leavenworth in Kansas. Most of the trail branches joined near what is now the town of Gardner in southwestern Johnson County, Kansas. The Santa Fe Trail overland route from Missouri, entered Kansas in Johnson County, passed the Shawnee Indian missions, and followed a route through Douglas, Osage, and Lyon counties to Council Grove and on westward to Santa Fe.

30 Ibid., 24, 107.
31 Ibid., 5.
Not only did Euro-Americans leave the western frontier of the United States to trade goods for silver species in Mexico, during the 1830s, Mexicans brought in silver amounting to as much as $300,000 per trip and furs and mules to trade for manufactured goods. The trade was very profitable for American merchants. In *Commerce of the Prairies*, Santa Fe trader, Josiah Gregg, reported that the volume of trade between 1822 and 1843 usually produced profits from 20 to 40 percent. During the Mexican War of 1846-1848, the Santa Fe Trail served as a military road. After the war, the U.S. military began to establish forts near the trail to protect travelers and to maintain peace among the various Indian nations.

During the 1850s, commerce and emigration increased. In 1860, more than three thousand freight wagons used the trail. Six years later, the number grew to between five thousand and six thousand wagons. The volume of trade encouraged railroad developers and work began on the Atchison, Topeka, and Santa Fe Railroad in 1868. The company completed the Kansas section in late December 1872. Overland stage and wagon freighting on the trail ended after 1878 when the railroad line reached Santa Fe, New Mexico.\(^\text{32}\)

Compared to the Santa Fe Trail, the Oregon Trail "... was known primarily as the emigrant's highway." It also served military and commercial traffic. The Oregon Trail was the longest overland trail, stretching from near Independence, Missouri to Oregon or California. It was never a single route but consisted of a series of alternate routes. In Kansas, the major routes began with the Santa Fe Trail at Independence or Westport, Missouri, diverged from the Santa Fe Trail near present-day Gardner, Kansas, and followed the Kansas River valley, turned northwest through present-day Westmoreland, crossed the Blue River near Marysville, and continued on into Nebraska.\(^\text{33}\) In Kansas, the route originated at the landing at Fort Leavenworth and also passed through or near the towns of Olathe, Gardner, Eudora, Lawrence, Big Springs, Topeka, Silver Lake, Rossville, St. Marys, and Westmoreland.

From the 1840s through the 1860s, an estimated 250,000 emigrants, prospectors, traders, and other travelers used this overland route to get to the Rocky Mountains, Utah, Oregon, and California. Already significant by the mid-1840s, traffic escalated with the discovery of gold in California in 1849.

At first, travelers had to ford the rivers and streams. As travel increased, several individuals started ferries. In 1850, guidebooks listed five ferries or bridges along the Oregon Trail in Kansas. Activity on the Oregon Trail declined as the railroads built transcontinental lines in the 1860s and 1870s.

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\(^{33}\) Ibid., 11-12.
The Kansas River was another important travel route through what is now Kansas. Early traders moved up and down the river in pirogues or keelboats. The first steamboats traveled the Kansas River in 1854. In the spring of 1855, several boats docked at Lawrence. This supported the belief that the settlement could become the western freight terminal for the new territory. The belief was contradicted by extreme variations in the flow of the Kansas River. The river was barely navigable in 1856. Drought in 1857 and again in 1860 made steamboat travel impossible.

**HISTORIC DEVELOPMENT OF THE KANSAS TERRITORY AND DOUGLAS COUNTY**

After the Mexican War, the issue of the expansion of slavery into thousands of acres of new territory created a national controversy. In 1854, Congress passed the Kansas-Nebraska Act, which opened the unsettled region west of the Missouri river and the western boundary of Missouri to white settlement. Departing from the earlier Missouri Compromise, Congress mandated that whether the former "Indian Country" would be slave or free would be determined by settlers' votes.

Abolitionists and other opponents of the extension of slavery organized to make Kansas a free state. Southerners, especially residents of Missouri, expected that their neighboring territory would become a slave state. The abolitionists of New England assisted anti-slavery emigrants planning to settle in Kansas. In July 1854, the first emigrant party left Boston to establish a town some forty miles west of the junction of the Kansas and the Missouri rivers. The emigrants named their newly established town Lawrence. Before the end of the year, five emigrant parties, including a total of about five hundred people, made their way to Kansas and Lawrence. The emigrant aid company sponsored groups that traveled to Topeka, Manhattan, and several other towns in 1854 and 1855.

When pro-slavery voters elected a territorial legislature in the spring of 1855, free-staters organized a rival legislature. Both provisional governments petitioned Congress to be admitted to the Union. For the next several years, the political situation remained confused. During the years from 1855 through 1857, frequent violent outbreaks in eastern Kansas, particularly in Douglas County, made national headlines. Raids by pro-slavery Missouri forces and abolitionist groups occurred on both sides of the Missouri-Kansas border and resulted in murders and the destruction of property. Because of such incidents, the territory became known as "Bleeding Kansas." By the end of 1857, the number of free-staters was increasing and the presence of federal troops and effective gubernatorial leadership began to control the violence. Many Missourians left the territory and in the fall of 1857, free-state voters gained control of the territorial legislature. Their leaders held a convention in 1859
at Wyandotte where they drafted the constitution under which Kansas, in January 1861, entered the Union as a free state.34

Some of the earliest towns founded in Douglas County were Lawrence, Franklin, and Lecompton. Located a few miles southeast of Lawrence, above the bottomlands where the Wakarusa joins the Kansas River, Franklin was the first stagecoach stop west of Westport, Missouri. When Kansas became a territory, many Missourians moved into Kansas, and Franklin became a town popular with Southern sympathizers. Other early Douglas County communities were Black Jack, Big Springs, and Lone Star.35

HISTORIC DEVELOPMENT OF LAWRENCE36

Settlement Period, 1854-1863
From the first year of settlement in 1854, Lawrence was a "planned community with metropolitan aspirations." Following the early years of settlement, activity during the "city-building" period from 1864 to 1873 defined the central commercial axis of Lawrence and the related network of residential districts. Industrial development in the late nineteenth century and the growth of the University of Kansas in the early twentieth century were also important determinants of the urban environment. For each period, the local population, institutions, activities, and artifacts formed a characteristic pattern.37

A majority of the historic buildings surviving in Lawrence date to the periods of slow, gradual growth and replacement dating from 1873 to 1945. This pattern contrasts with the rapid and extensive growth of the city-building period (1864-1873) and the modern period of prosperity, dramatic population growth, and building construction from 1945 to the present. The interpretation of significance in local history, then, must account for this tension between continuity, growth, and decline.

Agents for the New England Aid Company, an anti-slavery organization formed to counter

34 Ibid., 39-40.
36 Interpretation of the historical development of Lawrence is based on the chronology in a 1984 study, "Living with History: A Historic Preservation Plan for Lawrence, Kansas," by Dale Nimz. This study outlined a distinctive sequence of chronological periods in the history of the city's urban design, architecture, and landscape. Each period has an overall theme and associated geographical area. Since almost all of the existing historic buildings in Lawrence have associations with the periods after 1865, that study did not develop a context for the prehistoric period, exploration period, or for the post-World War II period from 1945 to 1965. As buildings and structures in Lawrence from that period age, an additional context for evaluating their historical and architectural significance will be necessary.
37 Nimz, "Living With History: A Historic Preservation Plan for Lawrence, Kansas" (Urban Studies Project for the City of Lawrence, Kansas, 1984), 59. City of Lawrence, Kansas.
the political influence of Southern slaveholders in Kansas, selected a town site located on an area of relatively level ground between the two valleys of the Kansas and Wakarusa rivers. The first party of emigrants from Massachusetts camped on Mount Oread on August 1, 1854. Given the perception in 1854 that steamboat travel was practical on the Kansas River, the Lawrence site seemed to have the potential to become the regional metropolis serving a vast territory.38

Overland travelers to California, Achilles B. Wade and Charles Robinson, camped near the future site of Lawrence in 1849-1850. The distinctive configuration of features at a point where the Kansas River turned northwest opposite a prominent ridge (later named Mount Oread) impressed both men and they returned to settle in Lawrence.

Oriented along a linear north-south main street perpendicular to the Kansas River, the original town plan created a regular grid street pattern including reservations for parks, schools, and public buildings that remained a significant aspect of the core of the city and its community. A. D. Searle's revised plat of 1855 established Lawrence's urban design. The original area of the town site was reduced from a tract extending for 2½ miles along the river and 1½ miles from the river south to an area one-mile square.39

In 1855, the pro-slavery territorial legislature established Douglas County. Later in 1857, Lecompton, a pro-slavery settlement west of Lawrence, became the first county seat. Residents of Lawrence then adopted their own town charter by acclamation rather than accept one from the hostile legislature. When free-state settlers gained control of the legislature, one of the first bills considered was a charter for Lawrence, which gained approval on February 11, 1858.40 From a settlement of approximately 400 in 1855, Lawrence grew to be a town of 1,645 residents by 1860, but it was smaller than other towns in the region. Kansas City, had a population of 4,418 and Leavenworth was the largest city in Kansas with a population of 7,400 residents.

The initial settlement area between Mount Oread and the Kansas River was relatively small. Most buildings were simple and impermanent. At the end of 1854, Lawrence had "... about fifty dwelling houses, some of shakes, some grass-covered, some sod and log, some of tarred canvas, and one or two covered with oak boards." There were two boarding

38 Ibid., 59-60.
houses, a saw and planning mill, a butcher's shop, and two stores. Reverend Richard Cordley reported that construction began of several substantial brick buildings on Massachusetts Street late in 1857 and was completed in the following year. When Cordley first arrived in autumn, however, the prospect was disappointing.

The town seemed smaller than I had expected to find it, and had a more unfinished look. There were not only no sidewalks, but no streets, except in name and on the map. The roads ran here and there, across lots and between houses, as each driver took a fancy. This gave a scattered appearance to the town... There were scarcely any fences or dooryards, and gardens were almost unknown. There had been hardly a tree or bush planted on the town site.

One of the greatest impediments to early commercial development was the problem of transportation. Originally, town planners envisioned Lawrence as a river town like Pittsburgh, Cincinnati, and St. Louis, but steamboating on the Kansas River was a failure. The pioneer ferry across the Kansas River became a critical link in the local transportation network. Along with building and transportation, the development of agriculture was the most important economic activity during this period.

Disputes over land claims in 1854-1855 signified the area east of Massachusetts Street as a "contested site" first associated with pro-slavery squatters. Environmental problems also delayed development in East Lawrence. Early issues of the Lawrence Herald of Freedom warned against settling in the edge of the timber near the Kansas River because of resulting sickness (possibly malaria). Although early settlers did not understand disease patterns, they considered the property in the low-lying area of East Lawrence less desirable.

A bird's eye view of Lawrence in 1858 shows only scattered residential development, with the greatest number of buildings near the Kansas River. An area west of Massachusetts was fairly well developed, but houses east of Massachusetts were scattered. Present-day 14th Street is the southern limit of street development. Typically, such promotional views included proposed street and properties as well as developed areas; but the Lawrence view suggests the early spatial differentiation of commercial and residential areas.

Quantrill's raid in 1863 was the most dramatic event of the settlement period. Although both Union and secessionist troops ranged back and forth across the border country of

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41 Andreas, 317.
42 Richard Cordley, Pioneer Days in Kansas (New York: Pilgrim Press, 1903), 58.
western Missouri and eastern Kansas during the Civil War, the most publicized raid occurred when about 300 Confederate guerrillas under the leadership of William C. Quantrill surprised Lawrence residents early in the morning of August 21. Meeting no organized resistance, the raiders looted banks, stores, and saloons. They killed approximately 200 men and burned most of the buildings in the central part of town.

The majority of business houses of Lawrence lined both sides of Massachusetts Street between 7th and 9th streets. Quantrill’s men destroyed about seventy-five buildings in this area. As the Lawrence Daily Journal explained in 1880, "The entire business part of the town was burned and a large number of private residences. The town, as we now see it, has mainly been built since that date."45

From the 1850s through the 1950s, the two-part commercial block was the prevalent commercial style in downtown Lawrence. This central commercial area also included churches, residences, and civic buildings representative of the popular styles of each period.46

The destruction of Quantrill’s raid in 1863 retarded residential development for only a short time. A witness to the raid recalled that "... nearly one-half of the residences were also burned [...] almost all those in the central portion of the town. Along the banks of the river, and around the outskirts, most of the houses were left." According to a list compiled on the fiftieth anniversary of the raid in 1913, eleven houses in East Lawrence survived the raid. Three of those listed remain today, but at least three other standing buildings identified in survey appear to date to a time prior to 1863, and four other houses date to the 1860s, possibly before the raid. In West Lawrence, only five houses constructed during the settlement period remain.47

**City-building Period, 1864-1873**

Rebuilding the town after Quantrill's raid, the completion of a railroad branch, and the end of the Civil War contributed to a notable, but short-lived boom in Lawrence. An influx of settlers increased the town's population to 8,320 by 1870. Most of this increase occurred in the last five years of the decade. After 1873, the town never experienced such a surge in growth until 1945.

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45 Lawrence Daily Journal "City of Lawrence," special edition (January, 1880), 2; and Andreas, 323.
Construction of the Kansas Pacific Railroad to North Lawrence in November 1864 and the Leavenworth, Lawrence, and Galveston to East Lawrence in 1867 created jobs in construction, associated businesses, and eventually in local manufacturing for immigrants and new residents of Lawrence. Overshadowing the earlier territorial conflict between New Englanders and Missourians, the emigration of new groups of Germans, Irish, Scandinavians, and African-Americans to Lawrence created a bustling western town. Population diversity was a significant theme during this city-building period. According to the 1865 State census, only 23 percent of the people in Lawrence were from New England, 29 percent were from the North Midland (Ohio, Illinois, and Indiana), 29 percent were from the Upper South, and 18 percent were from Europe.\(^48\)

Railroad construction also created a new town north of the river. Geographic separation meant that North Lawrence developed as a distinct community with its own schools, churches, and businesses. This community organized after the Kansas Pacific Railroad began operation. S. N. Simpson laid out a town site of 320 acres in 1866. Immediately after its incorporation a year later, "...building began in earnest, and many of the buildings constructed during this period still remain standing." An attempt in 1869 to annex the new town to Lawrence failed, but on March 17, 1870 the citizens of North Lawrence and Lawrence voted to consolidate. North Lawrence comprised the 5\(^{th}\) and 6\(^{th}\) wards of the city with the boundary between the two on what is now North 6th Street.\(^49\)

Rapid growth and unfulfilled ambition were themes of this period. Mud on Massachusetts Street was a problem during the wet years of 1868-1869. Late in 1870, a group of property owners petitioned the city council for permission to pave at least one block of the principal street. Instead of macadam (paving with crushed rock or gravel), the lot owners decided to use a patented system of wooden blocks. Since this technique failed after only two years, a solution to the paving problem required municipal intervention. From 1875 on, the city assumed responsibility for the main street and regularly repaved with macadam until they installed more permanent brick paving in 1899.\(^50\)

The city’s first streetcar line was an unsuccessful venture inspired by the rapid growth of Lawrence. In 1870, the city awarded a franchise for a horse-drawn line from the railroad depot in North Lawrence down Massachusetts Street. Although the franchise never paid expenses, the streetcar line continued to operate until 1879.


\(^{50}\) Cathy Ambler, "Mastering Mud on Main Street: Paving Technology in the Late Nineteenth Century," *Pioneer America Society Transactions* 17 (1994): 43, 45.
In 1869, the Lawrence Gas and Coal Company built a plant to manufacture coal gas for cooking and lighting. Because Lawrence did not develop as hoped, this plant "... proved to be larger and more expensive than the town and consumption then warranted, and for some years it was an unprofitable investment for its promoter."\(^{51}\)

Before 1869, the city and county transacted business at different locations in Lawrence. Quantrill's raid destroyed the county building and most county records; County Clerk George Bell was a casualty of the attack. The city purchased lots at the corner of 8th and Vermont in 1865 that they leased to a group of businessmen who planned to build a large city market. After the investors ran out of money, the city finally completed a large brick "Market House" in 1869. This downtown building housed all the county offices and courtroom as well as the city offices, council chamber, and the police and fire departments.\(^{52}\)

Since most of the extant buildings in the Lawrence downtown area date to the periods after Quantrill's raid in 1863, the downtown development patterns reflect building construction after the Civil War period. A. D. Searle's revised 1855 plan laid out the basic character-defining elements of streets and building lots to maximize the commercial potential of the downtown. At both ends, the linear commercial area had definite boundaries with the Kansas River to the north and South Park to the south.

**Commerce**

Extension of the Kansas Pacific Railroad to North Lawrence in November 1864 marked the beginning of a new stage of Lawrence's commercial history. Under construction at the time of Quantrill's raid, the railroad finally completed a permanent bridge across the Kansas River in December 1863. When the railroad reached North Lawrence, business boomed on both sides of the river. As the *Kansas Daily Tribune* reported on November 27, 1864,

> No man can stand an hour at the Lawrence bridge, and see the immense amount of merchandise constantly passing by teams, without being satisfied that a paying business will soon follow this new route, increasing day by day, until Southern Kansas will do all her business in Lawrence.\(^{53}\)

At this time Lawrence was second only to Leavenworth among Kansas cities in commercial importance. The rise of Kansas City to regional dominance, however, began with the construction of a key railroad bridge across the Missouri River in 1867. Kansas City, Missouri became the regional railroad and urban center with a population of more than


\(^{52}\) Andreas, 311-312; and Dary, 170.

\(^{53}\) Dary, 129.
32,000 in 1870 and more than 56,000 in 1880.54

The period of greatest commercial construction activity on Massachusetts Street occurred during the years from 1864 to 1873. After Quantrill’s raid, the city permitted only stone or brick buildings on Massachusetts Street because of the danger of fire in the close-packed commercial area. Merchants rebuilt their commercial buildings with stone or brick walls and cast-iron fronts.

The settlement pattern north of the Kansas River directly reflected rapid growth during the brief city-building period. Commercial and residential districts developed with the construction of the first permanent buildings north of the river and the districts established many of the enduring families and social institutions of the community. Two small intersecting commercial districts with residential districts paralleling the railroad tracks and the Kansas River evolved. Along with the businesses, North Lawrence consisted of residential neighborhoods, churches, homes, and gardens along with the Kansas Pacific Railroad repair shops and the Delaware grist and sawmill.

Sixty-two buildings remained on Massachusetts Street in 1994 that date to Lawrence’s city-building period.55 Many of these buildings underwent remodeling in later years and their present appearance no longer represents the architecture of the nineteenth century. On the south bank of the Kansas River, there are a number of nineteenth and twentieth century industrial and manufacturing buildings. Interest in the waterpower of the river began in the mid-nineteenth century, but waterpower was not of practical importance until later in the century.

Residences
Throughout the history of Lawrence, development of platted additions and subdivisions provided an underlying geographical structure for urban growth. At the end of the settlement period, developers platted four additions in 1863 — Babcock’s, Lane’s First, Oread, and Solomon’s additions. The post-war boom required additional subdivisions — 14 during the city-building period: Babcock’s Enlarged and Lane’s Second additions (1865); Simpson’s and South Lawrence (1866); Earl’s Addition (1867); West Lawrence (1869); Cranson’s Subdivision (1870); North Lawrence (annexed 1870); Christian’s, Lane Place, Northeast Central, and Wilson’s (1871); and Smith’s and Taylor’s (1872).56

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During this period, the school board erected the first permanent public school buildings in Lawrence: Central in 1865; Quincy in 1867, enlarged in 1871; New York School in 1869; Vermont in 1870; and Pinckney in 1871. As community landmarks, schools helped to define the identity of residential neighborhoods. The Board of Education erected two public schools in North Lawrence in 1868. They were known as the Fifth and Sixth Ward schools until the names changed to Lincoln and Woodlawn in 1890. The board replaced Lincoln School in 1916; that year this new building, along with McAllaster and Cordley schools south of the river, all featured the same plan.\(^{57}\)

The most important educational institution in Lawrence was the University of Kansas, which held its first classes in the fall of 1866. Identified as a symbol of community pride and distinction from the beginning, the University became a dominant economic institution after the turn of the century. Eventually, the demand for housing near the University of Kansas stimulated development near Mount Oread.

Examples of landscape architecture such as the city park system and Oak Hill Cemetery expressed significant community values and enhanced the pattern of residential development in Lawrence. The original Lawrence survey plat of 1854 reserved four large tracts for parks. Only South Park at the end of the Massachusetts Street commercial area and Clinton Park in the northwest part of the original town remain. Located in the center of historic Lawrence, South Park resembles a New England village green. As the central public space in the developing town, South Park was the site of baseball games, band concerts, and public speeches. Properties adjoining the park enjoyed higher property values than nearby property of equal size, testifying to the value of South Park as an amenity.

During the mid- to late-nineteenth century, the neighborhoods now known as Old West Lawrence and Pinckney formed one residential district. Similar economic, social, and architectural trends that developed after 1863 shaped the residential neighborhoods of East and North Lawrence and differentiated these districts from West and South Lawrence. During the brief period from 1865 to 1873, many new modest wood-frame houses in East and North Lawrence housed workers on the railroad and in associated manufacturing, agricultural processing, and business enterprises.\(^{58}\)

\[^{57}\text{Caldwell; and "Lincoln School is in 33rd Year," Lawrence (KS) Journal-World, 13 November 1948.}\]

\[^{58}\text{Benjamin and Enslinger, 15; and Wolfenbarger, "East Lawrence Survey," 11.}\]
City-building in Lawrence ended in the nationwide financial panic of 1873. The popular sentiment expressed in a *Lawrence Tribune* editorial on March 14, 1873 – that if more County bonds were approved, they should encourage manufacturing rather than railroads – reflects the end to the boom and the beginning of a shift to the development of local manufacturing. By this time, even the most optimistic booster realized that Lawrence was losing the competition with Kansas City for railroad connections, population, and economic growth.

The recession of the 1870s had its origins in the September 18 failure of the well-known New York investment firm of Jay Cooke and Company. Two days later, the New York Stock Exchange closed and credit became difficult to obtain. The impact on Lawrence was catastrophic. During the boom, the city and county issued a total of $900,000 in bonds to support railroad construction. After 1873, this debt became a crushing tax burden. In 1874, a drought and grasshopper invasion devastated the farms of Douglas County. Residents began to leave for more secure settlements to the east or possible opportunities in the West. By the time of the State census in 1875, Lawrence showed a loss of 1,052 residents, while the population of Douglas County declined by 2,087. By 1877, all five banks in Lawrence either failed or reorganized. Because of the recession, the population of Lawrence in 1880 (8,510) was only slightly larger than in 1870.

From 1874 to 1899, a pattern of slow population growth and building construction continued with an economy based on agricultural processing and manufacturing. Lawrence also functioned as a market town for agricultural businesses in Douglas County in a regional economy dominated by the nearby larger cities of Kansas City, Missouri and Topeka, Kansas. There was little increase in the overall population. The town's population in 1890 was 9,997. The rate of growth was even slower in the 1890s and by 1900 the population was only 10,682. In 1895, the editor of the *Lawrence Daily Journal* admitted that Lawrence was "...a little slow and conservative."60

When completed in 1879, the dam on the Kansas River provided waterpower for small manufacturing concerns. Among them were the Consolidated Barb Wire factory and the Wilder Brothers Shirt Factory. The dam and these two factories are surviving structures that represent the late nineteenth century period of industrial development in Lawrence. Although the Lawrence dam was unique as a power source in Kansas, manufacturing in Lawrence was fairly typical of local industry in the state and region. As industry consolidated in the late nineteenth century, the dam helped Lawrence retain enterprises

59 Nimz, 81; and Dary, 186-187.
Barbed wire manufacturing became the most important industry in Lawrence when the Consolidated Barb Wire Company completed a large new building in August 1884. In later years, "... more of the wire used by Kansas farmers came from the Lawrence plant than from all other sources combined, and the company sent miles of wire to Indian Territory, Colorado, New Mexico, Wyoming, Utah." Despite its success, the company ownership changed in a forced sale in January 1899 to the American Steel & Wire Company. When the Lawrence plant closed on March 21 that year, more than two hundred men lost their jobs. The Topeka Capital referred to the closing as one of the greatest misfortunes that had happened in Kansas.  

Except for the administration of limited police and fire protection, the city provided few municipal services in the nineteenth century. Inadequate water supply and sewage systems resulted in recurring sanitary problems. Gradually, an effort grew to address these problems. The Lawrence Journal on April 5, 1888 noted growing interest in "... an intelligent and complete storm water sewerage of the whole city." A. L. Selig, elected mayor in 1891, became known locally as the leader who provided Lawrence with "the best system of sewage of any city its size in the West." When individual wells and cisterns proved to be inadequate, a franchised company organized to distribute water. Although the central water supply system went into operation in 1887, the privately capitalized utility struggled to solve the problems of quality and supply. Water quality and distribution were not satisfactory until the city took over the system in 1916.  

Electricity was first generated in Lawrence in 1885 at the Pierson and Sons' flourmill. This mill was near the Kansas River at the north end of downtown. Planning for electric services began on July 13, 1887 when a Professor Marvin surveyed the businesses on Massachusetts Street to determine their demand for electrical power. Later in 1888, the Lawrence Gas, Fuel, and Electric Company acquired the Pierson dynamos along with another plant installed by the waterpower company. By August 31, 1888, Lawrence had fifteen electric streetlights along its main thoroughfares. Although the University had a few electric lights in 1888, engineering students installed the first lighting system in 1891.  

**Commerce**

Most of the significant commercial buildings associated with this period survive in the downtown, some are in North Lawrence and a few are in several residential neighborhoods.
Most of the commercial buildings on Massachusetts Street had been completed by 1873. Economic recovery from the recession began in late 1877 and continued through 1884. Information from the downtown survey indicated a period of modest prosperity during the 1880s. During this period, commercial construction occurred at the south end of Massachusetts, on New Hampshire, and on the cross streets. Commercial and institutional buildings were usually brick and/or stone. Masonry was more durable and fire-resistant. Before the advent of concrete, builders used stone in large quantities because it was locally available.

Detached from the Massachusetts Street business district by just two blocks, the neighborhood commercial buildings at 14th and Massachusetts include two generations of businesses. Neighborhood businesses were particularly common in East Lawrence, but such businesses also appeared in the West Lawrence and Oread neighborhoods. This pattern of mixed commercial and residential uses preceded later, segregated patterns dictated by automobile routes and zoning. At the end of the century, more commercial specialization occurred. In North Lawrence, for example, businesses provided goods and services only to the surrounding neighborhoods and the agricultural hinterland north of the river. By that time, clothing, drug, furniture, and hardware stores as well as attorneys and physicians were concentrated south of the river.65

Residences
Platting in Lawrence depended on local economic and population growth trends. The street railway reorganized in 1884 extended south to 19th and Massachusetts and down Tennessee to 17th Street. There were connections to Bismarck Grove in North Lawrence and to the Santa Fe Railroad Depot in East Lawrence.66 The dates of the seventeen additions recorded in the last decades of the nineteenth century reflect years of relative prosperity during the 1880s followed by slower growth in the 1890s. These included Bew's Addition, Doane's Addition, Sinclair's Subdivision (1881); Frazier's Addition in North Lawrence, Sinclair's Addition, Steel's Addition (1884); Walnut Park in North Lawrence (1885); Moreland Place (1886); Haskell Place, Logan Place, Raymond Place, South-view, University Place (1887); University Place Annex (1888); Rhode Island Street Extension (1891); and, Wilder's Addition (1897).67

The construction of several large houses on multiple lots in the area of West Lawrence south of 6th Street reflects the accumulation of wealth by a few leading residents of Lawrence. These homes now form the key contributing buildings in the Old West Lawrence

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65 Barbara Anderson, “North Lawrence Survey Report” (cultural resource report for City of Lawrence, Kansas 1996), 12. City of Lawrence, Kansas.
67 Hernly, Appendix B, 214.
Historic District. New architectural styles introduced during this period and earlier styles continued to be constructed. While a few of the prominent late nineteenth century residences are of brick and stone, most residences were of wood-frame construction. Residential construction also incorporated a wide variety of materials and new services into more elaborate and sophisticated homes. Machine-produced ornamentation, window glass, terra cotta, brick, plaster, and paint were available in varied and durable forms. "Sanitary" plumbing, forced-air furnaces, and gas and electric lighting were innovations that made up a higher percentage of the cost of a home.68

Both East and North Lawrence depended on their proximity to the riverfront manufacturing district on the south bank of the Kansas River. The surviving buildings constructed in East Lawrence during the 1880s and in the 1890s reflect a departure from the inactivity of the late 1870s. The same pattern of population stability and slow growth occurred in North Lawrence.

Compared to East and North Lawrence, there was much more residential construction during this period in the Oread neighborhood between Massachusetts Street and the University campus. The Oread neighborhood developed from the edges inward with early commercial development on Massachusetts and university-related development on Louisiana Street. Reportedly, Oread had residents of "diverse racial makeup" and families of all economic and social classes ranging from laborers and dressmakers to physicians and university professors. Students at the University of Kansas rented rooms in the adjacent neighborhood, although some complained, as one did in 1884, ". . . it is a long, cold climb to get to the university, especially hard on young women." The university did not build its first campus dormitory until 1923.69

Established on the east edge of town in 1865, after the large number of deaths resulting from Quantrill's raid in 1863, Oak Hill Cemetery formed a significant cultural landscape in Lawrence. The new cemetery augmented Oread, the community's first cemetery on the west side of town. The beautifully landscaped and maintained Oak Hill Cemetery demonstrated a civic pride and cultural sophistication appropriate for the new post-war "city." And, although Lawrence did not develop as expected, the new cemetery still ". . . provided a sense of social order and continuity" from the city-building period to the early twentieth century.70

68 Benjamin and Enslinger, 17-18; and Gwendolyn Wright, Moralism and the Model Home (Chicago: University of Chicago Press, 1980), 89.
The curving lanes and paths took advantage of the natural rise and fall of the land. The circular drive at the top of the main hill provided a northern panorama of the Kansas River valley. Their arrangement of large lots were planned to emphasize family monuments, and they [the designers] used the natural beauty of the location, along with the trees, shrubs, and flowers that they added, to create the effect they desired.71

As residential neighborhoods expanded, other public spaces and landscapes, such as Bismarck Grove and the Haskell Institute, developed during the late nineteenth century. Bismarck Grove was a tract in the countryside originally associated with the Kansas Pacific Railroad repair shops on the east side of North Lawrence. The grove became a popular community gathering place and hosted such formal meetings as the Odd Fellows Lodge convention in 1876, a national temperance convention in 1878, and regional fairs held by the Western National Fair Association from 1880 to 1888. Because of management problems and low farm prices, the association discontinued the fairs. Eventually, Captain W. S. Tough purchased the grounds in 1900 for use as a supply station for his horse and mule sales business in Kansas City.72

Just beyond the southern city limits, the Haskell Institute, a national Indian Training School, opened on September 1, 1884. By January 1885, the boarding school had 280 students. The Institute erected three stone buildings in the late 1880s. Because the school founders envisioned a self-supporting institution to train Native American youth in the skills of agriculture, the property included cropland and pastures. The campus setting in a pastoral landscape survives to the present.73

A Quiet University Town, 1900-1945

In the early twentieth century, the town’s population grew at a slow, gradual rate. There were 12,374 Lawrence residents in 1910; only 12,456 in 1920; 13,726 in 1930; and 14,390 in 1940. While Lawrence did not lose population, the town’s rate of growth was much slower than the larger urban centers of Kansas City and Topeka.

By the turn of the century, Lawrence had matured; its commercial and industrial interests were stable. In 1910, a promotional issue of the Lawrence Daily Journal boasted that the town was “...the trading metropolis for a rich and populous agricultural county.”74

71 Ibid., 243.
74 Middleton, 109.
this period, there was a trend toward centralization of some types of businesses in the downtown, although small neighborhood businesses also proliferated. At the same time, the town lost many of its most important manufacturing establishments. A 1940 assessment of manufacturing in Lawrence revealed four of the surviving nineteenth century enterprises depended on agricultural products (flour and feed milling, vegetable canning, vinegar and dairy products).\textsuperscript{75}

During this period, city leaders made some long overdue improvements in the urban infrastructure. Local publisher E. F. Caldwell boasted in 1898 that, "... a complete system of water works has been put in, uniform street grades have been established, a number of streets have been macadamized, a great mileage of curbing and guttering, and stone and brick sidewalks laid." Despite Caldwell's boast, macadam or gravel paving had never been satisfactory. During the 1890s, there was simultaneous agitation for paving the streets and for building up a fund for an electric trolley transportation service. Paved streets were necessary for efficient trolley operation and brick was the preferred paving material if it could be obtained locally. After the city made a commitment in the summer of 1899 to pave Massachusetts Street, the McFarlane brick plant in Lawrence expanded to provide durable paving brick. John and Ben McFarlane, along with other prominent citizens, became directors of the Lawrence Vitrified Brick and Tile Company that operated into the 1920s.\textsuperscript{76}

The transportation system matched improvements in public facilities. Beginning first with the downtown commercial area, the system encouraged the development of outlying residential neighborhoods. After the great 1903 flood, the horsecar street railway ended its operations. Six years later, the Lawrence Light and Railway Company organized to build an electric trolley system for Lawrence. Besides the main route from the Union Pacific Railroad Depot to the southern end of Massachusetts Street and branches on Indiana and Mississippi streets to Kansas University, in 1910 a new line extended to Woodlawn Park in East Lawrence. Later, in 1916, an electric interurban railway, the Kansas City, Kaw Valley and Western, began business. This line ran from the North Lawrence depot along the north side of the Kansas River to Kansas City, Missouri. The streetcar system in Lawrence reached its maximum extent during the years from 1922 to 1927. After that, the company gradually replaced trolleys with buses. In 1935, passenger service on the Kansas City interurban ceased.\textsuperscript{77}

In 1909, Lawrence had about one hundred automobiles; the owners formed an auto club. Later, in the 1920s and 1930s, growing use of the automobile stimulated the dispersal of

\textsuperscript{75} Ibid., 194, 197.
\textsuperscript{76} Caldwell; and Middleton, 165, 167.
\textsuperscript{77} Thor, 1.
retail services along traffic corridors. By the end of 1927, two paved roads connected Lawrence to Topeka, Kansas and to St. Joseph, Missouri. Along with the proliferation of automobiles during this period, the opening of a municipal airport in 1929 represented another new transportation trend.

In 1921, the Kansas legislature passed the first state zoning enabling act, which authorized cities with a population over 20,000 to implement zoning classifications. Although having a much smaller population, the leaders of Lawrence also wanted zoning authority and, in 1927, the revised State law allowed towns of all sizes to zone land uses. During this period, public concern about the commercial development along 9th Street and adjacent to the University of Kansas led to the appointment of the Lawrence Planning Commission in 1925 and the institution of the first city zoning ordinance in June 1926. Community leaders responded to a general alarm "Kansas University would be completely surrounded by 'business houses' unless some sort of regulations were adopted." By 1930, the first Lawrence City plan pointed out,

\[\ldots\text{the city has spread from the original site to the hills on the west beyond the promontory on which the University is located on the south, and to the tributary on the east, with some population beyond the valley outside the corporate limits. It has also covered a portion of the flat land to the north of the Kaw River.}\]

That same year, 15 percent of the population of Lawrence (13,708) was north of the river; 35 percent was north of 12th Street and west of Massachusetts Street; 17 percent was north of 12th Street and east of Massachusetts Street; 17 percent was south of 12th Street and east of Massachusetts Street; and 16 percent was south of 12th Street and west of Massachusetts Street. Planners recommended construction of a major thoroughfare system to provide for "\ldots the increasing demands of present day automobile traffic. \ldots\" but did not implement a system. They also noted that there was "\ldots no direct or convenient approach to the University of Kansas from the growing district on the south side." Following the planners recommendation, a street opened later along the south route of the streetcar line. This new access to the University facilitated the development of University Place and other residential additions south of the campus.

Like other Kansas communities, the Great Depression profoundly affected Lawrence.

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78 This phase of urban development has not been researched and documented.
79 Dary, 263, 326.
80 Hernly, 133; and Bartholomew and Associates, Comprehensive Plan: Lawrence, Kansas, volume 1 (St. Louis: Bartholomew and Associates, 1963), 40-41.
81 A City Plan for Lawrence, Kansas: Report of the City Planning Commission (Kansas City, MO: Hare and Hare, 1930), 6.
82 Ibid., 10, 18, 38.
Enrollment dropped at the University of Kansas in the early 1930s and the University cut faculty salaries. Enrollment later increased and, by 1939, the Lawrence Journal-World pointed out the importance of the University as "one of the city's major industries." Beginning in 1929, there was virtually no construction for years except for those projects financed by the State and federal governments. In the 1930s, federal programs assisted in improving the municipal water system, enlarging the public library, enhancing parks, and paving streets. Between 1933 and 1937, the Public Works Administration initiated twelve projects in Lawrence and Douglas County.83

**Commerce**

The first two decades of the twentieth century were years of prosperity and modest growth in Lawrence as manifested in the public buildings constructed during this period. In downtown Lawrence, the Douglas County Courthouse, the old Public Library (1904), and the old Post Office (1912) are landmarks from these years. Of the surviving downtown buildings dating from this period, almost twice as many date to the years from 1900 to 1920 as compared to the next twenty-five years. These different phases of commercial development reflect a stable local economy and gradual population growth followed by the national financial depression of the 1930s.

**Residences**

As the Lawrence Journal boasted in 1910, "Lawrence is conceded on all hands to be the most beautiful residence city in Kansas. Its homes present uniformity in good architecture, a tasteful construction and delightful surroundings." Few of these homes were for rent, "...most of them having been built up to be occupied by the owners, which means good construction, and well-kept grounds."84 Larger residences replaced many smaller houses in the Oread neighborhood.85 From the late nineteenth century, younger and more prosperous residents tended to move to new residential districts in West and South Lawrence. The 1922 School Survey reported,

> ... the desirable vacant lots available for future residences are for the most part west of Illinois street and north of the University, and in the territory south of the vicinity of 15th street ... It is an interesting fact that Lawrence is only about 50% occupied. Not more than one-half of all the lots in the city are occupied.86

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83 Nimz, 95; Dary, 331-334.
85 Gray, 10. Early in this period, the city assigned numbers instead of names to the east-west streets. See Lawrence City ordinance #973, "Renaming certain streets in Lawrence, Kansas," 13, December 1913.
86 School Survey of Lawrence, Kansas (Lawrence, Kansas State Printing Plant, 1922), 56.
The most densely settled area of the city was a zone three blocks wide on either side of Massachusetts extending south to the vicinity of 19th Street. During this period building continued in West Lawrence and Oread.

In 1895, the removal of the Leavenworth, Lawrence, and Galveston railroad bridge over the Kansas River hurt economic prospects in East Lawrence. Another blow to economic vitality and residential property values was the closing of the Barb Wire manufacturing plant in March 1899. The loss of jobs in the manufacturing enterprises located on the Kansas River also contributed to the neighborhood's decline. New residential construction continued in the south part of the neighborhood with few new homes constructed in the older, north part of the neighborhood.

Beginning in the early twentieth century; downtown businesses as well as residential neighborhoods in West and South Lawrence benefited from the growth and increasing importance of the University of Kansas while East and North Lawrence did not benefit from the university's growth. The "great floods" of 1903 and 1951 damaged North Lawrence. When the Kansas River inundated North Lawrence in 1903, residents fled across the bridge south into Lawrence and, after the bridge washed away, most were evacuated by small boats. On June 1, "the river was ten miles wide just east of Lawrence." The flood destroyed part of the original North Lawrence town site. The river geographically and socially separated Lawrence. According to the Lawrence Social Survey published in 1917, the floods of 1903, 1904, and 1908 intensified the "social and economic chasm between the two sections of the community."

The development of new residential districts south of 15th Street was a significant trend during this period. In the movement toward southern and western development, C. B. Hosford was a leader who began developing real estate in 1906 and incorporated his investment and mortgage company in 1910. Later, the Lawrence Journal World concluded that, "...one of the principal contributions to the city has been the residential development carried on by this firm. Eight additions and sub-divisions have been developed and placed on the market by them." Charles E. Sutton developed Breezedale Addition at the southern end of Massachusetts Street and the streetcar line where the street intersected with 23rd. On the site of the Poehler estate, Elmhurst, Sutton built five homes of noticeable architectural character between 1906 and 1913. This was the first attempt in Lawrence to create an identifiable suburban neighborhood. However, the addition, situated far from the center of Lawrence near the pastoral landscape of Haskell Institute, grew slowly over the next three decades. To the east, at the terminus of the streetcar route in far eastern

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87 Quastler, 344, 347.
89 Lawrence (KS) Journal World October 10-11, 1929, 8.
Lawrence, developers platted the Fairfax and Belmont additions at the intersection of 13th and Prairie streets.91

South of the University, the platting of University Place Addition in 1887 resulted from a proposed streetcar route on Louisiana, Illinois, 17th, and 18th streets. Development in the addition did not occur until after 1910. E. W. Sellards promoted University Place in 1914 as a neighborhood offering "... a beautiful view, fresh air, near the University — an Ideal spot for a home."92 The oldest extant residence is the Benjamin Akers residence constructed in 1874. Another landmark is "The Outlook," built by banker J. B. Watkins in 1913. The mansion is now the University Chancellor's residence. Several other homes constructed from circa 1910 to the 1930s were the homes of University professors

Although Professor F. O. Marvin presented the first plan for the original University of Kansas campus in 1897, the 1904 George Kessler plan for long-range campus development was more significant. Kessler proposed organizing future building around a huge central administration building. The construction of Strong Hall created this focal point. Kessler also projected the development of "Dormitories or Other Buildings," "Club Houses," and "Homes of Faculty" on the west ridge of Mount Oread.93 In this respect, the Kessler plan foreshadowed the eventual development of both University facilities and residential districts west of the campus. Individual professors in the School of Engineering and the Department of Architecture influenced campus planning and the design of residences west of campus.

In the chronological development of residential subdivisions in Lawrence, there was a pause between the prosperous early decades and modest growth during the 1920s and 1930s. Twenty-nine additions and subdivisions recorded between 1901 and 1919 were primarily in the south part of Lawrence. Only seven new plats date to the period after 1920 — the first in 1925 and the last two in 1938. These included some of the first residential developments adjacent to the University to the west and the first to break out of the western grid pattern. Given Court, platted in 1926, had the first looped and curving roads. Westhills Number 1, platted in 1931, had the earliest winding roads with lots not strictly oriented to the four cardinal directions. Colonial Court, platted in 1935, had the first true cul-de-sac in the City's residential development.94

With an innovative curvilinear street pattern and irregular building orientation, the development of University Heights west of the campus demonstrated modern trends in suburban design and residential architectural styles. Originally subdivided in 1909, the

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91 Hernly, 112, 110.
92 "University Place Homes Tour," (brochure, 1992) Kansas Collection, Spencer Research Library, University of Kansas.
93 Marvin's plan was discussed in the University Weekly 13 November 1897; and Taft, 164-165, 188-189.
94 Hernly, Appendix B, 215.
subdivision underwent re-platting in 1928, and its main street was renamed Crescent Road. The City of Lawrence annexed University Heights in 1947.95

In the period after World War I, a number of factors imposed controls on suburban development. Covenants became commonplace, particularly restrictive covenants that prevented the sale of property to ethnic and religious minorities, which came into widespread use across the nation. In Lawrence, some properties were subject to deed restrictions, which prohibited sale or occupancy by "any other than a member of the Aryan race." The 1948 decision of the United States Supreme Court in the case of Shelley v. Kramer outlawed the restrictions regarding the sale of property to a person of a minority race.96 After the war, developers began to set standards relating to lot sizes, street frontage, house dimensions, placement of outbuildings, architectural styles, and other landscape features. At the same time, the advent of zoning ordinances further defined the newly developing areas of towns. As previously mentioned, the city established the first zoning ordinances in Lawrence in 1926. The purpose of the ordinances was to mitigate nuisances, provide protections to increase property values and to address health and safety issues. Zoning routinely established "single family residential" as the highest zoning classification. By separating commercial, industrial, and residential uses, zoning prevented multi-family, industrial, and commercial development from harming the property values of single-family neighborhoods.97 Subdivisions platted after World War I reflected this trend; usually they were entirely residential. In Lawrence, for example, several subdivisions platted west of the University allowed only single-family residences and excluded apartments, boarding houses, fraternity buildings, and sorority houses.

While such social and legal factors influenced the development patterns, advances in technology also shaped the built environment of Lawrence. August 22, 1922 marks the date of the completion of the first paved road between Lawrence and Topeka. Street improvements for automobile traffic divided West Lawrence. In 1944, the proposed plan to make 6th Street a through route for east-west traffic on Highway 40 to reduce congestion at 7th and Massachusetts created controversy. Although the PTA and Board of Education opposed this routing in front of Pinckney Elementary School, in 1950 the State highway commission authorized the relocation. To solve the traffic hazard, the commission agreed

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97 Elizabeth Rosin and Sally Schwenk, "South Lawrence Survey Report," (cultural resource report prepared for the City of Lawrence, Kansas, 1999), 18. City of Lawrence, Kansas.
to construct a pedestrian underpass with ramps opposite the school.\textsuperscript{98} Construction of this trafficway divided the Pinckney neighborhood from what is now known as Old West Lawrence. The paving of the intersections of highways 10, 73W, and U.S. Highway 40, just north of the city limits, affected the North Lawrence neighborhood. This improved the connection between the road leading out of Lawrence and the main road linking Kansas City and Topeka.\textsuperscript{99}

**Post-World War II Lawrence**

The outbreak of World War II brought dramatic changes in the city's fortunes. Sunflower Ordinance Plant, which opened in nearby Johnson County in May 1942, brought three thousand new workers to the area. Most of them lived in Lawrence. After the war ended, the large number of veterans returning to finish their education at the University of Kansas launched the modern era in local history. Dramatic population growth and economic development characterized the post-World War II period in Lawrence. In the decade from 1940 to 1950, the population grew by more than 26 percent — from 14,390 to 18,638 residents. The student population increased from 3,412 in 1945 to 4,713 in 1950. By 1960, the town's population reached 32,858.\textsuperscript{100}

**Commerce**

New industrial enterprises and remarkable growth at the University ignited a modern boom. To compensate for the inaction of the depression and war years, a Civic Action Committee organized in 1945 to promote the "Lawrence Victory Plan" for community improvements. The plan provided for seventeen projects including new facades on downtown business buildings, an improved airport, additional city parks, city water improvements, and an effort to attract more visitors.\textsuperscript{101} As the Lawrence Journal-World reported on August 19, 1948, "The City of Lawrence is having its face lifted." On Massachusetts Street, some storefronts were "completely torn down and modern structures put in their place." The expected value of construction surpassed $1 million by the year's end.\textsuperscript{102} In 1949, the city revised its original zoning ordinance. This change instituted segregated uses and rezoned portions of the older residential districts; the revisions discouraged investment in the city core.

The construction of the Kansas Turnpike between Kansas City and Oklahoma further stimulated the economic development of Lawrence, particularly north of the river. The route for the high-speed toll road roughly paralleled U.S. Highway 40 on the north side of the Kansas River and linked the capital city of Topeka with the business centers of Kansas.

\textsuperscript{98} Lawrence (KS) Journal World, 22 May 1944; 7 November 1944; 4 September 1950.  
\textsuperscript{99} Ibid., 14 January 1930.  
\textsuperscript{100} Nimz, 95; Hernly, 158; and Wolfenbarger, "Lawrence Downtown Historic Building Survey," 51.  
\textsuperscript{101} Dary, 343-344.  
\textsuperscript{102} Nimz, 95.
City, Missouri and Kansas City, Kansas. The completed turnpike just north of the Lawrence city limits opened to motorists on October 21, 1956.103

In 1951, the Lawrence Chamber of Commerce boasted a 60 percent increase in the city's population since 1940. From 1949 to 1951, the industrial payroll increased 40 percent. A Chamber brochure promoted Lawrence as a site for plant relocation because the federal government recommended that "... industry move inland from heavily industrialized coastal areas." Lawrence offered a mid-America location, construction sites on mail-line transportation, proximity to markets, and "... a ready pool of skilled craftsmen and dependable labor."104 A Westvaco sodium phosphate plant and Cooperative Farm Chemicals nitrogen fertilizer plant opened in 1950 and 1951 east of Lawrence. In 1951, FMC Phosphorous Chemicals built a plant on the east edge of North Lawrence. Stokely Foods operated a canning plant on the east border of East Lawrence. During the Korean War, the federal government reactivated the Sunflower Ordinance plant in western Johnson County. Because of the plant, the National Defense Production Administration designated Lawrence as a critical defense area in 1952 and relaxed wartime economic controls on building materials.105

**Residences**

After 1945, suburban residential development in Lawrence resembled that of other communities throughout the nation. Home ownership, particularly for white middle-class families, became a public policy goal. Federal programs such as the Federal Housing Administration (FHA), which revolutionized home loan financing with the long-term, low-interest, amortized mortgage; the G.I. Bill, which allowed home purchase without a down payment; and the introduction of personal income tax deductions for mortgage interest provided a foundation for extraordinary residential construction and suburban expansion.106 The Housing Act of 1949 stimulated investment in large housing developments. A prominent example in Lawrence was Park Hill, a subdivision with one hundred homes located southwest of the intersection of 23rd and Vermont streets. On October 3, 1949, City leaders proposed the annexation of West Hills, Belmont, and Fairfax Additions in order to reach the population of fifteen thousand necessary for state designation as a first class city.107

105 Hernly, 151.
106 Ibid., 157; and Stan Hernly Architects, "West Lawrence Historic Resources Survey Report," (Cultural resource survey for the City of Lawrence, 1997), 5.
107 Hernly, 144, 149-150, 159; Lawrence Journal-World 3 October 1949.
During the post-war period, residential developers platted over 145 subdivisions and additions between 1945 and 1964, and from 1953 through 1959, the city averaged fifteen additions per year. Most of this new development occurred to the south, southwest, and west of the town center and included commercial centers as well as residential areas. 6th, Iowa, and 23rd streets became the main commercial arteries, serving the growing suburban developments.

After 1945, suburban planning dramatically changed the pattern of residential development so that developers laid out subdivision with long blocks, curved streets, T-intersections, and cul-de-sacs rather than streets arranged on a grid. In South Lawrence (south of 19th Street), Owens Addition (1951); Olmstead Subdivision (1953); Mitchell Addition (1953); Edmonds Addition (1954); Meadow Acres (1954); Southwest Addition (1954); Schaake Subdivision (1954); University Terrace (1955); and the James-Farr Addition (1956) demonstrate this trend. All of these developments contrast with the pre-war grid pattern apparent in the University Place additions north of 19th Street. However, most of the post-war additions retained an axial orientation, dominated by long, parallel east-west streets. Each subdivision plan incorporated extensions of major streets. Arterial and secondary streets run north and south at varying intervals. The most striking difference is the variety of lot sizes found both within and between the post-war additions.

During the 1960s, the population of Lawrence grew from 32,858 in 1960 to 45,698 in 1970, and to 53,029 in 1980. Nearly two thousand new industrial jobs were created in the 1960s. During this period, the platting of 266 subdivisions surpassed that of the 1950s building boom.

By the mid-1960s, the plan of suburban residential subdivisions began to change from the form of the post-war suburb. "Planned Unit Development" became important. These medium-density developments grouped apartments, townhouses, and single-family houses together and reserved green space and other areas for common use. Super blocks, served by winding streets and cul-de-sacs emerged as the most common design pattern.

City leaders responded to this growth and development by engaging one of the most prominent urban planning firms of the time, Harland Bartholomew and Associates, of St. Louis, Missouri. Beginning in 1963, the firm prepared a comprehensive plan, Guide for Growth: City of Lawrence, Kansas, 1965-1985. The plan consisted of six preliminary reports and a final report of some 130 pages. While the future projections of needs developing

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108 Hernly, 166.
109 Rosin and Schwenk, 24.
110 Ibid. 26.
111 Hernly, 174, 198.
112 Ibid.
from population and transportation growth were valuable, the emphasis on efficiency allowed little consideration for the significance of existing buildings and neighborhoods and historic preservation. For example, the Bartholomew plan focused on the central business district, stating "...remodeling and revitalization of its central area will surely increase the trade element of our city’s economy." Characteristic of a firm whose founder had extensive experience in the process of rebuilding cities through an approach known as urban renewal, the planners argued for physical improvements. "The present downtown, properly remodeled, can easily accommodate three or four times as many customers as it does today. It does not require a greater area; instead it demands a more intensive and efficient use of a smaller but more convenient area."\(^{113}\)

If the changes to traffic patterns and to Massachusetts Street suggested by Bartholomew and Associates had been implemented, the historic downtown district would have been very different. Instead, the effects of zoning instituted at this time affected the adjacent residential neighborhoods. In the land use plan section, the Bartholomew plan sought "...to encourage density in population in the central part of the city near the central business district and the University (preferably between them)." The planners went on to propose that high-density residential uses be concentrated between the University campus and the central business district." Actually, the land use plan adopted in 1964 provided for multi-family residential zoning on three sides of the Kansas University campus. That area extended to 9\(^{th}\) Street on the north, Vermont on the east, and to 19\(^{th}\) Street on the south.\(^{114}\)

The adopted land use plan in 1964 was followed by the adoption of a new zoning code in 1966. This zoning code was used by the City to implement the 1964 Plan. In 1997-1998, the City of Lawrence and Douglas County adopted a City/County comprehensive plan, Horizon 2020 the Comprehensive Plan for Lawrence and Unincorporated Douglas County. The 1966 Zoning Code was replaced in 2006 with a new Land Development Code – Chapter 20 of the Code of the City of Lawrence.


\(^{114}\) Ibid., 3-4.
Preservation Goals, Policies, and Implementation Strategies
Mechanisms are needed to integrate historic preservation efforts in all city and county planning processes. In addition, new policies and processes need to be developed to protect the visual character of areas that include historic resources and to inaugurate particular preservation and conservation initiatives that:

- encourage appropriate new infill construction in older neighborhoods and commercial centers;
- retain and create appropriate transition areas and buffer zones between historic districts, institutions, downtown, and commercial corridors, such as alleyways, landscape features, etc.;
- establish notification area boundaries and design issues in environs review; and
- encourage property maintenance.

**GOAL # 1: INCORPORATE PRESERVATION AS AN IMPORTANT COMPONENT OF THE CITY AND COUNTY PLANNING PROCESSES**

**POLICY 1.1: EXPAND HISTORIC PRESERVATION IDENTIFICATION, EVALUATION, AND PROTECTION PROGRAMS**

The basis of an integrated, community-based preservation plan is an inventory of the City and County’s historic assets. Effective preservation planning takes place when there is sufficient knowledge of the number, location, and significance of both above ground and buried resources. An historic resource survey identifies what resources exist, records their condition, and evaluates their level of significance. This knowledge can be used in a variety of ways:

- to develop programs and policies to protect significant resources from destruction or unsympathetic alteration;
- to determine the location and distribution of resources to aid in planning, development and incentive programs; and
- to establish funding priorities for further evaluation and protection efforts.
Implementation Strategies

a. **Expand the cultural resource survey process to identify important resources to be considered in all city and county planning processes.** Considerable research and publication, most of which occurred since 1984, documents the City of Lawrence’s architectural heritage. While these efforts identified most of the significant themes in local history, much of the research was not systematic or comprehensive — limiting a balanced understanding of the city’s history. There are individual properties and neighborhoods not yet identified that could have important roles in defining historic contexts of the city and the surrounding region. Specifically, the multiple property documentation form that establishes the context for historic properties in Lawrence ends at the period identified as “Quiet University Town, 1900-1945.” Many properties have achieved historic significance from 1945 to 1961, the fifty year mark established by the National Park Service for historic.¹

Very little survey work has been conducted in the unincorporated areas of Douglas County. Surveys should be conducted on a township-by-township basis. Special care should be taken to work with rural property owners to ensure proper notification is secured prior to conducting a survey.

b. **Update the existing National Register of Historic Places Multiple Property Documentation Form for Lawrence to include properties that have achieved historic significance since 1945.**

c. **Work with the State Historic Preservation Office’s interactive online database, the Kansas Historic Resources Inventory (KHRI), to establish an up-to-date survey database.** To facilitate analysis of survey information in the planning process, the city needs to bring the cultural resource inventory database up-to-date. KHRI contains all of the SHPO’s survey records and is fully searchable and available to the public. All future surveys in Lawrence and Douglas County should require consultants to enter the survey information into the KHRI system.

d. **Launch an ongoing effort to create National Register and local historic districts in the city with design guidelines to maximize the potential to stabilize and increase property values while protecting resources.** Properties listed in the Lawrence Register of Historic Places represent a small percentage of the city’s significant structures, sites, buildings, streetscapes, commercial centers, and cultural landscapes. As of 2011, the Lawrence Register includes only thirty-six individual properties and the Oread historic residential district.

e. **In conjunction with property owners, develop and implement a National Register, and State Register nomination plan for significant historic properties within the unincorporated areas of the county.**

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¹ In 2008, the National Park Service held an open meeting in Lawrence for stakeholders to discuss how the “Quiet University Town” period should end and be redefined to accommodate the period since 1945. The history of the city continues to be updated in the Lawrence Register of Historic Places and new properties are added each year to meet the current standard for “Nation’s Capital of Basketball.”
Multiple Property Documentation Form should be developed for the County identifying development periods and associated property types. Because of the potential issues with environs review, any property listed in the unincorporated areas of the county should only be listed upon completion of an environs definition that clearly defines the environs boundaries and design considerations. The property owner and adjacent property owners shall be consulted in the development of the environs definition.

f. Identify and evaluate, during the development review process, properties that are fifty years or older that will be affected by development proposals such as rezoning, platting, development plans, conditional use permits, and use permitted upon review permits. When properties are identified as “historic”, an assessment of historic integrity should be completed. If the identified property is eligible for listing in the Lawrence, Kansas or National registers, protection measures should be evaluated.

g. Working with property owners, develop a program to list as many eligible properties in the National Register and State Register as possible, enabling property owners to utilize the federal and state rehabilitation tax credits.

h. Reevaluate the city’s demolition ordinance and investigate streamlining the 30-day waiting period by developing a policy for properties which are potentially eligible for listing. Currently, city ordinances provide protection of significant resources from demolition only for properties listed individually or as contributing to a designated historic district in the Lawrence Register. Current ordinance provisions require a thirty day arbitrary delay before demolition can occur. However, there is no process to evaluate the significance, work with the property owner, or to seek alternative solutions. As a convenience to property owners and from a preservation perspective, a demolition policy that by ordinance outlines a process for public participation and consideration of all issues affecting a proposed demolition will benefit the city. For example, some cities, due to the large amount of significant historic properties that have not been inventoried or locally designated, have amended their ordinances to provide for demolition review for all properties in the city that are over fifty years in age. In these models, city staff conducts a preliminary review to determine if the property has historical integrity and significance. If not, the demolition permit process proceeds. For properties that are significant or have the potential to be significant, the local historic preservation review commission (i.e. the Lawrence Historic Resources Commission) conducts a review. The review includes consideration of whether the property is economically viable, what will replace the demolished building/structure, and consideration of economic hardship based on a model developed by the American Planning Association.

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1 The National Park Service’s criteria for evaluation of historical significance exclude properties that achieved significance within the last fifty years unless they are of exceptional importance. Fifty years is the general estimate of time needed to develop the necessary historical perspective to evaluate significance.
i. **Explore alternative protection mechanisms used in other communities for protection programs for identified significant rural resources.** Lawrence and Douglas County should initiate successful programs for evaluation, prioritization, and preservation of selected significant rural resources. The county and the city should work directly with property owners to determine the most appropriate protection mechanisms.

**POLICY 1.2: DEVELOP OR MODIFY APPROPRIATE ZONING, BUILDING CODE, AND FIRE CODE REGULATIONS TO FACILITATE THE PRESERVATION AND REHABILITATION OF HISTORIC PROPERTIES.**

Zoning regulations are a key preservation tool as they contribute to patterns of neighborhood change and investment as well as disinvestment. Neighborhood preservation and revitalization efforts benefit from compatible land use regulations, including the existing zoning ordinances.

**Implementation Strategies**

a. **Investigate the possibility of creating additional conservation districts as an alternative protection mechanism and standard for environs review.** Conservation Districts established by overlay zoning can be a successful tool to creating buffer zones for historic districts. In particular, they can encompass and define the design issues related to environs review. They can strategically address design issues for new construction in areas that have a “sense of place” but do not meet the criteria for Local, State or National Register designation. Conservation Districts can also be implemented to protect potentially significant resources that are not yet fifty years of age and therefore ineligible for local, State or national designation. They can also be used to protect and stabilize areas that, with the use of incentive programs, may be upgraded to meet National Register, State Register, and local historic district designation criteria.

Design guidelines for Conservation Districts can be specifically tailored to promote the desired visual character and allowable special land uses of specific geographical areas. For example, in a Conservation District created to serve as a buffer to a historic district or as a transition zone between an older residential streetscape and a commercial area, limited design review of major changes – such as new construction and demolition – limits adverse changes to the character of the district. At the same time, it encourages property owners to make positive changes to their buildings or to erect new buildings that are compatible to the streetscape. Usually the scope of the review helps to maintain the appropriate size, scale, massing, materials, and building setbacks within the designated area.

In a Conservation District for properties that might in the future be eligible for local or National Register designation, guidelines might address avoiding irreversible loss of specific character-defining architectural elements as well as retention of the appropriate zoning.
The City of Lawrence established the Urban Conservation Overlay District to allow for the creation of conservation districts. One of the key elements in the creation of an Urban Conservation Overlay District is the development of design guidelines and the identification of contributing and non-contributing structures.

b. **Review and update existing city zoning to be compatible with existing or desired land use that promotes preservation of intact residential neighborhoods and commercial centers that have historical, architectural, and physical integrity.** Among the issues to be considered are:

1. consistency between overlay zoning and base land use zoning among contiguous properties;
2. flexible provisions for developing compatible new “infill” construction on vacant lots;
3. allowance of innovative preservation alternatives, such as additional or specialty uses including “bed and breakfast,” studios, and other professional uses;
4. appropriate design guidelines and site development controls to encourage quality rehabilitation and compatible new construction worthy of preservation in the future; and
5. effective procedures to discourage demolition of significant buildings and structures.

c. **Require new development in established areas of the city to use designs complementary to the adjacent streetscape.**

d. **Create transition zones and flexible links within Lawrence by using setbacks, alleys, parks, and open space in a way that is consistent with established patterns.**

e. **Adopt a rehabilitation code to address building code and fire code requirements in historic structures for the City of Lawrence and Douglas County.**

**POLICY 1.3: DEVELOP AND IMPLEMENT FORMALIZED PROCEDURES TO COORDINATE PRESERVATION EFFORTS AMONG CITY AND COUNTY DEPARTMENTS AND AGENCIES**

Economic development, land use and property management issues are the purview of a number of different county and city departments and quasi-public agencies to which government bodies have delegated certain programmatic responsibilities. To integrate preservation methodologies in a manner that assures they become part of the day-to-day program administration, it is necessary to develop formalized policies and procedures. The result should guarantee that the public receives information on related preservation policies, procedures, and ordinances when undergoing compliance with any
department or public agency’s processes.

Implementation Strategies

a. Establish formalized procedures for the Lawrence Historic Resources Commission (HRC) or the Historic Resources Administrator to review and comment on City planning activities.

b. Facilitate the integration of the development review process and the building permitting process with the design review process. Consider alternative processes for project review.

c. Require historic preservation elements as part of comprehensive, watershed or sub-basin, sector, neighborhood, and special area plans.

d. Implement consistent and systematic building and maintenance code enforcement.

e. Enforce environmental code.

f. Explore a demolition by neglect ordinance.

g. Adopt a rehabilitation building and fire code for the city and the county.

h. When possible, historic preservation issues should be represented in appointed positions. Representatives of these entities should also be considered as appointed members on the HRC.

i. Working with property owners, target significant cultural landscapes for park/green space designation on the National, State or Local Register.

j. Working with property owners, target open space designation to areas with probability for the presence of a high level of archaeological artifacts. Given the limited amount of resources for archaeological investigations, consideration should be given to those sites which have been documented by creditable historical research.

k. Include a preservation element in the City of Lawrence’s Parks and Recreation Master Plan.

l. Require review of new ordinances for their impact on historic resources and historic preservation efforts.
POLICY 1.4: IMPROVE EXISTING LOCAL AND STATE LAW DESIGN REVIEW PROCESS

Successful and proactive design review must be “user friendly.” Review standards and processes must be clear, concise, and consistently administered.

Implementation Strategies

a. Conduct ongoing inspection of work after HRC review.

b. Develop review process that promotes more consistent and objective interpretation of environs law.

c. Provide legal enforcement of HRC decisions.

d. Reconcile the differences between state law environs review and City of Lawrence’s environs review standards.²

e. Establish a recording process with the Register of Deeds to record National Register, State Register, and Local Register properties.

f. Investigate ways to simplify the design review and the state law review process through the integration of building permit applications, design review applications, and development review applications.

POLICY 1.5: ESTABLISH CLEAR, WORKING DEVELOPMENT AND DESIGN REVIEW PROCESSES WITH FEDERAL, STATE, COUNTY, PUBLIC, AND PRIVATE INSTITUTIONS LOCATED NEAR HISTORIC RESOURCES.

In addition to the local city design review process for designated properties, there are a number of federal and State programs that require review to determine the impact of proposed work on significant cultural resources. Conflict over private and public institutional development needs and surrounding commercial and/or residential neighborhood needs, is most successfully addressed by establishment of processes that include a defined public participation component that establishes when, where, and what type of city or county jurisdiction is applicable. The city or county can play an important role in initiating establishment of such processes, particularly in the context of development of neighborhood, sector, or special area plans.

² There are a number of differences between the State law requirements and the local ordinance requirements. One of the main issues is that the standard of review required under the local ordinance places the burden of proof on the Historic Resources Commission in reviewing environs review cases while the state law places the burden of proof on the applicant. In cases that involve both local ordinance and state law review there is an inherent conflict.
Implementation Strategies

a. Develop and continue agreements regarding development policies for federal, state, public and private institutions such as the University of Kansas, Baker University, Haskell University, Lawrence Memorial Hospital, Lawrence School District, Townships, and Rural Water Districts, which are located near historic areas. Such agreements should include community expectations, a public participation process, and development requirements, including development of expansion boundaries.

b. Formulate Neighborhood, sector, and special area plans that establish clear boundaries for commercial areas as well as institutions.

c. Form stronger partnerships between the Campus Historic Preservation Board and the Lawrence Historic Preservation Commission.

POLICY 1.6: DEVELOP A PUBLIC RESOURCES POLICY THAT VALUES HISTORIC PUBLIC IMPROVEMENTS.

Participants in neighborhood planning processes and in the Preservation Plan workshops as well as cultural resource surveys identified streetscape infrastructure elements such as alleys, curbs, sidewalks, brick streets, bridges, etc. as important elements that define historic neighborhoods. Residents in historic neighborhoods note that choice of arterial and collector streets have a profound impact on residential neighborhoods. In rural areas, the selection of major new routes encourages development. Thus, the city and county should consider historic resources and their defining elements when implementing infrastructure projects.

Implementation Strategies

a. Create a comprehensive approach to infrastructure improvements on a neighborhood-by-neighborhood basis.

b. Protect and maintain existing brick streets, brick sidewalks, and hitching posts in the City of Lawrence.

c. Restore brick streets and sidewalks in the City of Lawrence.

d. Implement appropriate traffic calming measures in residential neighborhoods in the City of Lawrence. Traffic calming measures should be compatible with the character of the residential neighborhood.

e. Investigate and implement initiatives to improve parking in Downtown with minimal impact of older buildings.

f. Improve bicycle and pedestrian routes and rural trails.
g. Target Parks and Recreation tax revenues when appropriate for cultural resource projects on public lands.

h. Improve flood control to protect historic properties.

i. Develop a formal review process for all public improvements to determine the effects on historic preservation and/or historic preservation planning efforts.

Historic resources in the unincorporated areas of Douglas County are integral in defining the character of the county and the region. The ongoing preservation of significant resources and cultural landscapes can yield an improved quality of life and a sense of place for future generations. Specific preservation programs and processes are needed to assist in providing considerations of these resources in land use decisions to protect significant resources and to allow a balance between commercial, residential, institutional, agricultural, industrial, and natural land uses.

GOAL # 2: CONSERVE THE RURAL CHARACTER OF UNINCORPORATED DOUGLAS COUNTY IN STRATEGIC AREAS

POLICY 2.1: DEVELOP A PRESERVATION PROGRAM FOR THE IDENTIFICATION AND EVALUATION OF CULTURAL RESOURCES IN THE UNINCORPORATED AREAS OF DOUGLAS COUNTY

The basis of an integrated preservation plan is an inventory and analysis of the county’s historic assets. Effective preservation planning takes place only when there is sufficient knowledge of the number, location, and significance of both above ground and buried resources. A historic resource survey identifies what resources exist, collects information about each resource, analyzes its continuity and change, assesses its integrity, determines its significance, and places it within the historic context of similar resources. This knowledge can be used in a variety of ways:

- to develop programs and policies to protect significant resources from destruction or unsympathetic alteration;
- to determine the location and distribution of resources to aid in planning, development, and incentive programs; and
- to establish funding priorities for further evaluation and protection efforts.

Implementation Strategies

a. Develop and implement a rural survey plan to identify and evaluate rural resources based on a systematic approach by township areas, giving priority to areas with the highest rate of development. In 1997,
preservation consultants noted that the rapid pace of development outward from the municipalities threatened rural and early suburban properties that may have potential significance. Available information suggests that rural residences, barns, and other agricultural outbuildings are increasingly rare significant property types, as well as rural churches, schools, and commercial buildings. To date, only limited survey of the historic architectural and cultural resources has occurred in rural Douglas County and includes:

1. A reconnaissance survey of Palmyra Township (1989) identified a number of properties in the community of Vinland and 207 properties with associated structures, and six rural cemeteries in rural Palmyra Township that appeared to be more than fifty years old. The farmstead is the most common rural property type in this township. However, examples with a complete intact set of early outbuildings are uncommon.
2. “Commons on the Prairie,” (1990), an unpublished master's thesis by Dennis Domer, discussed the historic architecture and cultural landscape of Willow Springs Township; and

b. Working with rural property owners, develop a cultural landscape component for the identification and evaluation of cultural resources. Rural Douglas County is a landscape that evolved through human activities, which, in turn, shaped its appearance. Like historic buildings and districts, cultural landscapes “reveal aspects of our country's origins and development through their form and features and the ways they were used.” Therefore, a significant cultural landscape is a geographical area, "... including both cultural and natural resources, and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values." There are four recognized types of cultural landscapes: historic sites that include man-made and natural features, historic designed landscapes, historic vernacular landscapes that include man-made and natural features and ethnographic landscapes that reflect specific cultural and racial groups.

Vinland, for example, is a rural village situated in the Coal Creek Valley, Palmyra Township. It has a cultural landscape that includes buildings, structures, cultivated and uncultivated fields, and natural features. Farther west in Marion Township, the churches and farms of the Church of the Brethren community on Washington Creek represent a potentially significant cultural landscape. The Brethren community moved to Hickory Point, Douglas County, in 1856. They established two churches, Pleasant Grove in Willow Springs Township and Washington Creek Church to the west in Marion Township.

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4 Ibid.
c. Develop an archaeological survey plan for the County that:

1. includes an archaeological predictive model for Douglas County that identifies areas of high medium and low probability and
2. prioritizes archaeological survey to focus on areas in which development is ongoing and in which resources would most likely be expected.

The extent of potentially significant archaeological sites in Douglas County is not fully known. However, research and investigations indicate the potential for the presence of important sites throughout the county. In Douglas County, archaeological survey usually occurred only when triggered by federal law. As a result, little historical archaeological investigation has been conducted in the county.

In addition to the more obvious benefits of preserving information about past cultures, knowledge about the location of archaeological sites is crucial to facilitating both public and private development projects. Knowledge of the location or even the ability to predict the possible occurrence of archaeological sites provides developers and government agencies with the ability to investigate during project planning and avoid expensive last minute delays in project development.

Section 106 of the National Historic Preservation Act requires any public or private entity utilizing federal funds, loans, or permits to identify, evaluate, and mitigate damage to archaeological resources affected by the project. This affects agencies such as the General Services Administration, the Army Corps of Engineers, the Kansas Highway and Transportation Department, and County programs receiving federal funding.

One of the key issues to creating a successful archeological survey plan for the County is working with rural property owners. Only by creating partnerships with existing land owners can sites be identified and evaluated. Successful examples such as the Blanton’s Crossing project should be used as models. No survey or evaluation should take place on private property without the consent of the property owner.

d. Work with the State Historic Preservation Office’s interactive online database, the Kansas Historic Resources Inventory (KHRI), to establish an up-to-date survey database. To facilitate analysis of survey information in the planning process, the county needs to bring the cultural resource inventory database up-to-date. KHRI contains all of the SHPO’s survey records and is fully searchable and available to the public. All future surveys in Douglas County should require consultants to enter the survey information into the KHRI system.
**Policy 2.2:** Develop a Preservation Program for the Protection of Cultural Resources in the Unincorporated Areas of Douglas County to be Integrated into County Planning Policies and Processes.

Only after the identification, evaluation, and subsequent “mapping” of significant cultural resources through survey, can the county begin to target and prioritize preservation of significant resources. Rural preservation presents different challenges to integrating preservation strategies into the land use and development decision-making policies and processes. To be effective, preservation issues need to be considered early in the planning stages and in the context of other development and land use issues. Because of the many changes in agribusiness occurring as a result of international, national and local economic forces, farming and livestock enterprises that reflect nineteenth and twentieth century practices are vanishing. Preserving the physical reminders of these eras will require the cooperative, proactive efforts of property owners, private preservation and conservation organizations, and county planners. To assure a successful rural preservation program, the county should only initiate a detailed rural preservation plan, after the successful identification of significant resources. A detailed rural preservation plan must create a number of strategies or tools to be used in combination with other county, state, and federal programs to target the preservation of specific resources that have been identified as significant.

**Implementation Strategies**

- **a.** Develop and establish by ordinance a rural preservation program for the unincorporated areas of the county. Given all issues in developing such a program, the development will take the cooperation of property owners, county administrators, and preservationists. Public meetings must be held in all parts of the county and adequate time should be allowed for all parties to voice their opinions.

- **b.** Explore the benefits and liabilities of establishing Douglas County as a separate Local Certified Government (CLG). Establishing Douglas County as a separate CLG will allow the local community to conduct state law reviews at the local level. This will ensure that reviews are conducted in a timely manner and allow for greater community control. The CLG program will also allow the county to apply for the 10% pass through Historic Preservation Fund grants.

- **c.** Investigate successful protection strategies used in other areas of the nation and develop a plan to implement those that are applicable to Douglas County, such as conservation easements and incentives to encourage private stewardship. Because of growth, Lawrence and Douglas County should initiate successful programs for evaluation, prioritization, and preservation of selected significant rural resources.

- **d.** Develop and implement a National Register and State Register nomination plan for significant historic properties within the unincorporated area of the County. Only twelve properties in the unincorporated area that are listed in the National Register and one on the Kansas Register. The lack of listed properties can be contributed partly to the
lack of surveyed properties and the environs require requirements. To resolve these issues, a process should be developed to identify environs review issues prior to the listing of properties. Property owners shall provide permission for listing and shall help develop and environs definition for their property.

e. Target and prioritize sites such as the natural areas — unplowed prairie and woodlands — identified in Horizon 2020 for preservation.

f. Target significant cultural landscapes for park/green space designation.

g. Target open space to areas with a predictive model for the presence of a high level of archaeological artifacts.

h. Investigate the use of funding mechanisms to retain open space around historic sites.

**POLICY 2.3: ELIMINATE DISINCENTIVES TO ORDERLY PLANNED DEVELOPMENT**

Zoning is a key strategy for protecting cultural resources. Current zoning and land use policies act as a disincentive for orderly planned development that incorporates preservation planning strategies.

**Implementation Strategies**

a. Require annex plans and urban growth boundaries from all municipalities within Douglas County. This will help to eliminate some of the development pressures for undeveloped land and maintain the rural character of unincorporated areas.

b. Develop policies that encourage development in the urban growth boundaries of associated municipalities.

**POLICY 2.4: CONSERVE THE VISUAL DISTINCTION BETWEEN CITY AND RURAL AREAS**

As a matter of policy and practicality, the preservation of cultural landscapes requires an approach that first distinguishes and promotes distinction between developed land and farmland/natural terrain. The city and county currently have defined projected growth areas that allow orderly perimeter development outward from the City of Lawrence and other communities. Such a plan for orderly growth allows preservation of scattered significant historic resources and cultural landscapes to occur as part of planned orderly growth. In areas with significant resources or landscapes, it is important that the distinction between rural and city be maintained in the future.

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5 “Horizon 2020”.
Implementation Strategies

a. Create transition zones between rural areas and the city using wetlands, open spaces, parks, golf courses, "rails to trails," small farm transition areas, and commercial/rural transition areas, i.e., businesses that require open space. Maintaining the distinction between urban and rural areas through the establishment of greenhouses and other agricultural related uses maintains the distinction while allowing for orderly growth.

b. Continue to investigate and create limits on development outside the urban growth areas or boundaries.

c. Promote retention of agricultural land use through programs such as the transfer of development rights and conservation easements.

The city and county need to capitalize on the use of incentive programs to facilitate retention of past investment in infrastructure and built environment and to reap the benefits of historic preservation. The city has not actively implemented or funded economic incentives for preservation. Public incentives should reward and utilize preservation as a tool for economic revitalization. Priority should be given to areas with significant historic resources, capitalizing on existing assets and previous public investment.

GOAL # 3: INCORPORATE PRESERVATION INCENTIVES INTO THE CITY AND COUNTY’S ECONOMIC DEVELOPMENT POLICIES AND PROGRAMS

To fully utilize and promote the economic advantages of historic preservation, Lawrence and Douglas County must develop programs that assist property owners in the use of preservation incentive programs. In addition, the city and county need to reprioritize how they use existing incentive programs. These programs encourage a range of activities targeted to create certain types of results. Some, such as publicly supported transportation and parking incentives, seek to spur development on a broad level; others, such as tax abatement or tax credits, both by legal constraints and/or habit, address specific types of projects and activities. All must be seen as tools to be used in various combinations to encourage revitalization in older commercial and residential neighborhoods or in selected rural areas.

POLICY 3.1: ENCOURAGE THE UTILIZATION AND LINKAGE OF EXISTING INCENTIVES

In addition to the federal and state rehabilitation tax credits, many available incentive programs have “blight” or related conditions as criteria for participation. Others focus on development of businesses. None specifically address the reuse of older buildings; they are usually targeted to new construction and attracting new residents and businesses. The following public incentive programs, are among available programs that, when targeted individually or in combinations, have a demonstrated track record in
stimulating stabilization and revitalization of blighted or declining neighborhoods.

- Property Tax Exemptions
- Heritage Trust Fund (State Grant Program)
- Kansas Neighborhood Revitalization Act
- Low Income Housing Tax Credit Program
- Kansas Main Street Program
- Federal Charitable Deduction Easements
- KSA 12-1740 Revenue Bonds
- Kansas Technology Enterprise Programs

Implementation Strategies

a. **Develop a program to list as many eligible properties in the National and State Registers as possible, enabling property owners to utilize the federal and state rehabilitation tax credits.** Properties listed in the National Register of Historic Places are eligible for significant tax credits. The 20 percent federal rehabilitation tax credit applies to owners and some renters of income-producing National Register properties. The law also permits depreciation of such improvements over 27½ years for a rental residential property and over 31½ years for a nonresidential property. The rehabilitated building must be subject to depreciation.

All of the state’s National Register properties (commercial and residential) are eligible for a 25 percent rehabilitation tax credit. The federal and state tax credits can be used together.

The state tax credits can be sold, and while federal tax credits cannot be sold directly, a project can involve an equity partner, such as a bank, who participates in the project by contributing funds toward the rehabilitation in exchange for some or all of the tax credits.

Certain types of buildings that contribute to the significance of a historic district may also be eligible for rehabilitation tax credits. Within a district contributing buildings that are income-producing properties are eligible for both credits; non-income-producing residential properties are eligible for the state rehabilitation tax credit.

b. **Maximize the use of incentives by combining them into preservation “tool kits” – different combinations of incentives targeted for specific areas and tailored to certain needs – to provide flexible and lasting strategies to address stabilization and revitalization of older residential and commercial centers.**

c. **Target public incentives to projects in areas with existing public infrastructure and significant historic resources.**
d. Notify owners of eligible properties and assist them in providing access to applicable rehabilitation incentives and grants.

e. Investigate the use of Community Development Block Grant funds to foster historic preservation efforts.

f. Establish and fund the Historic Preservation Fund as described in city’s Conservation of Historic Resources Code.

**POLICY 3.2: DEVELOP INCENTIVES TO ENCOURAGE THE REHABILITATION AND OCCUPANCY OF HISTORIC PROPERTIES**

In addition to existing preservation incentives, many communities develop specific incentive programs to encourage rehabilitation and occupancy of historic properties in specific locations, both rural and urban. For example, many communities encourage façade improvements using preservation guidelines through funding grants and/or technical assistance.

**Implementation Strategies**

a. Attach appropriate design guidelines to incentive programs.

b. Create taxing incentives by using such tools as the Neighborhood Revitalization Act.

c. Create incentives to increase critical mass development in Downtown.

d. Create and target incentives to historic commercial areas such as façade improvement grants and economic incentives to owners or businesses that occupy or lease space in historic buildings.

e. Develop and implement policies and programs that eliminate parking issues as a disincentive to rehabilitation of buildings, including review of use permits and accompanying parking requirements and implementation of public/private shared use of parking structures.

f. Create incentives to maintain and preserve historically significant farming areas.

g. Provide design and/or technical assistance to property owners undertaking preservation projects, such as schematic architectural design assistance for renovation/restoration of residences, businesses, and rural structures.

h. Develop incentives to retain and strengthen small neighborhood commercial areas.
i. Utilize or create incentive programs for abatement of environmental hazards in significant historic buildings.

j. Provide incentives to reduce the number of multi-family units in houses originally designed as single-family residences that are located in historic and conservation districts.

**POLICY 3.3: ELIMINATE DISINCENTIVES TO PRESERVATION EFFORTS**

While incentives play an important role in promoting preservation, it is important to review current city and county policies that may discourage preservation. Removal of these obstacles may be as effective as implementation of incentives.

**Implementation Strategies**

a. Tax properties that are listed in the National Register, State Register or Local Register at a lower rate.

b. Abolish or develop a lower fee schedule for rehabilitation building permits.

The city and county need to develop a significant historic destination that establishes Lawrence and Douglas County as a gateway entity to the interpretation of regional history, linking historic preservation to a significant economic growth industry.

**GOAL # 4: INCORPORATE HERITAGE TOURISM AS AN ECONOMIC DEVELOPMENT PROGRAM**

**POLICY 4.1: DEVELOP A COMPREHENSIVE HERITAGE TOURISM PROGRAM THAT INTEGRATES HISTORIC RESOURCES AND VENDORS INTO PROGRAM PLANNING AND IMPLEMENTATION**

Tourism is big business and Heritage Tourism is a significant component of the tourism industry. Lawrence and Douglas County have a rich legacy of historic landmarks, sites, cultural landscapes, neighborhoods, buildings, structures, and archaeological resources that can bring knowledge and understanding of past cultures and events. These are assets that can be capitalized upon.

These assets have associations with national, state, and local events. They are tangible ties to prehistoric and historic native peoples, the era of European exploration, the Santa Fe, California and Oregon trails, the Border and Civil Wars, the development of regional agricultural industries, and the founding and development of a major state educational institution and multi-national Native American educational institution.

To capitalize on this legacy, Lawrence and Douglas County need to develop and
implement strategies to provide for the quality interpretation of the past, to preserve and protect historic and cultural resources, and to encourage collaboration and linkages within the city and county and throughout the region in developing a unified approach to capitalize on the Heritage Tourism market.

**Implementation Strategies**

a. **Support the Freedom’s Frontier National Heritage Area**  
   A National Heritage Area is an area or corridor designated by the United States Congress “. . . where natural, cultural, historic and recreational resources combine to form a cohesive, nationally distinctive landscape arising from patterns of human activity shaped by geography. These patterns make National Heritage Areas representative of the national experience through the physical features that remain and the traditions that have evolved in them.” National Heritage Areas are local partnerships with the National Park Service that:

   1. protect historic, environmental, scenic, and cultural resources;  
   2. increase sustainable tourism and economic development;  
   3. educate residents and visitors about community history, traditions, and the environment;  
   4. create new outdoor recreation opportunities, and  
   5. build partnerships among federal, State, and local governments.

b. **Encourage and enter into cooperative regional efforts in programming and networking in public relations and marketing efforts.**

c. **Revitalize the Watkins Community Museum.**

d. **Through the National Trust for Historic Preservation Heritage Tourism Program, the city/county should enlist the participation of all communities in Douglas County, sites, and museums to conduct a comprehensive management and interpretive assessment and to develop cooperative interpretative, marketing and programming plans.**

   1. Inventory of current and potential attractions.  
   2. Assess current attractions, visitor services, organizational capabilities, preservation resources, and marketing programs.  
   3. Establish priorities and measurable goals through organizing human and financial resources.  
   4. Prepare for visitors through development of long-term management goals that protect historic resources.  
   5. Market for success through development of a multi-year, multiple-tier targeted marketing plan involving local, regional, State, and national partners.  
   6. Develop cooperative efforts between the Lawrence/Douglas County Chamber of Commerce and local preservation groups.
**Policy 4.2: Encourage the Development of Black Jack Battlefield as a Significant Site in the History of the United States.**

As part of the public participation in the adoption of this plan, the Lawrence-Douglas County Planning Commission identified Black Jack Battlefield as a resource worthy of specific identification, evaluation, documentation and preservation. The majority of the battle site is listed in the National Register of Historic Places and the structure known as the Pearson House is listed in the Register of Historic Kansas Places. The national importance of this site should be recognized and celebrated.

**Implementation Strategies**

a. **Support the efforts of the Black Jack Battlefield & Nature Park to document the history of this site.**

b. **Support the efforts of the Black Jack Battlefield & Nature Park to encourage the development of this site as part of the Freedom’s Frontier National Heritage Area.**

c. **Encourage and enter into cooperative regional efforts in programming and networking in public relations and marketing efforts that promote this significant historic site.**

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Public awareness of historic resources is needed to develop public/private partnerships in promoting and implementing historic preservation.

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**Goal # 5: Establish Outreach and Educational Programs**

**Policy 5.1: Develop a Government Sponsored Public Information Outreach Program**

The city and county have a number of vehicles that could be used to disseminate information about historic preservation to the larger community. Among the most effective of these tools are the use of the city/county website to provide information about city/county efforts and links to other governmental and private entities in the federal, state, and local preservation network. Another important governmental tool is the publication and/or distribution of information brochures.

**Implementation Strategies**

a. **Make public aware of available funding sources.**

b. **Develop or provide hands-on materials that provide information on how to repair and preserve historic buildings according to the Secretary of the Interior’s Guidelines for the Rehabilitation of Historic Buildings.**
c. Provide information on historic neighborhoods (i.e. promote walking tours).

d. Provide notification each spring, prior to the construction season, to property owners in local districts, National Register properties, and State Register properties of the design guidelines and procedures to obtain a Certificate of Appropriateness and/or State Law Review.

e. Develop in-house materials for other city/county department staff about preservation processes and issues in order to assist in building consensus in applying preservation procedures.

f. Provide on-going preservation education sessions for members of appointed bodies including the Historic Resources Commission, City Commission, and Planning Commission.

g. Expand the city’s webpage to include additional information regarding National Register listing, survey information, how-to materials, etc.

h. Work with existing hardware and home improvement stores to provide hands on materials regarding historic preservation issues.

Policy 5.2: In partnership with an appropriate local organization, assist in developing and conducting a series of public workshops to educate the public about preservation

The city and the county can play a crucial role in convening and initial coordination of educational efforts. Although both governmental entities should develop in-house and public programs that communicate information about city and county preservation programs, the larger role of education and advocacy must be undertaken by private organizations.

Implementation Strategies:

a. Establish forums for realtors, rural lenders, developers, contractors, preservationists, business community leaders, and neighborhood groups to acquaint them with preservation benefits, issues and procedures.

Policy 5.3: Develop media relations to be an advocate for preservation

A crucial component of public education is the support of the media in coverage of events and issues. This involves both the city and county as well as private organizations. The city can play a role in assembling information and preparing press releases about its programs and related activities. However, a private organization should be designated to coordinate media relations and to respond to preservation issues related to advocacy of a particular course of action that the city/county cannot address.
Implementation Strategy

a. **Promote preservation news in local press through press releases during National Preservation Week** that focus on the economic impact of preservation, as well as local newsworthy events, and recent local, state or national designations, etc.

**POLICY 5.4: DEVELOP PROACTIVE RECOGNITION PROGRAMS**

Existing and new programs that recognize preservation efforts (particularly when timed to coincide with National Preservation Week) can have a positive and on-going impact on public awareness. Such programs should be part of larger media and promotions strategy promoting and understanding and support for historic preservation.

Implementation Strategy

a. **Develop a county-wide Heritage Farm honorific program.**

b. **Develop historic signage.**

c. **Encourage the nomination of projects for local, state and national awards programs.**

**POLICY 5.5: COORDINATE PRESERVATION PROGRAMS IN THE COUNTY AND CITY WITH OTHER LOCAL, STATE, AND FEDERAL GOVERNMENTS AND ORGANIZATIONS**

Coordinating preservation activities and programs with other local municipalities, state, and federal government organizations is a very difficult task. Preservation efforts will be more successful by facilitating cooperation between the various entities. Both the city and the county can play an important convening and facilitating role in coordinating private and public preservation efforts.

Implementation Strategy

a. **Establish a countywide coordinating entity that includes private and public organizations and agencies.** Primary goals should be:

1. development of an outreach program to unincorporated areas of the county to involve property owners in historic preservation initiatives; and

2. joining rural and city constituencies in cooperative efforts.
GOAL # 6: INCORPORATE SUSTAINABLE PRESERVATION INTO THE CITY AND COUNTY’S SUSTAINABILITY POLICIES AND PROGRAMS

The citizens of Lawrence and Douglas County increasingly support environmental conservation efforts. This growing awareness of how local conditions fit into larger environmental issues has led to the recognition of the importance of natural resources and of the embodied energy contained in the built environment. Historic preservation practices are tools for better stewardship of older buildings, neighborhoods, and rural landscapes. The conservation and improvement of our existing built resources, including the re-use and improvement of historic structures, is central to our community’s overall plan for environmental stewardship and sustainable development.

POLICY 6.1: ENCOURAGE AND INCORPORATE HISTORIC PRESERVATION IN SUSTAINABLE PLANNING AND BUILDING PRACTICES

To maximize the inherent sustainable qualities of historic preservation, long range planning and building practices should encourage the reuse of the existing built environment.

Implementation Strategies:

a. Foster a culture of reuse of existing structures by maximizing the life cycle of existing buildings.

b. Encourage reinvestment in the existing built environment.
   1. Explore and adopt building codes that give a discount on the overall permit fee for the reuse of historic structures.
   2. Identify and promote programs that identify historic building materials, like first growth wood and historic lath and plaster, and the values they bring to structures.

c. Explore the use of outcome-based codes.
   Building energy codes that focus on energy saving and consumption give existing structures proper credit for embodied energy and discourage teardowns.

d. Explore the adoption of building codes that create sustainable communities. Building codes can address issues associated with
   1. Optimizing site potential
   2. Minimizing energy consumption
   3. Protecting and preserving water
   4. Use of environmentally sound products
   5. Enhancing indoor environmental quality
   6. Optimizing operational and maintenance practices
e. Explore the adoption of demolition codes that require sustainable practices like
   1. A percentage of demolition debris to be recycled and reused
   2. Demolition permit fees that reflect the values of historic resources.

POLICY 6.2: DEVELOP PROGRAMS THAT ENCOURAGE PRESERVATION AS PART OF CREATING A SUSTAINABLE COMMUNITY.

The City and County have taken the lead in beginning to identify goals and programs that will help create a sustainable community. New goals and programs are needed to incorporate the maintenance, reuse/repurpose, and recycling of our significant historic resources.

Implementation Strategy
   a. Develop and adopt sustainability design guidelines for historic districts.
   b. Develop and implement programs for City and County buildings that maintain historic fabric and reduce natural resource consumption.
   c. Encourage and support the development of energy strategies. Energy strategies for energy conservation and generation should include
      1. Energy audits
      2. Evaluations of existing systems
      3. Establishing goals for energy savings.
   d. Encourage and support the development of sustainable energy systems that can provide energy for multiple historic properties that cannot achieve sustainable energy goals individually. Many historic structures do not have the land or roof capacity to install sustainable energy systems such as solar, geothermal, and wind for the individual structure. Energy districts can combine areas to create sustainable systems for multiple historic properties that do not have the requirements necessary to achieve this goal individually.
   e. Capitalize on the potential of the Green Economy and develop programs to encourage the manufacture and use of local products that are environmentally sound.
   f. Utilize increased permit fees for the demolition of historic structures to fund a preservation fund to create low interest loans or grants that facilitate the rehabilitation of historic structures.

POLICY 6.3: DEVELOP AN EDUCATION PROGRAM TO INCORPORATE SUSTAINABLE PRESERVATION INTO PUBLIC INFORMATION OUTREACH PROGRAMS ON SUSTAINABILITY

Historic preservation is an important component of any effort to promote sustainable development. The conservation and improvement of our existing built resources, including re-use of historic and older buildings, greening the existing building stock, and reinvestment in older and historic communities, is crucial to lowering our carbon footprint and reducing energy leakage.
Implementation Strategies

a. Develop City and County Sponsored Public Information Outreach Programs that promote sustainability through preservation and rehabilitation of historic structures.
   1. Establish forums for realtors, developers, contractors, and preservationists to inform them about sustainable preservation benefits, issues and procedures.

b. Align Historic Preservation Policies with sustainability policies.
   1. Assist the Sustainability Advisory Board with the development of goals and priorities for future cultural resource conservation efforts.
   2. Work with the Sustainability Coordinator to identify practical methods and programs to reach the City’s goals for sustainability.
   3. Identify and encourage the adoption of Preservation goals, policies, and programs that incorporate sustainable community ideals.

c. Work with the Sustainability Coordinator to identify education programs and opportunities to promote preservation and sustainability.

d. Promote educational programs that identify sustainable development and how it differs from sustainable design.
   1. Sustainable Development is not limited to environmental sustainability.
   2. Sustainable Development is also economic sustainability and cultural sustainability.
Action Plan and Time Line
# Chapter Six: Action Plan and Time Line

<table>
<thead>
<tr>
<th>GOAL # 1: INCORPORATE PRESERVATION AS AN IMPORTANT COMPONENT OF CITY AND COUNTY PLANNING PROCESSES</th>
<th>Partners</th>
<th>Timeframe</th>
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<tbody>
<tr>
<td><strong>POLICY 1.1: EXPAND HISTORIC PRESERVATION IDENTIFICATION, EVALUATION, AND PROTECTION PROGRAMS</strong></td>
<td>Historic Resources Commission</td>
<td>Lawrence/Douglas County Planning Office</td>
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<tr>
<td>a. Expand survey process to identify important resources to be considered in all city and county planning processes.</td>
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<td>b. Update the existing National Register of Historic Places Multiple Property Documentation form for Lawrence to include properties that have achieved historic significance since 1945.</td>
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<td>c. Establish an up-to-date survey database.</td>
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<td>d. Launch an ongoing effort to create National Register and local historic districts in the city with design guidelines to maximize the potential to stabilize and increase property values while protecting resources.</td>
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e. Develop and implement a Local, National Register, and State Register nomination plan for significant historic properties within the unincorporated areas of the county.   |   |   |   |
f. Identify and evaluate, during the development review process, properties that are 50 years or older that will be affected by development proposals such as rezoning, platting, development plans, conditional use permits, and use permitted upon review permits.   |   |   |   |
g. Develop a program to list as many eligible properties in the National Register and State Register as possible, enabling property owners to utilize the federal and state rehabilitation tax credits.   |   |   |   |
h. Evaluate and consider strengthening the city’s demolition ordinance.   |   |   |   |
i. Explore alternative protection mechanisms used in other communities for protection programs for identified significant rural resources.   |   |   |   |
**Policy 1.2:**

**Develop or Modify Appropriate Zoning, Building Code, and Fire Code Regulations to Facilitate the Preservation and Rehabilitation of Historic Properties**

<table>
<thead>
<tr>
<th>Historic Resources Commission</th>
<th>Lawrence/Douglas County Planning Commission</th>
<th>Lawrence Association of Neighborhoods Planning Commission</th>
<th>City Commission</th>
<th>County Commission</th>
<th>Lawrence Historic Preservation Alliance</th>
<th>Appropriate City Agency</th>
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a. Investigate the possibility of creating conservation districts as an alternative protection mechanism and standard for environs review.

b. Review and update existing city zoning to be compatible with existing or desired land use that promotes preservation of intact residential neighborhoods and commercial centers that have historical, architectural, and physical integrity.

1. consistency between overlay zoning and base land use zoning among contiguous properties;

2. flexible provisions for developing compatible new “infill” construction on vacant lots;

3. allowance of innovative preservation alternatives, such as additional or specialty uses including “bed and breakfast,” studios, and other professional uses;
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<tr>
<th>POLICY 1.2 CONT'D.</th>
<th>Historic Resources Commission</th>
<th>Lawrence/Douglas County Planning Commission</th>
<th>Lawrence Association of Neighborhoods</th>
<th>Planning Commission</th>
<th>City Commission</th>
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<td>4. appropriate design guidelines and site development controls to encourage quality rehabilitation and compatible new construction worthy of preservation in the future; and</td>
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<td>5. effective procedures to discourage demolition of significant buildings and structures.</td>
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<td>c. Require new development in established areas of the city to use designs complementary to the adjacent streetscape.</td>
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<td>d. Create transition zones and flexible links within Lawrence by using set backs, alleys, parks, and open space in a way that is consistent with established patterns.</td>
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<td>e. Adopt a rehabilitation code to address building code and fire code requirements in historic structures for the City of Lawrence and Douglas County.</td>
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**Policy 1.3:**
**Develop and Implement Formalized Procedures to Coordinate Preservation Efforts Among City Departments and Agencies**

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<tr>
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<tr>
<td>a. Establish formalized procedures for the Lawrence Historic Resources Commission (LHRC) or the Historic Resources Administrator to review and comment on city planning activities.</td>
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<td>h. When possible, historic preservation issues should be represented in appointed positions. Representatives of these entities should also be considered as appointed members on the LHRC.</td>
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<td>i. Working with property owners, target significant cultural landscapes for park/green space designation.</td>
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<td>j. Working with property owners, target open space designation to areas with probability for the presence of a high level of archaeological artifacts.</td>
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<td>k. Include a preservation element in the City of Lawrence's Parks and Recreation Master Plan.</td>
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<td>l. Require review of new ordinances for their impact on historic resources and historic preservation efforts.</td>
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</table>

**HORIZON 2020 Preservation Plan Element 6-7**

**Action Plan**
<table>
<thead>
<tr>
<th>POLICY 1.4: IMPROVE EXISTING DESIGN REVIEW AND STATE LAW REVIEW PROCESS</th>
<th>Historic Resources Commission</th>
<th>Lawrence/Douglas County Planning</th>
<th>Lawrence/Association of Neighborhoods Planning Commission</th>
<th>City Commission</th>
<th>County Commission</th>
<th>Lawrence Preservation Alliance</th>
<th>Appropriate City/County Agency</th>
<th>Ongoing</th>
<th>Short Range</th>
<th>Mid-Range</th>
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</thead>
<tbody>
<tr>
<td>a. Conduct ongoing inspection of work after LHRC review.</td>
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<td>b. Develop review process that promotes more consistent and objective interpretation of environs law.</td>
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<td>c. Provide legal enforcement of LHRC decisions.</td>
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<td>d. Reconcile the differences between State law environs review and the City of Lawrence’s environs review standards.</td>
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<td>e. Establish a recording process with the Register of Deeds to record National Register, State Register and Local Register properties.</td>
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<td>f. Investigate ways to simplify the design review process and the state law review process through the integration of building permit applications, design review applications, and development review applications.</td>
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</table>
Policy 1.5: **ESTABLISH CLEAR WORKING DEVELOPMENT AND DESIGN REVIEW PROCESSES WITH FEDERAL, STATE, COUNTY, PUBLIC, AND PRIVATE INSTITUTIONS LOCATED NEAR HISTORIC RESOURCES.**

<table>
<thead>
<tr>
<th>Historic Resources Commission</th>
<th>Lawrence/Douglas County Planning Office</th>
<th>Lawrence Association of Neighborhoods</th>
<th>Planning Commission</th>
<th>City Commission</th>
<th>County Commission</th>
<th>Lawrence Preservation Alliance</th>
<th>Appropriate Institutions</th>
<th>Ongoing</th>
<th>Short Range</th>
<th>Mid-Range</th>
<th>Long Range</th>
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</thead>
<tbody>
<tr>
<td>a. Develop agreements regarding development policies for federal, state, public and private institutions (such as the University of Kansas, Baker University, Haskell University, Lawrence Memorial Hospital, and Lawrence School District, Townships, Rural Water Districts), which are located near historic areas that include community expectations, a public participation process, and development requirements, including development of expansion boundaries.</td>
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<td>b. Neighborhood, sector, and area plans should establish clear boundaries for commercial areas as well as institutions.</td>
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<td>c. Form stronger partnerships between the Campus Historic Preservation Board and the Lawrence Historic Preservation Commission.</td>
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</table>
**POLICY 1.6: DEVELOP A PUBLIC RESOURCES POLICY THAT VALUES HISTORIC PUBLIC IMPROVEMENTS.**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Historic Resources Commission</th>
<th>Lawerence/Douglas County Planning Commission</th>
<th>Lawrence Association of Neighborhoods Planning Commission</th>
<th>City Commission</th>
<th>County Commission</th>
<th>Lawrence Preservation Alliance</th>
<th>Appropriate City/County Agency</th>
<th>Ongoing</th>
<th>Short Range</th>
<th>Mid-Range</th>
<th>Long Range</th>
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<tbody>
<tr>
<td>a.</td>
<td>Create a comprehensive approach to infrastructure improvements on a neighborhood-by-neighborhood basis.</td>
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<td>b.</td>
<td>Protect and maintain existing brick streets, brick sidewalks, and hitching posts in the City of Lawrence.</td>
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<td>c.</td>
<td>Restore brick streets and sidewalks in the City of Lawrence.</td>
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<td>d.</td>
<td>Implement appropriate traffic calming measures in residential neighborhoods in the City of Lawrence.</td>
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<td>e.</td>
<td>Investigate and implement initiatives to improve parking in Downtown Lawrence with minimal impact of older buildings.</td>
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<td>f.</td>
<td>Improve bicycle and pedestrian routes and rural trails in central and rural locations.</td>
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<td>g.</td>
<td>Target Parks and Recreation tax revenues when appropriate for cultural resource projects on public lands.</td>
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<td>h.</td>
<td>Improve flood control to protect historic properties.</td>
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<td>i. Develop a formal review process for all public improvements to determine the effects on historic preservation and/or historic preservation planning efforts.</td>
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### GOAL # 2: CONSERVE THE RURAL CHARACTER OF UNINCORPORATED DOUGLAS COUNTY IN STRATEGIC AREAS

#### POLICY 2.1:
Develop a Preservation Program for the Identification and Evaluation of Cultural Resources in the Unincorporated Areas of Douglas County

<table>
<thead>
<tr>
<th></th>
<th>Historic Resources Commission</th>
<th>Lawrence/Douglas County Planning Commission</th>
<th>Lawrence Association of Neighborhoods Planning Commission</th>
<th>City Commission</th>
<th>County Commission</th>
<th>Lawrence Preservation Alliance</th>
<th>Ongoing</th>
<th>Short Range</th>
<th>Mid-Range</th>
<th>Long Range</th>
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</thead>
<tbody>
<tr>
<td>a.</td>
<td>Develop and implement a rural survey plan to identify and evaluate rural resources based on a systematic approach by township areas, giving priority to areas with the highest rate of development.</td>
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<td>b.</td>
<td>Working with rural property owners, develop a cultural landscape component for the identification and evaluation of cultural resources.</td>
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<td>c.</td>
<td>Develop an archaeological survey plan for the County that:</td>
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<td></td>
<td>1. includes an archaeological predictive model for Douglas County that identifies areas of high medium and low probability; and</td>
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### Policy 2.1
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<tr>
<th></th>
<th>Historic Resources Commission</th>
<th>Lawrence/Douglas County Planning</th>
<th>Lawrence Association of Planning Commission</th>
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<th>Mid-Range</th>
<th>Long Range</th>
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<tbody>
<tr>
<td>2.</td>
<td>prioritizes archaeological survey to focus on areas in which development is ongoing and in which resources would most likely be expected.</td>
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<td>d.</td>
<td>Work with the State Historic Preservation Office’s interactive online database, the Kansas Historic Resources Inventory (KHRI), to establish an up-to-date survey database.</td>
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### Policy 2.2:
**Develop a Preservation Program for the Protection of Cultural Resources in the Unincorporated Areas of Douglas County to be Integrated into County Planning Policies and Processes.**

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<thead>
<tr>
<th></th>
<th>Historic Resources Commission</th>
<th>Lawrence/Douglas County Planning</th>
<th>Lawrence Association of Planning Commission</th>
<th>City Commission</th>
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<th>Short Range</th>
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<tbody>
<tr>
<td>a.</td>
<td>Develop and establish by ordinance a rural preservation program for the unincorporated areas of the county.</td>
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<td>b.</td>
<td>Explore the benefits and liabilities of establishing Douglas County as a separate Local Certified Government.</td>
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<td>c.</td>
<td>Investigate successful protection strategies used in other areas of the nation and develop a plan to implement those that are applicable to Douglas County, such as conservation easements and incentives to encourage private stewardship.</td>
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**Policy 2.2 Contd.**

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<th>Lawrence Preservation</th>
<th>Kaw Valley Heritage Alliance</th>
<th>Ongoing</th>
<th>Short Range</th>
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<tr>
<td>d. Develop and implement a local and National Register and State Register nomination plan for significant historic properties within the unincorporated area of the county.</td>
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<td>e. Target and prioritize sites such as the natural areas - unplowed prairie and woodlands - identified in Horizon 2020 for preservation.</td>
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<td>f. Target significant cultural landscapes for park/green space designation.</td>
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<td>g. Target open space to areas with a predictive model for the presence of a high level of archaeological artifacts.</td>
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<td>h. Investigate the use of funding mechanisms to retain open space around historic sites.</td>
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### POLICY 2.3: ELIMINATE DISINCENTIVES TO ORDERLY PLANNED DEVELOPMENT

<table>
<thead>
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<th>Association of Neighborhood Planning</th>
<th>City Commission</th>
<th>Lawrence County Preservation Alliance</th>
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<th>Short Range</th>
<th>Mid-Range</th>
<th>Long Range</th>
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<tbody>
<tr>
<td>a. Require annexation plans and urban growth boundaries from all municipalities within Douglas County.</td>
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<td>b. Develop policies that encourage development within the urban growth boundaries of associated municipalities.</td>
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### POLICY 2.4: CONSERVE THE VISUAL DISTINCTION BETWEEN CITY AND RURAL AREAS

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<tr>
<th>Historic Resources Commission</th>
<th>Lawrence/Douglas County Planning</th>
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<th>City Commission</th>
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<th>Long Range</th>
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</thead>
<tbody>
<tr>
<td>a. Create transition zones from rural areas to the city using wetlands, open spaces, parks, golf courses, &quot;rails to trails,&quot; small farm transition areas, and commercial/rural transition areas, i.e., businesses that require open space.</td>
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<td>b. Create limits on development outside the urban growth areas or boundaries.</td>
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<td>c. Promote retention of agricultural land use through programs such as the transfer of development rights and conservation easements.</td>
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**GOAL # 3:**
Incorporate Preservation Incentives into THE CITY and County’s Economic Development Policies and Programs

Policy 3.1: Encourage the Utilization and Linkage of Existing Incentives

<table>
<thead>
<tr>
<th>Historic Resources Commission</th>
<th>Lawrence/Douglas County Planning</th>
<th>Lawrence Association of Neighborhoods</th>
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<th>Short Range</th>
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<tbody>
<tr>
<td>a. Develop a program to list as many eligible properties in the National Register and State Register as possible, enabling property owners to utilize the federal and state rehabilitation tax credits.</td>
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<td>b. Maximize the use of incentives by combining them into preservation “tool kits” – different combinations of incentives targeted for specific areas and tailored to certain needs – to provide flexible and lasting strategies to address stabilization and revitalization of older residential and commercial centers.</td>
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<td>c. Target public incentives to projects in areas with existing public infrastructure and significant historic resources.</td>
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### POLICY 3.1: CONT'D.

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<tr>
<td>d.</td>
<td>Notify owners of eligible properties and assist them in providing access to applicable rehabilitation incentives and grants.</td>
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<td>e.</td>
<td>Investigate the use of Community Development Block Grant funds to foster historic preservation efforts.</td>
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<td>f.</td>
<td>Establish and fund the Historic Preservation Fund as described in city's Conservation of Historic Resources Code.</td>
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**POLICY 3.2:**
**DEVELOP INCENTIVES TO ENCOURAGE THE REHABILITATION AND OCCUPANCY OF HISTORIC PROPERTIES**

<table>
<thead>
<tr>
<th>Policy Item</th>
<th>Historic Resources Commission</th>
<th>Lawrence/Douglas County Planning Office</th>
<th>Lawrence Association of Neighborhoods</th>
<th>Planning Commission</th>
<th>City Commission</th>
<th>County Commission</th>
<th>Lawrence Alliance of Preservation</th>
<th>Chamber of Commerce</th>
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<tbody>
<tr>
<td>a. Attach appropriate design guidelines to incentive programs.</td>
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<td>b. Create taxing incentives by using such tools as the Neighborhood Revitalization Act.</td>
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<td>c. Create incentives to increase critical mass development in Downtown Lawrence.</td>
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<td>d. Create and target incentives to historic commercial areas such as façade improvement grants and economic incentives to owners or businesses that occupy or lease space in historic buildings.</td>
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<td>e. Develop and implement policies and programs that eliminate parking issues as a disincentive to rehabilitation of buildings, including review of use permits and accompanying parking requirements and implementation of public/private shared use of parking structures.</td>
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<td>POLICY 3.2: CONT'D.</td>
<td>Historic Resources Commission</td>
<td>Lawrence/Douglas County Planning Office</td>
<td>Lawrence Association of Neighborhoods Planning Commission</td>
<td>City Commission</td>
<td>County Commission</td>
<td>Lawrence Preservation Alliance</td>
<td>Chamber of Commerce</td>
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<td>f. Create incentives to preserve significant farming areas.</td>
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<td>g. Provide design and/or technical assistance to property owners undertaking preservation projects, such as schematic architectural design assistance for renovation/restoration of residences, businesses, and rural structures.</td>
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<td>h. Develop incentives to retain and strengthen small neighborhood commercial areas.</td>
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<td>i. Utilize or create incentive programs for abatement of environmental hazards in significant historic buildings.</td>
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<td>j. Provide incentives to reduce the number of multi-family units in houses originally designed as single-family residences that are located in historic and conservation districts.</td>
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**POLICY 3.3:**
**ELIMINATE DISINCENTIVES TO PRESERVATION EFFORTS**

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<tr>
<th>Historic Resources Commission</th>
<th>Lawrence/Douglas County Planning Office</th>
<th>Lawrence Association of Neighborhoods</th>
<th>Planning Commission</th>
<th>City Commission</th>
<th>County Commission</th>
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<td>a. Tax properties that are listed in the National Register, State Register, or Local Register at a lower rate.</td>
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<td>b. Abolish or develop a lower fee schedule for rehabilitation building permits.</td>
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**GOAL # 4: INCORPORATE HERITAGE TOURISM AS AN ECONOMIC DEVELOPMENT PROGRAM**

**POLICY 4.1:**
**DEVELOP A COMPREHENSIVE HERITAGE TOURISM PROGRAM THAT INTEGRATES HISTORIC RESOURCES AND VENDORS INTO PROGRAM PLANNING AND IMPLEMENTATION**

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<thead>
<tr>
<th>Historic Resources Commission</th>
<th>Lawrence/Douglas County Planning Commission</th>
<th>Lawrence Association of Neighborhoods Planning Commission</th>
<th>City Commission</th>
<th>Lawrence Preservation Alliance</th>
<th>Lawrence Convention &amp; Visitors Bureau</th>
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<tr>
<td>a. Investigate and pursue National Heritage Area Designation.</td>
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<td>b. Encourage and enter into cooperative regional efforts in programming and networking in public relations and marketing efforts.</td>
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<td>c. Revitalize the Watkins Community Museum.</td>
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<td>d. Through the National Trust for Historic Preservation Heritage Tourism Program, the city/county should enlist the participation of all communities, site and museums in Douglas County to conduct a comprehensive management and interpretive assessment and to develop cooperative interpretive, marketing and programming plans.</td>
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**HORIZON 2020 Preservation Plan Element 6-21 Action Plan**
**POLICY 4.1:**
**DEVELOP A COMPREHENSIVE HERITAGE TOURISM PROGRAM THAT INTEGRATES HISTORIC RESOURCES AND VENDORS INTO PROGRAM PLANNING AND IMPLEMENTATION**

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<thead>
<tr>
<th>Historic Resources Commission</th>
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e. Develop cooperative efforts between the Lawrence/Douglas County Chamber of Commerce and local preservation groups.
### GOAL # 5: ESTABLISH OUTREACH AND EDUCATIONAL PROGRAMS

#### POLICY 5.1: DEVELOP A GOVERNMENT SPONSORED PUBLIC INFORMATION OUTREACH PROGRAM

<table>
<thead>
<tr>
<th>Action</th>
<th>Historic Resources Commission</th>
<th>Lawrence/Douglas County Planning Office</th>
<th>Lawrence Association of Neighborhoods</th>
<th>Planning Commission</th>
<th>City Commission</th>
<th>County Commission</th>
<th>Lawrence Preservation Alliance</th>
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<td>Make public aware of available funding sources.</td>
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<td>Develop or provide hands-on material that provides information on how to repair and preserve historic buildings according to the Secretary of the Interior’s Guidelines for the Rehabilitation of Historic Buildings.</td>
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<td>Provide information on historic neighborhoods (i.e. promote walking tours).</td>
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<td>Provide notification each spring, prior to the construction season, to property owners in local districts, National Register properties, and State Register properties of the design guidelines and procedures to obtain a Certificate of Appropriateness and/or Certified Local Government Review.</td>
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### Policy 5.1 Contd.

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<th>Action</th>
<th>Historic Resources Commission</th>
<th>Lawrence/Douglas County Planning Office</th>
<th>Lawrence Association of Neighborhoods Planning Commission</th>
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<td></td>
<td>Develop in-house materials for</td>
<td>other city/county department staff about preservation processes and issues to assist in building consensus in applying preservation procedures.</td>
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<td>f.</td>
<td>Provide ongoing preservation education sessions for members of appointed bodies including the Historic Resources Commission, City Commission, and Planning Commission.</td>
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<td>g.</td>
<td>Expand the city’s webpage to include additional information regarding National Register listing, survey information, how-to materials, etc.</td>
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<td>h.</td>
<td>Work with existing hardware and home improvement stores to provide hands on materials regarding historic preservation issues.</td>
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**POLICY 5.2:**
**IN PARTNERSHIP WITH AN APPROPRIATE LOCAL ORGANIZATION, ASSIST IN DEVELOPING AND CONDUCTING A SERIES OF PUBLIC WORKSHOPS TO EDUCATE THE PUBLIC ABOUT PRESERVATION**

<table>
<thead>
<tr>
<th>Historic Resources Commission</th>
<th>Lawrence/Douglas County Planning</th>
<th>Lawrence Association of Neighborhoods Planning Commission</th>
<th>City Commission</th>
<th>County Commission</th>
<th>Lawrence Preservation Alliance</th>
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<tr>
<td>a. Establish forums for realtors, developers, preservationists, business community leaders, and neighborhood groups to acquaint them with preservation benefits, issues, and procedures.</td>
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**POLICY 5.3:**
**DEVELOP MEDIA RELATIONS TO BE AN ADVOCATE FOR PRESERVATION**

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<tr>
<th>Historic Resources Commission</th>
<th>Lawrence/Douglas County Planning</th>
<th>Lawrence Association of Neighborhoods Planning Commission</th>
<th>City Commission</th>
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<tr>
<td>a. Promote preservation news in local press through press releases during National Preservation Week that focus on the economic impact of preservation, as well as local newsworthy events, and recent local, state or national designations, etc.</td>
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### POLICY 5.4: DEVELOP PROACTIVE RECOGNITION PROGRAMS

**a.** Develop a countywide Heritage Farm honorific program.

**b.** Develop historic signage.

**c.** Continue the Paul Wilson Preservation Awards program.

### POLICY 5.5: COORDINATE PRESERVATION PROGRAMS IN THE COUNTY AND CITY WITH OTHER LOCAL, STATE, AND FEDERAL GOVERNMENTS AND ORGANIZATIONS

**a.** Establish a countywide coordinating entity that includes private and public organizations and agencies. Primary goals should be:

1. Development of an outreach program to unincorporated areas of the county to involve property owners in historic preservation initiatives; and

2. Joining rural and city constituencies in cooperative efforts.
**GOAL # 6:**
INTEGRATE SUSTAINABLE PRESERVATION INTO THE CITY AND COUNTY’S SUSTAINABILITY POLICIES AND PROGRAMS

### POLICY 6.1:
ENCOURAGE AND INCORPORATE HISTORIC PRESERVATION IN SUSTAINABLE PLANNING AND BUILDING PRACTICES

- Foster a culture of reuse of existing structures by maximizing the life cycle of existing buildings.
- Encourage reinvestment in the existing built environment.
  - Explore and adopt building codes that give a discount on the overall permit fee for the reuse of historic structures.
  - Identify and promote programs that identify historic building materials, like first growth wood and historic lath and plaster, and the values they bring to structures.
- Explore the use of outcome-based codes.
- Explore the adoption of building codes that create sustainable communities.
**Policy 6.2: Develop Programs that Encourage Preservation as Part of Creating a Sustainable Community.**

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| e. | Explore the adoption of demolition codes that require sustainable practices like  
  1. A percentage of demolition debris to be recycled and reused  
  2. Demolition permit fees that reflect the values of historic resources. |   |   |   |   |
| a. | Develop and adopt sustainability design guidelines for historic districts. |   |   |   |   |
| b. | Develop and implement programs for City and County buildings that maintain historic fabric and reduce natural resource consumption. |   |   |   |   |
| c. | Encourage and support the development of energy strategies. |   |   |   |   |
| d. | Encourage and support the development of sustainable energy systems that can provide energy for multiple historic properties that cannot achieve sustainable energy goals individually. |   |   |   |   |
| e. | Capitalize on the potential of the Green Economy and develop programs to encourage the manufacture and use of local products that are environmentally sound. |   |   |   |   |
| f. | Utilize increased permit fees for the demolition of historic structures to fund a preservation fund to create low interest loans or grants that facilitate the rehabilitation of historic structures. |   |   |   |   |
**Policy 6.3:**
**Develop an Education Program to Incorporate Sustainable Preservation into Public Information Outreach Programs on Sustainability**

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<thead>
<tr>
<th>Task</th>
<th>Responsible Parties</th>
<th>Timeline</th>
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<tr>
<td>a. Develop City and County Sponsored Public Information Outreach Programs that promote sustainability through preservation and rehabilitation of historic structures.</td>
<td>Historic Resources Commission, Lawrence/Douglas County Planning Office, Lawrence Association of Neighborhoods Planning Commission, City Commission, County Commission, Lawrence Preservation Alliance</td>
<td>Ongoing</td>
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<tr>
<td>1. Establish forums for realtors, developers, contractors, and preservationists to inform them about sustainable preservation benefits, issues and procedures.</td>
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<td>b. Align Historic Preservation Policies with sustainability policies.</td>
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<td>1. Assist the Sustainability Advisory Board with the development of goals and priorities for future cultural resource conservation efforts.</td>
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<td>2. Work with the Sustainability Coordinator to identify practical methods and programs to reach the City's goals for sustainability.</td>
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<td>3. Identify and encourage the adoption of Preservation goals, policies, and programs that incorporate sustainable community ideals.</td>
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*HORIZON 2020 Preservation Plan Element 6-29*  
*Action Plan*
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<td>c. Work with the Sustainability Coordinator to identify education programs and opportunities to promote preservation and sustainability.</td>
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<td>d. Promote educational programs that identify sustainable development and how it differs from sustainable design.</td>
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Appendices
Exhibits and Maps

List of Douglas County National Register and State Register Properties

List of Lawrence Register Properties

City of Lawrence Surveyed Properties

City of Lawrence Recommended Survey Plan

Douglas County Unincorporated Area Surveyed Properties

Douglas County Unincorporated Area Survey Plan
NATIONAL REGISTER OF HISTORIC PLACES
City of Lawrence

- Achning, Ralph and Cloyd, House, Craftsman Bungalow, c.1924
  846 Missouri Street
  Listed in the National Register in 1987
  Criterion B (Commerce: Ralph and Cloyd Achning) and Criterion C
  (Architecture: Bungalow)
  Period of Significance: 1924

- Bailey Hall, c.1900
  University of Kansas, Jayhawk Boulevard
  Listed in the National Register in 2001
  Criterion A, B (Science and Education [E. H. S. Bailey])
  Period of Significance: 1899-1949

- Bell, George and Annie, House, Folk House National, c.1862-1863
  1008 Ohio Street
  Listed in the National Register in 1983
  Criterion A (Associated with the Quantrill's Raid); Criterion A (Exploration and
  Settlement: Patterns of Lawrence Development; and Criterion C (Architecture:
  Folk House National)
  Period of Significance: 1862-1864

- Benedict House, Vernacular/Folk Victorian, c.1869
  922 Tennessee Street
  Listed in the National Register in 1992
  Criterion A (Social History: Growth and Development of Lawrence) and
  Criterion C (Architecture: Folk Victorian)
  Period of Significance: 1869-1890

  1015 Tennessee Street
  Listed in the National Register in 1972
  Criterion C (Architecture: Italianate)
  Period of Significance: 1870

- Breezedale Historic District
  Massachusetts Street south of 23rd Street
  Listed in the National Register in 2007
  Criterion A, C (Community Planning and Architecture)
  Period of Significance: 1910-1945
• Carnegie Library (Old Lawrence City Library), Beaux Arts/Classical Revival, c.1904
  200 West 9th Street
  Listed in the National Register in 1975
  Criterion A (Education: Library of Lawrence) and Criterion C (Architecture: Classical Revival)
  Period of Significance: 1904-1975

• Double Hyperbolic Paraboloid, c. 1956
  934 W 21st Street
  Listed in the National Register in 2007
  Criterion C, (Architecture and Engineering)
  Period of Significance: 1956

• Douglas County Court House, Richardson Romanesque, 1903-1904
  1100 Massachusetts Street
  Listed in the National Register in 1975
  Criterion C (Architecture and Work of a Master: Richardson Romanesque and John G. Haskell)
  Period of Significance: 1903-1904

• Duncan, Charles and Adeline, House, Italianate, c.1869
  933 Tennessee Street
  Listed in the National Register in 1986
  Criterion A (Exploration and Settlement: Development of Lawrence) and Criterion C (Architecture: Italianate)
  Period of Significance: 1869

• Dyche Hall, Romanesque, c.1901
  University of Kansas, 1031 Oread Avenue
  Listed in the National Register in 1974
  Criterion B (Education Lewis Lindsay Dyche) and Criterion C (Architecture: Romanesque)
  Period of Significance: 1901-1945

• East Lawrence Industrial Historic District
  8th Street on north, 9th Street on south, Pennsylvania Street on west and Delaware Street on west
  Listed in the National Register in 2007
  Criterion A (Commerce, Industry and Community Planning)
  Period of Significance: 1883-1955

• Eldridge Hotel, Neo-Georgian, c.1925-1928
  701 Massachusetts Street
  Listed in the National Register in 1986
  Criterion B (Commerce: William G. Huston) and Criterion C (Architecture: Neo-Georgian)
  Period of Significance: 1925-1928
• **English Lutheran Church, Gothic Revival, c.1870**
  1040 New Hampshire Street
  Listed in the National Register in 1995
  Criterion B (Social History: English Lutheran Church) and Criterion C
  (Architecture: Gothic Revival)
  Period of Significance: 1870-1929

• **Fernand-Strong, c. 1872**
  1515 University Drive
  Listed in the National Register in 2007
  Criterion A (Community Development) and Criterion B (Significant Person,
  Frank Strong)
  Period of Significance: 1872-1939

• **Goodrich, Eugene F., House, Queen Anne, c.1890-1891**
  1711 Massachusetts Street
  Listed in the National Register in 2001
  Criterion C (Architecture: Late Victorian – Queen Anne) Nomination also
  discusses association with Goodrich who resided in the residence until 1911.
  Period of Significance: 1890

• **Green Hall, Beaux Arts/ Greco Roman Revival, c.1904**
  University of Kansas, 1300 Jayhawk Boulevard
  Listed in the National Register in 1974
  Criterion C (Architecture: Greco-Roman Revival)
  Period of Significance: 1904

• **Greenlee, Michael D. House, c. 1903**
  947 Louisiana Street
  Listed in the National Register in 2004
  Criterion C (Architecture)
  Period of Significance: 1903

• **Hancock Historic District**
  Mississippi Street on west, property lines on north, Indiana Street or Oread Ave
  on east and property lines on south
  Listed in the National Register in 2004
  Criterion A (Community Planning) and Criterion C (Architecture)
  Period of Significance: 1907-1925

• **Haskell Institute (Nomination was altered to be multiple-property listing).**
  Includes The Arch (1926); Haskell Stadium (1926); Auditorium (1933);
  Hiawatha Hall (1898); Tecumseh Hall (1915); Pushmataha Hall (1929); Band
  Stand (1908); Pocahontas Hall (1931); Kiva Hall (1898); Powhatan Hall (1932);
  Old Dairy (1907); and Indian Cemetery.

  Haskell Campus, 23rd Street and Barker Avenue
  Listed as a National Historic Landmark in 1961
  Listed in the National Register in 1987
Criterion B (Education: Haskell Institute) and Criterion C (Architecture)
Period of Significance: 1884-1935

- House, Edward Residence, c. 1894
  1646 Massachusetts Street
  Listed in the National Register in 2007
  Criterion C (Architecture)
  Period of Significance: 1894

- Lawrence's Downtown Historic District
  Massachusetts Street from 6th Street to South Park Street
  Listed in the National Register in 2004
  Criterion A (Commerce and Community Planning) and Criterion C (Architecture)
  Period of Significance: 1856-1953

- Ludington/Thacher Houses, Italianate, c.1870-1889
  1613 Tennessee Street
  Listed in the National Register in 1971
  Criterion C (Architecture: Italianate)
  Period of Significance 1860-1872
  Environ delineation adopted in 1998

- Mackie, George K, House, c. 1917
  1941 Massachusetts Street
  Listed in the National Register in 2009
  Criterion A (Commerce) and Criterion C (Architecture)
  Period of Significance: 1917

- McCurdy, Witter S., House, c.1870
  909 West 6th Street
  Listed in the National Register in 2001
  Criterion C (Architecture: Folk House National)
  Period of Significance: 1870

- Miller, Robert H., House, Folk House National, c.1858-1863
  1111 East 19th Street
  Listed in the National Register in 1984
  Criterion B (Exploration/Settlement: Robert M. Miller) and Criterion C
  (Architecture: Folk House National)
  Period of Significance: 1858-1863

- Morse, Dr. Frederick D., House, Late Victorian: Queen Anne, c.1889
  1041 Tennessee Street
  Listed in the National Register in 1991
  Criterion B (Health and Medicine: Frederick Morse) and Criterion C
  (Architecture: Queen Anne)
  Period of Significance: Criterion B: 1889-1931; Criterion C: 1888-1889
- North Rhode Island Historic District
  700-1144, 901-1047, 1201-1215 Rhode Island Street
  Listed in the National Register in 2004
  Criterion A (Community Development) and Criterion C (Architecture)
  Period of Significance: 1857-1935

- Old West Lawrence
  Tennessee Street: 600s, 700s, and 800s (odd only)
  Ohio Street: 600s, 700s, and 805
  Louisiana Street: 600s, 700s, 800, and 801
  Indiana Street: 600s, 700s, and 801
  Listed in the National Register in 1972
  Criterion C (Architecture)
  Period of Significance: 1864-1945

- Oread Neighborhood Historic District
  Between W 9th and 12th Streets and alleys behind Louisiana and Kentucky Streets
  Listed in the National Register in 2007
  Criterion A (Community Development) and Criterion C (Architecture)
  Period of Significance: 1863-1946

- Pinckney I Historic District
  W 5th Street, Tennessee Street, W 6th Street, includes 501-533 Louisiana and 444-445 W 5th Street
  Listed in the National Register in 2004
  Criterion A (Community Development) and Criterion C (Architecture)
  Period of Significance: 1860-1927

- Pinckney II Historic District
  W 3rd Street, Louisiana Street, W 4th Street and Mississippi Street
  Listed in the National Register in 2004
  Criterion A (Community Development) and Criterion C (Architecture)
  Period of Significance: 1867-1924

- Plymouth Congregational Church, c. 1870
  925 Vermont Street
  Listed in the National Register in 2006
  Criterion C (Architecture: John G Haskell, Architect)
  Period of Significance: 1870-1936

- Priestly, William, House, Folk House National, c.1864
  1505 Kentucky Street
  Listed in the National Register in 1988
  Criterion A (Social History: Development of Lawrence) and Criterion C (Architecture: Folk Victorian)
  Period of Significance: 1864-1874
• Riggs, Samuel, House, Italianate, c.1863-1864 and 1910-1914
  1501 Pennsylvania Street
  Listed in the National Register in 1977
  Criterion B (Politics/Government: Samuel Riggs and Western Settlement) and
  Criterion C (Architecture: Italianate)
  Period of Significance: 1864

• Roberts, John N., House, Richardson Romanesque, c.1893-1894
  1307 Massachusetts Street
  Listed in the National Register in 1974
  Criterion C (Architecture: Richardson Romanesque)
  Period of Significance: 1893-1894

• Saint Luke African Methodist Episcopal Church, c. 1910
  900 New York Street
  Listed in the National Register in 2005
  Criterion A (Ethnic Heritage: African American) and Criterion C (Architecture)
  Period of Significance: 1910-1955

• South Rhode Island Historic District
  1120-1340 E Rhode Island, 1301-1345 W Rhode Island, 1300-1346 E New
  Hampshire, 1301-1347 W New Hampshire
  Listed in the National Register in 2004
  Criterion A (Community Development) and Criterion C (Architecture)
  Period of Significance: Criterion A, 1854-1945, Criterion C, 1873-1945

• Snow, Jane A., Residence, Shingle Style, c.1910
  706 West 12th Street
  Listed in the National Register in 1996
  Criterion B (Person: William Griffith) and Criterion C (Architecture: Shingle
  Style)
  Period of Significance: 1910

• Spooner Hall, Romanesque, c.1894
  University of Kansas, 1335-1345 Louisiana Street
  Listed in the National Register in 1974
  Criterion C (Architecture and the Work of a Master: Richardson Romanesque
  and Henry Van Brunt)
  Period of Significance: 1894

• Stephens, Judge Nelson T., House, Folk House National, c.1871
  340 North Michigan
  Listed in the National Register in 1982
  Criterion B (Politics/Government: Judge Nelson T. Stephens) and Criterion C
  (Architecture: Farmstead/Folk House National)
  Period of Significance: 1871
• Strong Hall, Beaux Arts, c. 1911-1923  
  University of Kansas, Jayhawk Boulevard  
  Listed in the Register of Kansas Historic Places in 1998  
  Criterion A (Education; University of Kansas) and Criterion C (Architecture: Beaux Arts)  
  Period of Significance: 1911-1944

• Taylor, Lucy Hobbs, House, Italianate, c. 1870  
  809 Vermont Street  
  Listed in the National Register in 1982  
  Criterion B (Social Science History: Lucy Hobbs Taylor)  
  Period of Significance: 1850-1874

• United States Post Office, c. 1906  
  645 New Hampshire Street  
  Listed in the National Register in 2002  
  Criterion C (Architecture: James Knox Taylor)  
  Period of Significance: 1906

• Usher, John Palmer and Margaret, House, Italianate, c. 1872-1873  
  1425 Tennessee Street  
  Listed in the National Register in 1975  
  Criterion B (Commerce; Union Pacific Railroad; Political: John Palmer Usher) and Criterion C (Architecture: Italianate)  
  Period of Significance: 1872-1900

• United Presbyterian Center/ Ecumenical Christian Ministries Building  
  1204 Oread Avenue  
  Listed in the National Register in 2009  
  Criterion C (Architecture: Modern)  
  Period of Significance: 1959

• Watkins Bank (Old City Hall), Richardson Romanesque, c. 1888  
  1047 Massachusetts Street  
  Listed in the National Register in 1971  
  Criterion B (Commerce: Jabez B. Watkins Bank) and Criterion C (Architecture: Richardson Romanesque)  
  Period of Significance: 1887-1929

• Zimmerman, Albert and S. T., House, Second Empire, c. 1870  
  304 Indiana Street  
  Listed in the National Register in 1974  
  Criterion C (Architecture: Second Empire)  
  Period of Significance: 1870
Douglas County

- Barnes Apple Barn, c.1857
  714 E 1728 Rd, Baldwin City vicinity
  Listed in the National Register in 2006
  Criterion B (Significant Person: William Barnes) and Criterion C (Architecture)
  Period of Significance: 1857-1920

- Black Jack Battlefield
  US Highway 56 and County Road 200, 3 miles east of Baldwin City
  Listed in the National Register in 2004
  Criterion A (Military)
  Period of Significance: 1856

- Case Library at Baker University
  Eighth and Grover, Baldwin City
  Listed in the National Register in 1986
  Criterion A (Community Planning) and Criterion C (Architecture)
  Period of Significance: 1904-1907

- Chicken Creek Bridge, c. 1913
  Lone Star vicinity
  Listed in the National Register in 1990
  Criterion C (Transportation and Engineering)
  Period of Significance: 1913

- Clinton School District 25, c. 1866
  1180 North 604 East Road, Lawrence vicinity
  Listed in the National Register in 1998
  Criterion A (Education)
  Period of Significance: 1866-1884

- Coal Creek Library, c.1900
  698 E 1719 Road, Baldwin City vicinity
  Listed in the National Register in 2003
  Criterion A (Entertainment and Recreation) and Criterion C (Architecture)
  Period of Significance: 1900-1953

- Douglas County Trail Segments, Douglas County Prairie Park
  Three miles east of Baldwin on US-56, Douglas County

- Lane University
  Lecompton
  Listed in National Register in 1971
  Criterion A (Education)
  Period of Significance: 1882-1902
• Lecompton Constitution Hall, c. 1857
  319 Elmore, Lecompton
  Listed in the National Register in 1971
  Criterion A (Political)
  Period of Significance: 1857-1858
  National Historic Landmark: 1971

• Old Castle Hall, c. 1858
  513 Fifth Street, Baldwin City
  Listed in the National Register in 1971
  Criterion C (Architecture)
  Period of Significance: 1858

• Parmenter Hall, Baker University
  Eighth and Dearborn, Baldwin City
  Listed in National Register in 1977
  Criterion A (Education)
  Period of Significance: 1865-1871

• Pilla, Charles House, c. 1894
  615 Elm, Eudora
  Listed in National Register in 1974
  Criterion A (Commerce: Charles Pilla) and Criterion C (Architecture)
  Period of Significance: 1894

• Quayle, William A. House, c. 1913
  210 N. 6th Street
  Listed in the National Register in 2001
  Criterion B (Education: William Quayle) and Criterion C (Architecture)
  Period of Significance: 1913-1925

• Santa Fe Depot, c. 1907
  1601 High, Baldwin City
  Listed in National Register in 1983
  Criterion A (Transportation) and Criterion C (Architecture)
  Period of Significance: 1907

• Stoebener Barn, c. 1914
  NW ¼ SW ¼ NE ¾, SW ¼ S6-T15S-R19E
  Listed in the National Register in 1989
  Criterion C (Architecture: two-story vernacular barn)
  Period of Significance: 1914

• Stony Point Evangelical Lutheran Church, c. 1882
  1575 N 600 Road, Baldwin City
  Listed in the National Register in 2006
  Criterion A (Social History) and Criterion C (Architecture)
  Period of Significance: 1882-1907
• Vermilya-Boener House, c.1866-1868
  NE ¼ SE ¼ SE ¼ SE ¼, S-12, T-12S, R-19E
  Listed in the National Register of Historic Places in 1991
  Criterion B (Association with Persons: Elijah and Cynthia Vermilya, William
  Boener, and Ella Virginia Vermilya-Boener) and Criterion C (Architecture: Italian
  Villa, Italianate)
  Period of Significance: 1864-1915

• Vinland Association Fairgrounds Exhibit Building, c.1927
  1736 N 700 Road, Vinland
  Listed in National Register in 2004
  Criterion A (Entertainment and Recreation) and Criterion C (Architecture)
  Period of Significance: 1927-1953

• Vinland Grange Hall, 1875
  Junction of Oak and Main streets
  Listed in the National Register in 2000
  Period of Significance: 1875-1899, 1900-1924, 1925-1949

• Vinland Presbyterian Church, c.1879
  697 E 1725 Road, Vinland
  Listed in National Register in 2003
  Criterion C (Architecture)
  Period of Significance: 1879

REGISTER OF KANSAS HISTORIC PLACES
[All properties listed in the National Register of Historic Places are listed in the Register of
Kansas Historic Places.]

City of Lawrence

• Bailey Hall, c.1900
  University of Kansas, Jayhawk Boulevard
  Listed in the Register of Kansas Historic Places in 1995
  Criterion B (Education [E. H. S. Bailey])
  Period of Significance: 1899-1949

• Eldridge, Shalor, Residence, Folk House National, c.1857-1867
  945 Rhode Island
  Listed in the Register of Kansas Historic Places in 1979
  Criterion B (Person: Shalor Eldridge)
  Period of Significance: 1857-1874
• Chi Omega Sorority House, Jacobethan, c.1925
  1345 West Campus Road
  Listed in the Register of Kansas Historic Places in 1983
  Criterion C (Architecture: Jacobethan)
  Period of Significance: 1925

• Consolidated Barb Wire Building, c.1892
  546 New Hampshire
  Listed in the Register of Kansas Historic Places in 1988
  Criterion A (Industry: Industrial Development of Lawrence) and Criterion C
  (Architecture: Industrial)
  Period of Significance: 1892-1899

• Ferdinand Fuller House, c.1863
  1005 Sunset Drive
  Listed in the Register of Kansas Historic Places in 2011
  Criterion B (Settlement: Ferdinand Fuller) and Criterion C (Architecture)
  Period of Significance: 1854-1886

• Greenlees, John Robert House, c.1899
  714 Mississippi Street
  Listed in the Register of Kansas Historic Places in 2009
  Criterion A (Commerce, Industry and Economics)
  Period of Significance: 1865-1947

• House Building, c. 1863
  729-731 Massachusetts Street
  Listed in the Register of Kansas Historic Places in 2000
  Criterion A (Community Development and Economics)
  Period of Significance: 1863-1921

• Union Pacific Depot, Romanesque, c.1889
  402 North 2nd Street
  Listed in the Register of Kansas Historic Places in 1989
  Criterion B (Person: Henry Van Brunt) and Criterion C (Architecture:
  Romanesque)

• Wiggins, Dudley, Residence, Folk Victorian, c.1858
  840 West 21st Street
  Listed in the Register of Kansas Historic Places in 1986
  Criterion B (Person: Dudley Wiggins)
  Period of Significance: 1858-1880
**Douglas County**

- **Palmyra Mason Lodge, c.1894**  
  602-604 High Street, Baldwin City  
  Listed in Register of Kansas Historic Places in 2011  
  Criterion A (Social History)  
  Period of Significance: 1894

- **Robert Hall Pearson Farm, c.1886**  
  163 E 2000 Road, Baldwin City vicinity  
  Listed in Register of Kansas Historic Places in 2005  
  Criterion A (Settlement and Social History) and Criterion C (Architecture)  
  Period of Significance: 1886-1906

**LAWRENCE REGISTER OF HISTORIC PLACES**

- **820 New Jersey**  
  Listed in Lawrence Register of Historic Places in 2006  
  Criterion #1 (Community Development), #4 (Architecture)  
  Period of Significance: 1868-1870

- **Bailey, E. H. S., Residence, Dutch Colonial Revival, c.1908**  
  1101 Ohio Street  
  Listed in the Lawrence Register of Historic Places in 2000  
  Criterion #3 (Person: E. H. S. Bailey)  
  Period of Significance: 1908-1933  
  Environs delineated March 2000

- **Bell, George and Annie, House, Folk House National, c.1862-1863**  
  1008 Ohio Street  
  Listed in the Lawrence Register of Historic Places in 1991  
  Criterion #1 (Shows evolution of residential structures); Criterion #2 (Site: Quantrill's Raid); Criterion #3 (Person: George Bell); Criterion #4 (Architecture: Greek Temple Form); and Criterion #6 (Architecture: Greek Temple Form)  
  Period of Significance: Not Listed

- **Benedict House, Folk Victorian, c.1869**  
  923 Tennessee Street  
  Listed in the Lawrence Register of Historic Places in 1990  
  Criterion #4 (Architecture: Queen Anne)  
  Period of Significance: Not Listed

- **Dillard House, Queen Anne, c.1890**  
  520 Louisiana Street  
  Listed in the Lawrence Register of Historic Places in 1990  
  Criterion #3 (Person: Dillard Family/African-American Heritage)  
  Period of Significance: Not Listed
• Double Hyperbolic Paraboloid, c. 1956
  934 W 21st Street
  Listed in the Lawrence Register of Historic Places in 2008
  Criterion #4 (Architecture) and #6 (Engineering)
  Period of Significance: 1956

• Duncan House, Italianate, c.1869
  933 Tennessee Street
  Listed in the Lawrence Register of Historic Places in 1990
  Criterion #3 (Person: Charles S. Duncan) and Criterion #4 (Architecture: Italianate)
  Period of Significance: Not Listed

• East Lawrence Industrial Historic District
  8th Street on north, 9th Street on south, Pennsylvania Street on west and
  Delaware Street on west
  Listed in the Lawrence Register of Historic Places in 1990
  Criterion #1 (Community Development), #3 (Significant Person), #4 (Architecture)
  Period of Significance: 1883-1955

• Eldridge, Shalor, House, Folk House National, 1857-1867
  945 Rhode Island Street
  Listed in the Lawrence Register of Historic Places in 1990
  Criterion #3 (Person: Colonel Shalor Eldridge)
  Period of Significance: Not Listed

• Fernand-Strong, c. 1872
  1515 University Drive
  Listed in the Lawrence Register of Historic Places in 2010
  Criterion #1 (Development) and #3 (Person: Frank Strong)
  Period of Significance: 1872-1939

• Fire Station #2
  1839 Massachusetts Street
  Listed in the Lawrence Register of Historic Places in 2006
  Criterion #1 (Development) and #4 (Architecture)
  Period of Significance: 1928

• Fischer, Otto House, c. 1892
  621 Connecticut Street
  Listed in the Lawrence Register of Historic Places in 2007
  Criterion #3 (Person: Otto Fischer) and #4 (Architecture)
  Period of Significance: 1892
• Greenlees, John Robert House, c.1899
  714 Mississippi Street
  Listed in the Lawrence Register of Historic Places in 2010
  Criterion #4 (Architecture)
  Period of Significance: 1865-1947

• Griffith House, Stick Style, c.1888
  511 Ohio Street
  Listed in the Lawrence Register of Historic Places in 1990
  Criterion #4 (Architecture: Stick Style)
  Period of Significance: 1888

• Grover Barn, c.1858
  2819 Stone Barn Terrace
  Listed in the Lawrence Register of Historic Places in 2006
  Criterion #1 (Development), #2 (Location), #3 (Person)
  Period of Significance: 1858

• Hanna Building, c.
  933 Massachusetts
  Listed in the Lawrence Register of Historic Places in 2002
  Criterion #4 (Architecture) and #6 (Design)
  Period of Significance: Not Listed

• Hendry House, I-House, c.1858-1885
  941 Rhode Island Street
  Listed in the Lawrence Register of Historic Places in 1990
  Criterion #2 (Site: Survived Quantrill’s Raid); Criterion #3 (Person: Judge Hendry); and Criterion #4 (Architecture: Georgian I-House)
  Period of Significance: Not Listed

• Hobbs Park, c.1946
  702 E 11th Street
  Listed in the Lawrence Register of Historic Places in 2006
  Criterion #1 (Development), #2 (Location), #3 (Person: Hobbs)
  Period of Significance:

• House Building, Early Twentieth-century Commercial, c.1863-1921
  729-731 Massachusetts Street
  Listed in the Lawrence Register of Historic Places in 1990
  Criterion #2 (Site: Quantrill’s Raid) and Criterion #3 (Person: Robert House)
  Period of Significance: 1860-1940

• House, Edward Residence, c. 1894
  1646 Massachusetts Street
  Listed in the Lawrence Register of Historic Places in 2007
  Criterion #4 (Architecture), #6 (Design)
  Period of Significance: 1894
• Ludington/Thacher Residence, Italianate, c.1870-1889
  1615 Tennessee Street
  Listed in the Lawrence Register of Historic Places in 1998
  Criterion #3 (Person: R. W. Ludington and Judge Solon O. Thacher); Criterion
  #4 (Architecture); and Criterion #8 (Unique location/visual feature)
  Period of Significance: 1870-1912
  Environ delineated May 1997

• McAllaster, Octavius W., Residence, Vernacular (Gable-front form), c.1858, 1863
  724 Rhode Island Street
  Listed in the Lawrence Register of Historic Places in 1997
  Criterion #2 (Quantrill’s Raid); Criterion #3 (Person: Octavius W. McAllaster);
  and Criterion #4 (Architecture: Vernacular/Greek Temple)
  Period of Significance: Not Listed

• McCurdy House, I-house, c.1870
  909 West 6th Street
  Listed in the Lawrence Register of Historic Places in 1990
  Criterion #3 (Person: Witter S., Jesse and Emily McCurdy) and Criterion #4
  (Architecture: I-House)
  Period of Significance: Not Listed

• McFarland House, Folk House National, Queen Anne, c.1904-1905
  940 Rhode Island Street
  Listed in the Lawrence Register of Historic Places in 1990
  Criterion #3 (Person: Charles McFarland)
  Period of Significance: Not Listed

• Miller’s Hall, Italianate, c.1864-1865
  723-725 Massachusetts Street
  Listed in the Lawrence Register of Historic Places
  Criterion #1 (Social: Gathering place for many groups); Criterion #2 (Site of
  the first newspaper published in Kansas); and Criterion #6 (Architecture/
  craftsmanship: Italianate)
  Period of Significance: Not Listed

• Miller, Robert H., House, Folk House National, c.1858-1863
  1111 East 19th Street
  Listed in the Lawrence Register of Historic Places in 1990
  Criterion #2 (Site: Survived Quantrill’s Raid); Criterion #3 (Person: Robert
  Miller); Criterion #4 (Architecture: Greek Temple form); and Criterion #5
  (Master Builder: Not Identified)
  Period of Significance: Listed as 1854-1861
• Morse, Dr. Frederick, House, Queen Anne, c.1889
  1041 Tennessee Street
  Listed in the Lawrence Register of Historic Places in 1990
  Criterion #3 (Person: Dr. Frederick D. Morse) and Criterion #4 (Architecture: Queen Anne)
  Period of Significance: Not Listed

• Oread Historic District
  Even numbers of the 1000 block of Ohio Street and the Odd numbers of the 1000 block of Tennessee Street.
  Listed in the Lawrence Register of Historic Places in 1990
  Criterion #1 (Development of Lawrence: Typical Oread Block); #3 (Person: Many Prominent Citizens); and #4 (Architecture: Represents several styles – e.g. Queen Anne, Vernacular, Italianate)
  Period of Significance: 1861-1927

• Plymouth Congregational Church, c. 1870
  925 Vermont Street
  Listed in the Lawrence Register of Historic Places in 2007
  Criterion #1 (Development), #4 (Architecture), #5 (Master Builder), #6 (Design)
  Period of Significance: 1870-1936

• Roberts, John N., House, Richardson Romanesque, c.1893-1894
  1307 Massachusetts Street
  Listed in the Lawrence Register of Historic Places in 1990
  Criterion #3 (Person: John Roberts); Criterion #5 (Architect: John G. Haskell); and Criterion #6(Architecture: Richardson Romanesque)
  Period of Significance: Not Listed

• Shane, J. B., Juno Bell Shane Thompson Studio, c.1885
  615 Massachusetts Street
  Listed in the Lawrence Register of Historic Places in 1990
  Criterion #3 (Person: J. B. Shane and Juno-Bell Shane)
  Period of Significance: Not listed

• Snow, Jane A., Residence, Shingle Style, c.1910
  706 West 12th Street
  Listed in the Lawrence Register of Historic Places in 1990
  Criterion #3 (Person: William A. Griffith) and Criterion #4 (Architecture: Shingle Style)
  Period of Significance: 1910

• Social Service League, Folk House National, c.1864-1888
  905-907 Rhode Island
  Listed in the Lawrence Register of Historic Places in 2000
  Criterion #3 (Group: Social Service League); Criterion #4 (Architecture: Stone Vernacular); Criterion #8 (Unique location/visual feature); and Criterion #9 (Utilitarian structure)

HORIZON 2020 Preservation Plan Element 6-48 Action Plan
Period of Significance: (1864-Present)
Environs delineated March 2000

- South Park, c.1854-Present
  Bounded by Vermont Street on the west, New Hampshire Street and vacated New Hampshire Street on the east, North Park Street on the north, and South Park Street on the south.
  Listed in the Lawrence Register of Historic Places in 2000
  Criterion #2 (Location of a significant local, county, or state event) and Criterion #8 (Unique location/visual feature)
  Period of Significance: 1854-Present
  Environs delineated March 2000

- Stephens, Judge Nelson, House, Folk House National, c.1871
  340 North Michigan
  Listed in the Lawrence Register of Historic Places in 1990
  Criterion #1 (Representative of 1880s farmstead); Criterion #3 (Person: Judge Nelson T. Stephens); Criterion #4 (Architecture: 1870 Vernacular/ gravity flow water system); and Criterion #5 (Master builder not identified)
  Period of Significance: Not Listed

- Zinn-Burroughs House, c.
  1927 Learnard Avenue
  Listed in the Lawrence Register of Historic Places in 2005
  Criterion #3 (Person: William Burroughs) and #4 (Architecture)
  Period of Significance: Not Listed
City of Lawrence Surveyed Properties

HORIZON 2020 Preservation Plan Element

Map
City of Lawrence Recommended Survey Plan

- Highest Priority
- Medium Priority
- Lower Priority

City of Lawrence Recommended Survey Plan
Unincorporated Douglas County Areas Surveyed

Date: May 26th, 2011

Legend
- Reconnaissance Survey
- Palmyra Township 1988

Douglas County Unincorporated Area Surveyed Properties
Glossary
Adaptive Use — The process of converting a building to a use other than that for which it was designed.

Alteration — Any act or process that changes one or more historic, architectural, or physical features of an area, site, landscape, place, and/or structure, including, but not limited to, the erection, construction, reconstruction, or removal of any structure; the expansion or significant modification of agricultural activities; and the clearing, grading, or other modification of an area, site, or landscape that changes its current condition.

Amenity — A building, object area, or landscape feature that makes an aesthetic contribution to the environment, rather than one that is purely utilitarian.

Americans with Disabilities Act (ADA) — A federal act that mandates reasonable access and accommodation of the needs of all individuals, regardless of the presence of a handicap or disability.

Archaeology — The study of the cultural remains of prehistoric and historic peoples and cultural groups including excavated material as well as above-ground resources.

Certificate of Appropriateness — A document awarded by a local preservation commission or architectural review board allowing an applicant to proceed with a proposed alteration, demolition, or new construction in a designated area, following a determination of the proposal’s suitability according to applicable criteria.

Certified Historic Structure — For the purposes of the federal preservation tax incentives, any structure subject to depreciation, as defined by the Internal Revenue Code, that is listed individually in the National Register of Historic Places or listed as a contributing property to a National Register Historic District.

Certified Rehabilitation — Any rehabilitation of a certified property that the Secretary of the Interior has determined is consistent with the historical character of the property or the district in which the property is located.

Code Enforcement — The local regulation of building practices and enforcement of safety and housing code provisions, a principal tool to ensure neighborhood upkeep.

Community Development Block Grant (CDBG) — A federal funding program that provides annual funding to eligible local governments for housing and community revitalization and development programs and for social services, particularly in low- and moderate-income areas.

Comprehensive Plan — A document guiding the future growth and development of a specified geographic area and/or governmental entity. It provides a vision and direction for the city and a cohesive framework for decision-making.
**Conservation District** — An area designated by city ordinance that possesses lesser historic significance and/or historic architectural integrity than a historic district, but which retains sufficient amounts of its historical and architectural visual characteristics to interpret areas of special historic, architectural, and/or cultural significance that are part of a city's history.

**Construction** — The act of adding an addition to an existing structure or the erection of a new principal or accessory structure on a lot or property.

**Cultural Landscape** — A geographical area, including both cultural and natural resources, and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values. There are four recognized types of cultural landscapes: historic sites that include man-made and natural features, historic designed landscapes, historic vernacular landscapes that include man-made and natural features, and ethnographic landscapes that reflect specific cultural and racial groups.

**Cultural Resource** — The districts, sites, structures, objects, and evidence of some importance to a culture, a subculture, or a community for scientific, engineering, art tradition, religious, or other reasons significant in providing resource and environmental data necessary for the study and interpretation of past lifeways and for interpreting human behavior.

**Database** — A collection of background information collected and organized for easy and quick retrieval.

**Demolition** — Any act or process that removes or destroys in part or in whole a building, structure, or object of a site.

**Demolition by Neglect** — The destruction of a building through abandonment or lack of maintenance or an act or process that threatens to destroy a building, structure, or object of a site by failure to maintain it in a condition of good repair and maintenance.

**Design Guideline** — A standard of appropriate activity that guides rehabilitation and new construction efforts that preserve and enhance the historic, architectural, scenic, or aesthetic character of an area. It includes criteria developed by preservation commissions and architectural review boards to identify design concerns in a specific area and to assist property owners to ensure that rehabilitation and new construction respect the character of designated buildings and districts.

**Design Review** — The process of ascertaining whether modifications to historic and other structures, settings, and districts meet established legal standards of appropriateness.

**Dismantling** — Taking apart a building or structure piece by piece, often with the intention of reconstructing it elsewhere.

**Easement** — A less-than-fee interest in real property acquired through donation or purchase and carried as a deed restriction or covenant to protect important open spaces, building façades, and interiors.

**Eminent Domain** — The power of government to acquire private property for public benefit after payment of just compensation to the owners.
**Enabling Legislation** — Federal and state laws that authorize governing bodies within their jurisdictions to enact particular measures or delegate powers such as enactment of local landmarks historic and conservation district ordinances, zoning, and taxation.

**Environ Review** — The State of Kansas Statutes require projects (any undertaken, licensed, or permitted by the state or its political subdivisions [such as a city, county, township, school district, etc.]) that are within 500 feet of the listed property to be reviewed for the project’s impact on the listed property or its environs.

**Exterior Architectural Appearance** — The architectural character and general composition of the exterior of a building, structure, object, or site, including but not limited to the kind, color, and texture of the building material and the type, design, and character of all windows, doors, light fixtures, signs, and appurtenant elements.

**Fabric** — The physical material of a building, structure, or city connotating an interweaving of component parts.

**Green Space** — Land not available for construction and designated for conservation, preservation, recreation, or landscaping.

**Historic District** — A geographic area designated as a "historic district" by city ordinance may include individual Landmarks as well as other properties or structures that while not of such historic and or architectural significance individually, as a whole they contribute to the overall visual characteristics and historical significance of the Historic District. Historic districts contain a significant concentration of buildings, structures, sites, spaces, and/or objects unified by past events, physical development, design, setting, materials, workmanship, sense of cohesiveness, or related historical and aesthetic associations. The significance of a district may be recognized through listing in a local or national landmark register and may be protected legally through enactment of a local historic district ordinance administered by a historic district board or commission.

**Historic Significance** — Character, interest or value as part of the development, heritage, or culture of the community, county, state or country, such as the location of an important local, county, state or national event, or the identification with a person or persons who made an important contribution to the development of the community, county, state or country.

**Incentives** — Inducements provided by government such as tax abatement, tax reduction, loan, and grant programs to encourage behavior that is in the public interest.

**Implementation Strategies** — Ideas developed during the Preservation Plan process that can be explored as possible ways to put the principles for policy and goals into effect.

**Incentives** — Inducements provided by government such as tax abatement, tax reduction, and tax incentives to encourage development in specific areas or for certain classifications of property.

**Landmark** — A property or structure designated by the city that is worthy of rehabilitation, restoration, interpretation, and preservation because of its historic, architectural, or archaeological significance.
Landscape — The totality of the built or human-influenced habitat experienced at any one place. Dominant features are topography, plant cover, buildings, or other structures and their patterns.

Mixed Use — A variety of authorized activities in an area or a building as distinguished from the isolated uses and planned separatism prescribed by many zoning ordinances.

Neighborhood Improvement District — A voter-authorized state enabling legislation in Missouri granting authority to establish and operate special taxing districts to raise and spend funds for public improvements in a specified geographic area.

Ordinary Maintenance — Any work for which a building permit is not required by municipal ordinance, where the purpose and effect of such work is to correct any deterioration or decay of, or damage to, a structure or any part thereof and to restore the same, as nearly as may be practical, to its condition prior to the occurrence of such deterioration, decay, or damage, and does not involve change of materials nor of form.

Overlay Zoning — The creation of a special zoning classification that is added to existing zoning in a specific geographic area. The new zoning adds new provisions to existing zoning while still retaining the original zoning requirements.

Planning Commission — A generic term for an appointed municipal or county board that makes recommendations regarding land use issues to the governing body.

Preservation — Generally saving from destruction or deterioration old and historic buildings, sites, structures, and objects and providing for their continued use by means of restoration, rehabilitation, or adaptive use. Specifically, “the act or process of applying measures to sustain the existing form, integrity and material of a building, site, structure or object.”

Preservation Commission — A generic term for an appointed municipal or county board that recommends the designation of and regulates changes to historic districts and landmarks.

Property Maintenance Code — The part of a city’s code of ordinances that sets standards for the maintenance and rehabilitation of properties to ensure public health, safety and welfare and to upgrade neighborhoods.

Public Improvement Project — An action by a government entity and any of its departments or agencies involving major modification or replacement of streets, sidewalks, curbs, street lights, street or sidewalk furniture, landscaping, parking, or other portions of the public infrastructure servicing commercial, residential, recreational, or industrial development; or any undertakings effecting city parks or city-owned structures.

Reconstruction — The act or process of reproducing by new construction the exact form and detail of a vanished building, structure, or object or a part thereof, as it appeared at a specific period of time.

Rehabilitation — The act or process of returning a property to a state of utility through repair or alteration that makes possible an efficient contemporary use while preserving those portions...
or features of the property that are significant to its historical, architectural, and cultural values.

**Rehabilitation Tax Incentive** — A tax incentive designed to encourage private investment in historic preservation and rehabilitation projects.

**Removal** — Any relocation of a structure, object, or artifact on its site or to another site.

**Renovation** — The modernization of an old or historic building that may or may not produce inappropriate alterations or eliminate important features and details.

**Repair** — Any change that is not construction, alteration, demolition, or removal and is necessary or useful for continuing normal maintenance and upkeep.

**Restoration** — The act or process of accurately recovering the form and details of a property and its setting as it appeared at a particular period of time by means of the removal of later work or by the replacement of missing earlier work.

**Revitalization** — To give new life or vigor to an area by introducing new uses and/or by upgrading the infrastructure and physical conditions of buildings.

**Revolving Fund** — A funding source that makes loans to accomplish some preservation purpose, e.g. the purchase and rehabilitation of an endangered property. The loans are repaid to maintain the fund for other projects.

**Section 106** — The provision of the National Historic Preservation Act of 1966, as amended, that requires federal agencies to determine and mitigate negative impact of an undertaking on properties listed or eligible for listing in the National Register of Historic Places.

**Sense of Place** — The sum of attributes of a locality, neighborhood, or property that give it a unique and distinctive character.

**Stabilization** — The act or process of applying measures designed to reestablish a weather-resistant enclosure and the structural stability of an unsafe or deteriorated property, while maintaining the essential form as it exists at present.

**Streetscape** — The distinguishing character of a particular street as created by its width, degree of curvature, paving materials, design of the street furniture and of the forms of surrounding buildings.

**Structure** — Anything constructed or erected, the use of which requires permanent or temporary location on or in the ground, including, but without limiting the generality of the foregoing, buildings, fences, gazebos, advertising signs, billboards, backstops for tennis courts, radio and television antennae and towers, and swimming pools.

**Style** — A type of architecture distinguished by special characteristics of structure and ornament and often related in time; also, a general quality of distinctive character.

**Synergy** — An act of cooperation where different uses, property types and styles work collectively to contribute to a more vibrant and dynamic area.
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Taft, Robert. Across the Years on Mount Oread. Lawrence: University of Kansas, 1941.


"University Place Homes Tour." Brochure, 1992. Kansas Collection, Spencer Research Library, University of Kansas.

University Weekly. November 13, 1897.


June 19, 2011

Mr. Charles Blaser, Chairman
Members
Lawrence-Douglas County Metropolitan Planning Commission
City Hall
Lawrence, Kansas 66044

RE: ITEM NO. 6: COMPREHENSIVE PLAN AMENDMENT TO HORIZON 2020; UPDATE OF CHAPTER 11 (LBZ)

Dear Chairman Blaser and Planning Commissioners:

We want to thank the staff for the carefully crafted update to Horizon 2020, the Chapter 11, Historic Resources plan amendment.

We have only one comment. Goal Two, “Conserve the Rural Character of Unincorporated Douglas County in Strategic Areas,” gave us concern because it is subject to possible misinterpretation. It implies that only those areas of Douglas County will be conserved for their Rural Character that are identified as “strategic.” The implication is that everything else is subject to non-rural development. We don’t believe that this is what is intended. It would be more to the point to state, “Conserve the Rural Character of Unincorporated Douglas County,” which is a major theme of Horizon 2020.

Alternatively, we suggest that the wording for Goal Two be modified as follows:

“Identify and conserve the historic areas and places in unincorporated Douglas County.”

We hope that this is the concept that you intend.

Again we thank the staff and the commissions who have contributed to this amendment, and hope you will look favorably on our suggested change to Goal Two.

Sincerely yours,

Caleb Morse
Member of the Board

Alan Black
Chairman, Land Use Committee
PLANNING COMMISSION REPORT  
Non Public Hearing Item

MISCELLANEOUS ITEM NO. 1: FINAL DEVELOPMENT PLAN; BURGER KING – BAUER FARM PCD; 4671 BAUER FARM DRIVE (SLD)

FDP-5-2-11: Consider Final Development Plan for a 2,855 SF drive-thru restaurant [Burger King – Bauer Farm PCD], located on approximately 0.7 acres, at 4671 Bauer Farm Drive. Submitted by Bartlett & West Engineering for Genesh Inc., property owner of record.

STAFF RECOMMENDATION: Planning staff recommends approval of the Final Development Plan based upon the findings of fact presented in the body of the Staff Report subject to the following conditions:

1. Submission of building elevations to be recorded with the Final Development Plan.
2. Provision of a mylar for the site plan and applicable recording fees.

Reason for Request: The Final Development Plan is required prior to development of site.

Attachments:
- Proposed Final Development Plan
- Development History Summary

KEY POINTS:
- The Preliminary Development Plan was originally approved under the City’s pre-2006 Zoning Regulations. The Final Development Plan is also being considered under these regulations.
- Proposed development is for a single use on a single lot for a drive-thru restaurant.

Design Standards to Consider
- Consistency with Article 10 of the 1966 Zoning Code.
- Consistency with the approved Preliminary Development Plan.

ASSOCIATED CASES/OTHER ACTION REQUIRED
- PDP-12-4-10; revised preliminary development plan administratively approved on 2/15/11.
- MS-12-10-10; Minor Subdivision recorded Book 1072, Page 3162 on 3/10/11.
- Recording of a Final Development Plan with the Register of Deeds Office.

PUBLIC COMMENT RECEIVED PRIOR TO PRINTING
- None

PLANS AND STUDIES REQUIRED
- Traffic Study – Not required for application.
- Downstream Sanitary Sewer Analysis – Not required for this application.
- Commercial Design Guidelines – Applied to proposed development.
- Drainage Study – Not required for application.
- Retail Market Study – Not applicable to application.
- Alternative Compliance – None proposed.

GENERAL INFORMATION
Surrounding Zoning and Land Use: PD - [Bauer Farm PCD] to the north, east, and west; developing commercial center.

PD - [Westgate PCD] to the south of W. 6th Street developed commercial center including office uses.

**STAFF SUMMARY**

This proposed Final Development Plan includes a single lot for the development of a 2,855 SF drive-thru restaurant. This lot will share access from Bauer Farm Drive with the property to the east. A revised Preliminary Development Plan was administratively approved in February 2011.

The proposed parking exceeds the minimum requirement of the development but is consistent with previous Preliminary Development Plan approval.

**STAFF REVIEW**

Section 20-1011(c) states that a public hearing shall not be required for a Final Development Plan that is in substantial compliance with the approved Preliminary Development Plan.

**Common Open Space**

A minimum of 20% of the lot is required to be provided in open space. The proposed development includes approximately 30% open space located around the perimeter of the site and within interior parking lot islands.

**Landscaping**

Landscaping treatments along the public right of way provide buffering to the site and screen the proposed parking lot.

**Signs**

The location of a ground mounted sign is shown on the plan. Elevations depict proposed wall signage. A separate sign permit is required and approval of the Final Development Plan does not include specific approval of Signage.

**Access**

A shared driveway from Bauer Farm Drive provides vehicular access to the site. The driveway will be constructed with this development.

**Floodplain**

This property is not encumbered by regulatory floodplain.

**Conclusion**

The total square footage of the retail building is consistent with the approved Preliminary Development Plan. A Final Development Plan along with appropriate building elevations shall be recorded with the Register of Deeds Office prior is issuance of a building permit for construction.

<table>
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<tr>
<th>Site Summary (Lot 1 Champion Addition)</th>
<th>Area (SF)</th>
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<tbody>
<tr>
<td>Total Lot Area</td>
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<td>Total Building</td>
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<td>Total impervious</td>
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<table>
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<tr>
<th>Parking Summary</th>
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<tbody>
<tr>
<td>Parking Requirements</td>
<td>1 space per 200 NSF = 11 spaces</td>
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<tr>
<td>Proposed Parking</td>
<td>28 spaces</td>
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</table>
### Approved PDP Block 9 Lots 1 and 2
- Access for each lot
- Access for Lot 1 closer to intersection
- Drive thru on east side of building (Lot 1)
- Trash enclosure oriented to street intersection
- Parking row along building on west side (Lot 1)
- Parking spaces Lot 1 = 11 space
- Parking spaces Lot 2 = 34.5 spaces

### Proposed Block 9 Lots 1 and 2
- Single shared access
- Access farther from intersection
- Drive thru on west side of building (Lot 1)
- Trash enclosure oriented and screened by building
- Parking row extends to W. 6th Street
- Parking spaces Lot 1 = 29
- Parking spaces Lot 2 = 20
SUMMARY OF ASSOCIATED CASES

REZONINGS
(COMMERCIAL--West portion of project)
- Z-6-19-03; 18.93 acres; A to PCD-2; Ord. 7756 [original request].
- Z-3-17-05; 8.23 acres; PRD-2 to PCD-2 [revised residential/commercial boundary].
- Z-7-48-05 18.93 acres PCD-2 to PCD-2 revise use restrictions between Wakarusa and Champion.

(OFFICE--Southeast portion of project)
- Z-3-16-05; 2.59 acres, PRD-2 to POD-1 [southeast portion of project; unpublished].

(RESIDENTIAL--East portion of project)
- Z-6-20-03; 25.214 acres, A to PRD-2; Ord. 7757 [original request].
- Z-6-08-07; 16.53 acres PRD-2 to PRD-3; [pending recordation of final plat]

FINAL PLATS
- PF-05-04-08; Final Plat Bauer Farms First Plat (Portion of PCD);
- PF-07-03-09; Bauer Farm Second Plat (PRD and POD); PC approved with conditions, 9/21/09. [Placed on hold at applicant's request.]
- PF-9-7-09; Bauer Farm Third Plat (Portion of PCD – carwash)
- PF-4-3-10; Bauer Farm 4th Plat (PRD portion – retirement housing)
- MS-12-10-10; Champion Addition (two lots east of Champion Lane)

PRELIMINARY DEVELOPMENT PLANS
- PDP-03-02-05; CC approved March 4, 2008
- PDP-6-1-09; CC approved September 8, 2009 [addition of carwash to PCD].
- PDP-1-1-10; cc approved April, 6, 2010 [retirement residence].

<table>
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<th>PDP Comparison Table</th>
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<tr>
<td><strong>PCD</strong></td>
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<td>PDP-12-4-10</td>
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</table>

**FINAL DEVELOPMENT PLANS**

(PCD PORTION)
- FPD-5-7-09; CVS, Taco Bell, Spec Building; PC approved 7/21/08.
- FDP-9-8-09; Tunnel Car Wash; PC approved 11/16/09.
- FDP-1-1-10; addition of outdoor dining to Lot 3, Block 7; administratively approved.

(PRD PORTION)
- FDP-1-2-09; Bauer Farms- Phase 2 (residential development) PC approved on 5/18/09 [Placed ‘on hold’ at applicant’s request].
Memorandum
City of Lawrence
Planning & Development Services

TO: Planning Commission
FROM: Mary Miller, Planning Staff
CC: Scott McCullough, Planning and Development Services Director
Sheila Stogsdill, Assistant Planning Director

Date: For June 22, 2011 meeting

RE: Agenda Item No. 8: Extension request for PP-10-5-09 A Revised Preliminary Plat for lots 7, 8 and 9, Block Four and Lots 2, 3, and 4, Block Seven as shown on the approved Preliminary Plat for Mercato dated 4/26/06

Attachments: A—Extension Request Letter
B—City Commission Minutes and Staff Memo regarding Renaissance Drive Right-of-Way.
C—Preliminary Plat approved by the Planning Commission at their December 14, 2009 meeting with conditions

BACKGROUND
The revised preliminary plat referenced above was submitted in 2009 in conjunction with a rezoning request for 24 acres to the CC400 District, Z-10-17-09, to allow additional commercial uses in the Mercato development. Additional commercial space became available upon the expiration of the plat for the Northgate Development to the south of W 6th Street/Hwy 40. The revised preliminary plat proposed an additional access onto W 6th Street and the construction of a street along the west perimeter of the property, in the area that at that time was KDOT right-of-way for the K-10 Bypass. A copy of the revised preliminary plat is included with this memo as an attachment.

The Planning Commission approved the preliminary plat on December 14, 2009 and forwarded it to the City Commission for acceptance of dedications. The City Commission approved the rezoning to the CC400 District and accepted the dedications shown on the preliminary plat at their January 5, 2010 meeting.

EXTENSION REQUEST
The applicant’s extension request is included with this memo as an attachment. The preliminary plat was approved subject to the following conditions:
1) The preliminary plat shall be revised as follows:
   a. The dimension of the western width of right-of-way for Overland Drive shall be noted on the plat.
   b. The plat shall be revised to clearly identify the Southern Star easement which is being proposed for vacation.
c. The plat shall show the relocation of the Southern Star gas line to the south rather than extending through the easement which is to be vacated.

d. The extension of the Southern Star gas line off-site to tie into the existing gas line to the southeast must be approved by Southern Star.

2) Prior to recording the final plat, the applicant shall provide the Planning Office with documentation that right-of-way for Renaissance Drive is available prior to final approval of the plat.

3) Prior to recording the final plat, the applicant shall provide the Planning Office with documentation that Southern Star approves the relocation of the gas line and easement between Lots 1 and 2 of Block Two and the relocation of the off-site gas line to tie into the existing line.

4) Prior to recording the final plat, the applicant shall provide the Planning Office with documentation that Southern Star approves the design of Renaissance Drive in relation to the gas line location.

5) Prior to recording the final plat for the remainder of the Mercato Development (PF-03-04-07), the applicant shall revise the previously approved preliminary plat (PP-01-02-06) and final plat (PF-03-04-07) to reflect the changes approved with this preliminary plat.

6) Prior to recording the final plat, the applicant shall gain approval of an access permit from the Kansas Department of Transportation to access W. 6th Street (Hwy 40).

7) Prior to recording the final plat, the rezoning request [Z-10-17-09] from UR (RMO pending) to CC400 District shall be adopted and published.

The applicant worked with KDOT and the City to finalize the transfer of the right-of-way necessary for the construction of Renaissance Drive and the City Commission accepted the dedication of this right-of-way at their September 14, 2010 meeting. The meeting minutes and staff memo are attached with this memo. The applicant indicated that the amount of time necessary to complete Condition No. 2 (dedications were accepted for the plat in January, 2010 and dedication of Renaissance Drive was accepted in September, 2010) slowed the progress on the completion of the other conditions and is requesting a one-year extension to meet the remaining conditions of approval and submit a final plat.

STAFF REVIEW
Per Section 20-809(j) of the Subdivision Regulations, Planning Commission approval of a preliminary plat shall expire within 18 months after the approval date unless a final plat has been submitted. If the cause of the failure to submit a final plat within that time frame is beyond the subdivider’s control, the Planning Commission may approve a one-year extension. The applicant worked to complete Condition No 5 in advance of the other conditions as the proposed site layout was dependent on the transfer of right-of-way.

The image below shows development activity in the area since the revised plat was approved in 2009:
Mercato development area is outlined in black. Area with development approvals since the approval of the Mercato revised preliminary plat is outlined in blue.

Development approvals since the approval of the Mercato revised preliminary plat include rezonings to the RM24 and CO Districts which were approved by the City Commission on September 28, 2010. The preliminary plat for the Hunters Ridge Addition was approved by the Planning Commission at their May 23, 2011 meeting. A 300 unit multi-dwelling residential development is being proposed on the RM24 property. No development has been proposed on the CO property at this time.

**Staff Recommendation:**
As the character of the area has remained fairly constant since the revised plat was approved and the delay in the submittal of the final plat was due to the timing of the transfer of right-of-way, which was not within the subdivider's control, Planning Staff recommends approval of the 1 year extension request which would permit the plat approval to remain valid until June 14, 2012.
Location map. Subject property is outlined in blue.
May 19, 2011

Via E-Mail and U.S. Mail

mmiller@ci.lawrence.ks.us
Ms. Mary Miller
Douglas County Planning Department
6th E. 6th Street
City Hall
Lawrence, Kansas 66044

Re: Request for a One Year Extension of Preliminary Plat: PP-10-5-09

Dear Ms. Miller:

On December 15, 2009 the Lawrence Douglas County Planning Commission approved the Mercato preliminary plat, PP-10-5-09. On January 5, 2010, the City Commission accepted the dedication of easements and rights-of-way for this preliminary plat subject to seven conditions. One of those conditions was just recently finalized with the City, the County, Kansas Department of Transportation and Mercato agreeing to the terms and conditions that would allow the construction of Mercato Lane.

Pursuant to City Code Section 20-809(j), the owners have been unable to submit a final plat yet, due in part to the lengthy negotiations that were required to obtain the city, county, and KDOT approval of Mercato Lane.

Therefore, on behalf of Mercato, they respectfully request that the approval of the preliminary plat be extended for a period of an additional year.
May 19, 2011
Page 2

Thank you for your consideration. Please let me know when this will appear on the agenda.

Sincerely,

BARBER EMERSON, L.C.

Jane M. Eldredge

JME:anc
cc: Steve Schwada
Dwelling Residential), located at 200 North Michigan Street for Northwind Apartments. Motion carried unanimously.

As part of the consent agenda, **it was moved by Chestnut, seconded by Cromwell**, to concur with the Planning Commission’s recommendations to adopt the findings of fact and approve the rezoning request and adopt on first reading Ordinance No. 8567, the rezoning (Z-6-11-10) of approximately 3.92 acres from CS (Commercial Strip) and RM12 (Multi-Dwelling Residential) to RM12 (Multi-Dwelling Residential), located at 2130 Silicon Avenue for Crosswinds East. Motion carried unanimously.

As part of the consent agenda, **it was moved by Chestnut, seconded by Cromwell**, to approve acceptance of the Right-of-Way and Easement dedication from KDOT for Renaissance Drive, Mercato Development located at the northeast corner of K-10 and US-40 (West 6th Street) as outlined in the Quitclaim Deed. Motion carried unanimously.

As part of the consent agenda, **it was moved by Chestnut, seconded by Cromwell**, to authorize staff to negotiate an engineering services agreement with URS Corporation for transitional engineering services to assist upon transfer of the former Farmland Industries Plant from the Farmland Trust Fund to the City of Lawrence. Motion carried unanimously.

As part of the consent agenda, **it was moved by Chestnut, seconded by Cromwell**, to receive a request from the University of Kansas requesting pedestrian crosswalks at 11th Street and West Campus Road. Motion carried unanimously.

As part of the consent agenda, **it was moved by Chestnut, seconded by Cromwell** to receive a request from the Friends of the Lawrence Public Library to place as signs of community interest, yard signs advertising the Friends of the Public Library Book Sale. The signs would be placed between 6th and 9th Streets and between Massachusetts and Tennessee Streets on October 1 and would be removed October 5, 2010. Motion carried unanimously.

**CITY MANAGER’S REPORT:**
Memorandum
City of Lawrence
Department of Public Works

TO: Chuck Soules, Public Works Director
FROM: Shoeb Uddin, City Engineer
CC: Dave Corliss, Mike Stock, Phil Struble, Jane Eldredge, Keith Browning, Walt Ward
Date: September 07, 2010
RE: Renaissance Drive – Right-of-Way Dedication

Mercato Development
Northeast Corner of K-10 and US-40 (West 6th)

Background
The proposed Mercato Development is a mixed-use commercial and residential development located on the northeast corner of K-10 and US-40 (West 6th Street) highways. City staff has been working with KDOT engineers and the developer/owner of the Mercato property for the past several months to figure out the details related to the right-of-way dedication for the proposed Renaissance Drive, closure of the existing access onto US-40 (West 6th), and construction of a new right-in/right-out access onto West 6th Street.

The existing frontage road along the east side of K-10 will be named “Renaissance Drive” as part of the Mercato Development. Currently, the Frontage Road connects to US-40 (West 6th) just east of the US-40/K-10 interchange. As part of the Mercato development plan and agreement with KDOT, this access will be closed and traded for a new right-in/right-out access onto West 6th Street, approximately 1,000 feet east of the current access. [See Exhibit]

The proposed Renaissance Drive (the existing Frontage Road), currently located within KDOT/K-10 right-of-way, will become a city street as part of the Final Plat of the Mercato Tract, hence requiring the road right-of-way to be dedicated to the City of Lawrence. KDOT has agreed to dedicate the necessary right-of-way and easements (at no cost to the city) to construct the proposed Renaissance Drive as a city street. Attached are the Exhibit and Quit Claim Deed outlining the details of the proposed “Road Right-Of-Way”, “Temporary Construction Easement” and “Excess Right of Way”.

Proposed Right of Way Details
As shown in the Exhibit, there are three parts in this dedication.

1. **Road Right of Way** – shown in “red” in the Exhibit. This is a permanent dedication to the city for the purpose of the construction and maintenance of Renaissance Drive. The proposed right-of-way is adequate to construct the roadway and other ambient features, e.g. sidewalk, landscaping etc.

2. **Temporary Construction Easement** – This is the area directly west of the proposed Mercato street right-of-way, shown in ‘blue”. This easement is intended to be used during construction of the Renaissance Drive and closing of the existing Frontage Road access onto US-40. This construction easement is temporary and will become void after the construction of Renaissance Drive is complete.
The existing hike/bike path is within this temporary construction easement. Maintenance of the hike/bike path is currently performed by Douglas County Road Department under Transportation Enhancement (TE) grant agreement between the County and KDOT. Based on the conditions of the TE grant agreement, the maintenance responsibility of the hike/bike path will remain with the County for the life span of the h/b path.

3. **Excess Right of Way** – shown in “green” in the Exhibit. This is the small sliver of land between the proposed Renaissance Drive right-of-way and the Mercato property line. KDOT is proposing to dedicate this portion to the city as “Excess Right-of-Way”. The excess right-of-way would belong to the city and could be used for all public purposes. However, according to the terms and conditions of the Quit Claim Deed by KDOT, the city is prohibited from transferring / selling this land to any private entities.

**Action Request**

If appropriate, accept the Right-of-Way and Easement dedication from KDOT as outlined in the Quit Claim Deed and in the Exhibit.

**Attachments**

- Exhibit
- Quit Claim Deed
ITEM NO 9: PRELIMINARY PLAT; KASOLD WATER TOWER ADDITION; SE OF TAM O’SHANTER & KASOLD DR (MKM)

PP-4-4-11: Consider a Preliminary Plat for Kasold Water Tower Addition, approximately .5 acre containing 1 lot, located southeast of the Tam O’Shanter and Kasold Drive intersection. Submitted by the City of Lawrence, property owner of record.

STAFF RECOMMENDATION ON VARIANCE REQUEST FROM SECTION 20-810(d)(4)(i)
Staff recommends approval of the requested variance from the requirement to dedicate 150 ft of right-of-way for a principal arterial to permit the dedication of 40 ft, resulting in a total of 140 ft of right-of-way in this location.

STAFF RECOMMENDATION ON WAIVER REQUEST FROM SECTION 20-811(c)
Staff recommends approval of the requested waiver from the requirement to install a 6 ft wide sidewalk along the east side of Kasold Drive along the frontage of this subdivision and forwarding the request to the City Commission with a recommendation for approval subject to the following condition:

Addition of the following note to the preliminary plat: “A 6 ft wide sidewalk shall be constructed on this lot when sidewalks are installed on either of the adjacent properties.”

STAFF RECOMMENDATION:
Staff recommends approval of the Preliminary Plat of the Kasold Water Tower Addition and forwarding the plat to the City Commission for acceptance of dedication of right-of-way and easements subject to the following conditions:

1. The plat shall be revised with the following changes:
   a. If the requested waiver is approved the plat shall be revised with a note indicating the date of approval. If the requested waiver is not approved, the plat shall be revised to show the location of the 6 ft wide sidewalk.
   b. The amount of right-of-way being dedicated shall be increased to 40 ft from the centerline of Kasold Drive.
   c. The distance of the shed to the right-of-way line shall be dimensioned on the plat.

Reason for Request: Unplatted property is not eligible for building permits. The property is being platted so improvements could be made in the future.

KEY POINTS
- The existing water tower is classified as a minor utility which is a permitted land use in the RS7 District with approval of a Special Use Permit.
- Section 20-1306(b) of the Development Code states that uses which were allowed by right at the time they were established but that now require a Special Use Permit will be considered an approved Special Use and will be allowed to continue without a public
hearing. Any alterations or expansions of the use are subject to the Special Use amendment procedures of Section 20-1306(l).

- No physical changes are being proposed to the site at this time.

**SUBDIVISION CITATIONS TO CONSIDER**

- This application is being reviewed under the Subdivision Regulations for Lawrence and Unincorporated Douglas County, effective Jan 1, 2007.
- Section 20-810(d)(4)(i) requires 150 ft of right-of-way for principal arterial streets. A variance has been requested from this requirement.
- Section 20-811(c) requires 6 ft wide sidewalks along both sides of arterial streets. A waiver has been requested from this requirement.

**ASSOCIATED CASES/OTHER ACTION REQUIRED**

- City Commission determination on the waiver request.
- City Commission acceptance of dedication of easements and right-of-way as shown on the preliminary plat.
- Final Plat submitted to Planning Office for administrative approval and recordation at the Douglas County Register of Deeds.
- Any future development on the site shall be in accordance with Special Use Amendment provisions in Section 20-1306(l).

**PLANS AND STUDIES REQUIRED**

- **Traffic Study** - The water tower is a very low traffic generator, utility workers access the site to maintain or repair the tower. Given the nature of the use no traffic study is required.
- **Downstream Sanitary Sewer Analysis** - No DSSA is necessary as there are no sanitary sewer facilities on the site.
- **Drainage Study** - Not required
- **Retail Market Study** - Not required.

**PUBLIC COMMENT RECEIVED PRIOR TO PRINTING**

- Received a call from a nearby property owner asking how the water tower is accessed and if a new access point is proposed. The City Utility Engineer indicated that the tower is accessed from north bound Kasold Drive via an existing curb cut. There are no changes planned for the access at this time.

**Site Summary**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross Area</td>
<td>.952 acres (21,796.91 sq ft)</td>
</tr>
<tr>
<td>Right-of-Way Area</td>
<td>.075 acres (3,269.45 sq ft)</td>
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<tr>
<td>Net Area</td>
<td>.425 acres (18,527.46 sq ft)</td>
</tr>
<tr>
<td>Number of Lots</td>
<td>1</td>
</tr>
</tbody>
</table>
STAFF REVIEW

The subject property is currently unplatted and is developed with a water tower. No new development is being proposed at this time, but the property is being platted so that improvements could be made to the site in the future. Per Section 20-801(c), unplatted property is not eligible for a building permit.

The Development Code identifies two types of utility uses, ‘major’ and ‘minor’. Major utilities are defined as those that have substantial impacts such as water treatment facilities, airports and power generation plants. Minor utilities are defined as those that have a local impact on surrounding properties. Water towers are among the list of utilities that are considered ‘minor’.

Zoning and Land Use

The subject property is located within the RS7 (Single-Dwelling Residential) Zoning District. This district permits residential development with a minimum lot area of 7000 sq ft. The RS7 District also permits minor utilities that serve more than one specific development with approval of a Special Use Permit. As this water tower serves more than one development, a Special Use Permit is required. Section 20-1306(b) of the Development Code provides an Automatic Special Use Status for a use which was permitted by right when it was established but now requires a Special Use Permit. The water tower was permitted by right when it was established but with the adoption of the 2006 Development Code, a Special Use Permit is now required. The water tower has automatic Special Use Status; however, any revisions or alterations to the site or use are subject to the Special Use amendment procedures of Section 20-1306(l).

Streets and Access

The property is located on and takes access from Kasold Drive. A driveway located near the southwest corner of the property provides access from the northbound lane of Kasold Drive. No change in access is being proposed.

Kasold Drive is classified as a principal arterial on the Major Thoroughfares Map. Per Section 20-811(c) of the Subdivision Regulations, a 6 ft wide sidewalk is required on both sides of arterial streets. This section also states that a waiver may be requested from this requirement. The Planning Commission may make a recommendation on such waiver request, but final action shall be by the governing body as part of the preliminary plat review. A waiver from the requirement to install a 6 ft wide sidewalk along Kasold Drive has been requested and is discussed later in this staff report.
Utilities and Infrastructure
The subject property contains a water tower which is classified as a minor utility. Sanitary sewer facilities and a water supply are not necessary as employees are on the site only as necessary to maintain/service the tower and no water or sanitary sewer facilities are located on the site. No additional utilities or infrastructure are necessary for this use.

Easements and Rights-of-way
Per Section 20-810(d)(4)(i) of the Subdivision Regulations, Kasold Drive, a principal arterial, requires 150 ft of right-of-way. The GIS maps show approximately 135 ft of right-of-way for Kasold in this area. A wider right-of-way is provided to the west (100 ft) than to the east (50 ft) of the centerline of Kasold Drive due to the location of a frontage road along the west of Kasold Drive. To achieve the required amount of right-of-way on the east side, 50 ft of right-of-way would need to be dedicated from the centerline of Kasold Drive. The applicant indicated concern with the dedication of this amount of right-of-way as this would place some of their facility within the right-of-way. A variance has been requested from the requirement to dedicate a total of 50 ft to allow 40 ft of right-of-way to be dedicated in this location. This variance is discussed later in the report.

The property contains a framed shed which will be located within the front setback when this additional right-of-way is dedicated. This property is zoned RS7, so a 25 ft front yard setback is required. The plat should note the dimension of the shed to the right-of-way line. With the dedication of additional right-of-way, the shed will be located within the required front setback for the RS7 District (25 ft). As the structure complied with the Zoning Regulations at the time it was built, it would be considered a nonconforming structure. Per Section 20-1503, a nonconforming structure can continue to be used; however, if it is abandoned or damaged to a degree of more than 60% of its fair market value it must be restored in compliance with the setback requirements of the Zoning District in which it is located. If the structure were to be restored in the same location, it would be necessary to obtain a variance from the setback requirements from the Board of Zoning Appeals.

Utility easements are provided along the rear of the adjacent lots for the sanitary sewer line serving these properties. As this property is City-owned property, no easement is necessary for the location of City utility lines.

VARIANCE
Variance from Right-of-Way Requirement in Section 20-810(d)(4)(i)
Section 20-813(g) states that the Planning Commission may grant a variance from the design standards of these regulations only if the following three criteria are met: that the strict application of these regulations will create an unnecessary hardship upon the Subdivider, that the proposed variance is in harmony with the intended purpose of these regulations and that the public health, safety and welfare will be protected.

The evaluation below reviews the proposed development with the criteria necessary for granting a variance.

Criteria 1: Strict application of these regulations will create an unnecessary hardship upon the Subdivider.
Right-of-Way is obtained during platting so it is not necessary to purchase additional right-of-way from a property owner when a street is widened or otherwise improved. Dedicating the full right-of-way for Kasold Drive would result in existing and anticipated above- and under-ground facilities being located within the right-of-way. The City Engineer indicated that 40 ft of right-of-way would accommodate future widening of the street or construction of sidewalks. As the property is under City ownership, it would not be necessary to purchase the land if additional right-of-way is necessary in the future. Given these facts, requiring the dedication of the full 50 ft of right-of-way would constitute an unnecessary hardship on the subdivider. It should be noted that 50' of right-of-way exists south of this lot but will need to be dedicated for properties to the north, including the KU Endowment property. The specific physical constraints of improving the water tower site justifies the reduced right-of-way in this instance. It is presumed that the other undeveloped, unplatted properties along Kasold will dedicate the required 50' of right-of-way when appropriate.

**Criteria 2: The proposed variance is in harmony with the intended purpose of these regulations.**

The purpose of the Subdivision Regulations is to provide for the harmonious and orderly development of land and to contribute to conditions conducive to health, safety, aesthetics, convenience, prosperity and efficiency. The wider right-of-way required in the 2006 Subdivision Regulations is intended to provide adequate space for the roadway, utilities, sidewalks and other features. The Subdivision Regulations are also intended to coordinate the development of each parcel of land with the existing community and facilitate the proper development of adjoining land [Section 20-801(2)(iv)]. In this case, additional right-of-way has been deemed necessary but 140 ft (40 ft on this property) has been determined to be adequate for any future improvements to Kasold Drive in this area recognizing that a conflict exists between anticipated future improvements to the water tower site. The proposed variance is in harmony with the intended purpose of the Subdivision Regulations and the right-of-way being dedicated will presumably provide the necessary room to place additional street improvements, such as a sidewalk, along Kasold.

**Criteria 3: The public health, safety and welfare will be protected.**

The property is being subdivided in preparation for future improvements to the facility. The lot meets the density and dimensional requirements of the RS7 Zoning District. The variance will permit the right-of-way for Kasold Drive to be increased to 140 ft in this location, which the City Engineer has indicated is acceptable for this one lot due to the physical conflicts with improving the water tower site. In staff’s opinion, there will be no negative impact on the public, health, safety and welfare with the granting of this variance.

**WAIVER**

**Waiver from Sidewalk Requirement in Section 20-811(c)**

The west side of Kasold Drive contains a continuous sidewalk system from its origin at the curve connection with W 31st Street to W 6th Street. The sidewalk system on the east side is not continuous. Sidewalks are located along the east side of Kasold Drive north of Bob Billings Parkway and south of Clinton Parkway but not in the area between the 2 streets, a distance of approximately 1 mile. The subject property has approximately 93 ft of frontage. Adding a sidewalk to this frontage would not improve pedestrian connectivity in this area. As the figure on Page 5 shows, the east side of Kasold Drive between Bob Billings and Clinton Parkway is developed with the exception of property which is owned by the University of Kansas
Endowment Association. The City Engineer indicated that he would support the waiver from the requirement to install a sidewalk on the east side of Kasold Drive in this area as it is unlikely that the property to the south would be replatted and sidewalks added in this area. A sidewalk to the north may be a possibility in the event the Kansas University property develops; therefore, the waiver should defer the installation from the requirement to install a sidewalk to a time when other sidewalks are available in the area. A note should be added to the plat that the property owner shall install a 6 ft wide sidewalk when sidewalks are installed on other properties on the east side of Kasold between Bob Billings and Clinton Parkways.

CONFORMANCE
With the recommended conditions and waiver, the preliminary plat is in conformance with the standards and requirements of the Subdivision Regulations and the Development Code.
Development in the area. Subject property is outlined in red.
A PRELIMINARY PLAT OF
KASOLD WATER TOWER ADDITION
IN THE NORTHWEST QUARTER OF SECTION 2, TOWNSHIP 13 SOUTH, RANGE 19 EAST OF THE 6TH P.M.
AN ADDITION TO THE CITY OF LAWRENCE, DOUGLAS COUNTY, KANSAS

DESCRIPTION:
PLAT NOTE: DIGITAL COPY SUBMITTED AND A COPY OF THE ORIGINAL TYPED COPY SUBMITTED TO THE LAWRENCE CLERK OF RECORDS OR CLERK OF THE COURT OF LAWRENCE COUNTY, LAWRENCE, KANSAS.

BENCHMARK:
BM-1 CHECKED SQUARE ON WEST SIDE OF CRAWFORD STREET AT 15TH STREET. (333.14' E 333.10')

LOCATION MAP:

Site Summary:

Lot Area
Lot # 1 10,020 sf

General Notes:

1. CITY OF LAWRENCE, DOUGLAS COUNTY, KANSAS
2. PROJECT ENGINEER
   JOHNSON GROUP, LLC
   105 W 7TH STREET
   LAWRENCE, KANSAS 66044
3. PROJECT SURVEYOR
   DICKSON ENGINEERING
   105 W 7TH STREET
   LAWRENCE, KANSAS 66044

4. TOPONOMON INFORMATION OBTAINED FROM SOURCE FORMATION OF D. W. SLOCUM, LLC MARCH 2017

5. EXISTING FENCE, WIRING, SOD, FERTILIZER, BULK STORAGE, ETC.

6. ALL PHONE, CABLE TELEVISION, AND ELECTRICAL SERVICES TO BE LOCATED UNDERGROUND

7. A WATER TOWER BASE PLAN IS TO BE DRAWN WITH THE FINAL PLAT FOR THE PROPERTY

8. LOTS SHALL BE FACED SOUTH ACROSS THE CITY OF LAWRENCE

9. REVISIONS FOR THE PROPERTIES LOCATED AT TOWNE-PARK PLACE, FAIRLESS HILL, AND VARIOUS MATURE CONDOMINIUMS AS IDENTIFIED BY NAME.

10. Replay portion of the subdivision lots within the "TOWN HOUSE" according to the town house plan, with the exception of the subdivision lots identified on the plat dated 11/30/11.

11. "Not for Construction" and "Revision" in Section 21-202-1801:1 (m) (5) (b) (2) (A) (T) (X) to allow the property to have an energy efficiency of 100,000 Btu and not to 100,000 Btu in the location.

Not for Construction

Sheets: 1 of 1

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PLANNING COMMISSION REPORT
Regular Agenda – Public Hearing Item

PC Staff Report
6/22/11
ITEM NO. 10: A TO B-1; 2.9 ACRES; N OF N 650 RD & E OF E 1250 RD (MKM)

Z-4-12-11: Consider a request to rezone approximately 2.9 acres from A (Agricultural) to B-1 (Neighborhood Commercial), located North of N. 650 Road and East of E. 1250 Road. Submitted by Stanley Zaremba, property owner of record.

STAFF RECOMMENDATION: Staff recommends approval of the rezoning request for approximately 3 acres from A (Agricultural) District to B-1 (Neighborhood Business) and forwarding it to the Board of County Commissioners with a recommendation for approval based on the findings of fact found in the body of the staff report and subject to the following condition:

1. Health Board approval of a variance from the 3 acre area requirement in the Douglas County Sanitary Code for on-site septic systems for properties that are served with Rural Water.

Applicant’s reason for request: “To sell product.”

KEY POINT
- A parcel on the southwest corner of the intersection of Hwy 59 and N 650 Road owned by Stanley Zaremba, was zoned B-1 and developed with a filling station/convenience store. This development was removed with the realignment of Hwy 59. The property owner is seeking to move the commercial zoning to this property in the northeast corner of the intersection which is also under his ownership.

ATTACHMENTS
Attachment A: Sections 12-309 and 12-308 of the Zoning Regulations for the Unincorporated Territory of Douglas County with permitted uses in the B-1 District
Attachment B: Map showing the realignment of Hwy 59 in this area.

OTHER ACTION REQUIRED
- Approval of rezoning by Board of County Commissioners and publication of resolution.
- The property shall be platted and site planned prior to development.

PUBLIC COMMENT RECEIVED PRIOR TO PRINTING
- The neighbor to the east called to inquire as to the property owner’s plans. I provided her with the list of permitted uses in the B-1 District and encouraged the applicant to contact the neighbor to discuss the future plans and any measures which might be taken to insure compatibility.

GENERAL INFORMATION
Current Zoning and Land Use: A (Agricultural) District; Agricultural uses.
Surrounding Zoning and Land Use: To the east and north: A (Agricultural) District; rural residence and agricultural uses.
To the west: A (Agricultural) District; KDOT right-of-way containing realigned Hwy 59 and frontage road with agricultural uses further to the west.

To the south: A (Agricultural) District; agricultural uses.

I. ZONING AND LAND USES OF SURROUNDING PROPERTIES

The surrounding properties are zoned A (Agricultural) and contain agricultural, residential, and transportation land uses. (Figure 1) Hwy 59 and a frontage road are located to the west of the subject property. The frontage road will provide access to N 650 Road, County Route 460, which is south of the subject property. A rural residence is located on the adjacent property to the north and east. Some features of a commercial business could be incompatible with a rural residence. To insure compatibility, the particular use would be evaluated during the site planning process and the proposed design would need to minimize the impact on the adjacent residential property through site layout, building orientation, lighting provisions, screening and buffering.

Staff Finding  - The area contains a major transportation network with the intersection of US Hwy 59 and County Route 460 (N 650 Road). Surrounding properties are zoned Agricultural and agriculture and rural residences are the principal land uses. The proposed rezoning to the B-1 District could be compatible with the surrounding land uses provided that a principal concept of the development's design is the minimizing of negative impacts associated with the commercial use on the adjacent residential property to the east.

Figure 1. Zoning of the area is predominately Agricultural with B-1 zoning now located within the Hwy 59 right-of-way.
II. CHARACTER OF THE AREA
The area consists primarily of agricultural land and rural residences. Good access to the transportation network is available with the intersection of US Highway 59 and N 650 Road (County Route 460). Both are identified on the Major Thoroughfares Map as principal arterials. (Figure 2)

An area zoned B-1 with a commercial business, the Zarco Filling Station, was previously located in the southwest corner of the intersection of N 650 Rd and US Highway 59. This filling station served the travelling public as well as residents in this portion of the county. The filling station and the B-1 Zoning District was removed when KDOT acquired the property for right-of-way for the realignment of Highway 59. The rezoning request seeks to move the commercial zoning previously located on the southwest corner of the intersection to the subject property on the northeast corner for development of a neighborhood business use.

Staff Finding -- This is predominately a rural residential and agricultural area which previously contained an area zoned for, and developed with, a neighborhood business use. The area contains good access to the arterial road network with the intersection of US Highway 59 and County Route 460. Commercial uses in this location could be compatible with the character of the area.

Figure 2. A major transportation network, rural residences, and agriculture characterize the area.
III. SUITABILITY OF SUBJECT PROPERTY FOR THE USES TO WHICH IT HAS BEEN RESTRICTED

Applicant's Response:

“Excellent.”

The subject property had been a part of a larger parcel that was used for agriculture; however, the majority of the agricultural parcel was acquired by KDOT for US Highway 59 right-of-way. The remaining parcel contains slightly less than 3 acres. The A District permits agricultural land uses as well as animal hospitals or clinics, commercial dog kennels, commercial greenhouses, commercial riding stables, detached dwellings, churches, schools, country clubs, and parks. The property may be too small to be suitable for agricultural purposes, but it is possible that it could be developed with another use that is permitted within the A District with the exception of a residence. The property may not be suitable for residential uses given its location at the corner of 2 principal arterials.

The property does not contain the required area for a septic system under the Douglas County Sanitary Code (3 acres with a Rural Water District meter); however, the Lawrence-Douglas County Health Official recommended that the property owner request a variance to permit the establishment of a septic system on this parcel. This variance would be necessary for the development of this parcel with any use other than agricultural.

However, as the parcel is located at the intersection of US Highway 59 and County Route 460, which are both designated as 'principal arterials' on the Major Thoroughfares Map the property is suited for commercial uses permitted within the B-1 District as well, with the exception of residential. The property is served by Rural Water District #2. The RWD indicated that the meter which had served the filling station could be moved to the new location and confirmed that water is available.

Staff Finding – The property has limited suitability for agricultural uses but is suited to other uses which are permitted in the A District and the B-1 District.

IV. LENGTH OF TIME SUBJECT PROPERTY HAS REMAINED VACANT AS ZONED

Staff Finding – The property has never been developed but has been utilized for agricultural purposes.

V. EXTENT TO WHICH REMOVAL OF RESTRICTIONS WILL DETERMINATELY AFFECT NEARBY PROPERTY

Applicant's response:

“None.”

The property is located at the intersection of two roads which are classified as ‘principal arterials’ on the Future Thoroughfares Map and is adjacent to US Hwy 59 and a frontage road. Given this transportation network, the additional traffic generated by commercial uses at this location should have no negative impact on nearby properties.
The property is separated from other properties to the west and south by the wide right-of-way utilized for Highway 59 and the frontage road, E 1260 Road. The property is in close proximity to only one property, that being the rural residence on the parcel to the north and east. (Figure 3) It is possible that commercial uses in such close proximity could detrimentally affect the adjacent property. The residence on the adjacent property is located approximately 250 ft from the subject property and is oriented to the south. (Figure 4) Several outbuildings are located on the west side of the parcel, between the proposed commercial development and the residence. The Commercial use would take access to the frontage road along the west side of the property and should be oriented to the west. This orientation and access will remove much of the activity of this site from view of the nearby residence. The distance between the residence and the subject property and the location of the outbuildings on the west side of the property will help buffer the residence from the commercial use and activity. As mentioned earlier, appropriate site design and buffering will reduce the impact of the commercial use.

**Staff Finding** - With appropriate landscaping and site design, the requested zoning B-1 (Neighborhood Business) should have minimal detrimental effect on nearby properties.

![Figure 3](image-url) Location of right-of-way in the area. Subject property is outlined in blue.
VI. RELATIVE GAIN TO THE PUBLIC HEALTH, SAFETY AND WELFARE BY THE DESTRUCTION OF THE VALUE OF THE PETITIONER’S PROPERTY AS COMPARED TO THE HARDSHIP IMPOSED UPON THE INDIVIDUAL LANDOWNERS

Evaluation of these criteria includes weighing the benefits the denial of the rezoning request would provide for the public versus the hardship the denial would impose on the owner of the subject property. Benefits are measured based on the anticipated impacts of the rezoning request on the public health, safety and welfare.

If the rezoning were denied, the use of the property would remain limited to uses which are permitted in the Agricultural District. The property has been reduced to slightly less than 3 acres due to acquisition of right-of-way and a 3 acre parcel is not well suited to agricultural uses. It is unlikely that this property would be suited to residential development given its location at the intersection of two principal arterial roads. Other uses which are permitted in the A District: church, school, dog kennel, veterinary hospital would have a similar impact on the adjacent property as many of the commercial uses permitted in the B-1 District.

Given the arterial transportation network that is available and the separation of this property from most other properties by wide right-of-way, denying the rezoning request would provide...
little if any gain to the public health, safety and welfare. Denying the rezoning may reduce the impact on the adjacent residence; however, as the property is not suited for agricultural or residential uses it is possible that a more intensive use permitted within the A District would be located here. Regardless of the zoning district, it is likely that the property will be developed with a more commercial or more intensive use than agriculture or residential. In these cases, a site plan with a focus on minimizing impacts on the nearby residence would be necessary.

**Staff Finding** - There would be little, if any, gain to the public health, safety or welfare from the denial of the rezoning request given type of transportation network the property is adjacent to and the unsuitability of the property for agricultural or residential land uses. If the rezoning were denied, the development of the property would be limited to those uses permitted within the Agricultural District for which it is suited.

**VII. CONFORMANCE WITH THE COMPREHENSIVE PLAN**

Applicant’s Response:

“Well.”

**CHAPTER SIX. COMMERCIAL**

**Policy 3.12: Criteria for Commercial Development in Unincorporated Areas** (page 6-38)

“Existing commercial areas that are located at the intersection of a hard surfaced County Route and a state or federally designated highway should be allowed to expand if the necessary infrastructure (water, road, approved wastewater treatment facility, etc.) is available.”

**Staff Comments:**

The property is located at the intersection of County Route 460 and US Hwy 59. This is not technically an ‘expansion’ of the previously existing commercial area, but it is a relocation of a previously approved B-1 Zoning District and neighborhood business use from one corner of an intersection of a US Highway and County Route to another.

The rural water district indicated that the water meter that had been utilized for the previous filling station could be relocated and used with this new development. The property contains less than 3 acres; therefore an on-site sewage management system would require a variance from the Sanitary Code. The rezoning would be contingent upon the approval of this variance. A permit for an on-site sewage management system must be obtained prior to obtaining building permits for any commercial development.

Based on the information above, the subject property meets the criteria for commercial zoning.

**STAFF REVIEW**

The Zoning Regulations for the Unincorporated Territory of Douglas County indicate that the requested zoning, the B-1 District, is intended to provide primarily for retail shopping and personal service uses to serve the needs of nearby residential neighborhoods. (Section 12-309-1) The B-1 District anticipates that residences will be nearby; therefore, the uses in the B-1 District should be compatible with residential uses. Compatibility can be ensured on a site specific basis with appropriate site design and buffering through the site planning process.

Principal considerations with commercial rezonings in the unincorporated portions of the county are the capacity of the transportation network, the availability of publicly treated water, sewage
management, and the impact the future development may have on nearby properties. The property is located at the intersection of a hard surfaced County Route and a federal highway and a meter has been obtained from Rural Water District 2 for this development. The property does not contain adequate area for an on-site sewage management system, due to acquisition of right-of-way. A variance from the area requirement, 3 acres, must be obtained from the Douglas County Health Board prior to the rezoning becoming effective.

With the variance from the Sanitary Code and appropriate design and buffering of the commercial development, the rezoning request meets Code requirements and will be compatible with surrounding properties.
12-309-1. The regulations set forth in this section, or set forth elsewhere in this Resolution, when referred to in this section, are the regulations in the "B-1" Neighborhood Business District. This district provides primarily for retail shopping and personal service uses to be developed either as a unit or in individual parcels to serve the needs of nearby residential neighborhoods.

12-309-2. **USE REGULATIONS**
A building or premises shall be used only for the following purposes:

12-309-2.01. Any use permitted in the "R-1" Single-Family Residential District.

12-309-2.02. Automobile parking lots and storage garages.

12-309-2.03. Display room for merchandise to be sold on order where merchandise sold is stored elsewhere.

12-309-2.04. Dressmaking, tailoring, decorating, shoe repairing, repair of household appliances and bicycles, dry cleaning and pressing and bakery, with sale of bakery products on the premises and other uses of a similar character; provided that no use permitted in this item shall occupy more than 2,500 square feet of floor area.

12-309-2.05. Filling stations, so long as bulk storage of inflammable liquids is underground.

12-309-2.06. Frozen food lockers for individual or family use.

12-309-2.07. Hospital or clinic for large or small animals, such as cattle, horses, dogs, cats, birds and the like, provided that such hospital or clinic and any treatment rooms, cages, pens or kennels be maintained within a completely enclosed building with soundproof walls and that such hospital or clinic be operated in such a way as to produce no objectionable odors outside its walls and located on a sewer.

12-309-2.08. Offices and office buildings, including clinics.

12-309-2.09. Outdoor advertising structure or non-flashing sign pertaining only to a use conducted within the building, and any sign or display in excess of 30 square feet in area shall be attached flat against a wall of the building, and in no case shall any sign or display attached to a building project above the roof line. The permitted 30 square feet of sign area for projecting or free-standing signs may be in one sign or the aggregate area of several signs.

12-309-2.10. Personal service uses including barber shops, banks, beauty parlors, photographic or artists' studios, messengers, taxicabs, newspaper or telegraphic service stations, dry cleaning receiving stations, restaurants, (but not drive-in restaurants), taverns, undertaking establishments and other personal service uses of a similar character.

12-309-2.11. Retail stores, including florist shops and greenhouses in connection with such shops, but there shall be no slaughtering of animals or poultry on the premises of any retail store.


12-309-2.14. A retail fireworks stand only as authorized by permit issued and operated pursuant to applicable resolutions of the Board of County Commissioners.

12-309-3. PARKING REGULATIONS
The parking regulations for permitted uses are contained in section 12-316 of this Resolution.

12-309-4. OFF-STREET LOADING REGULATIONS
The off-street loading regulations for permitted uses are contained in section 12-317.

12-309-5. HEIGHT AND AREA REGULATIONS
Height and area requirements shall be as set forth in the chart of section 12-318.

12-309-6. Supplementary use regulations are contained in section 12-319.

12-309-7. Supplementary height and area regulations are contained in section 12-321.
12-308-1. The regulations set forth in this section, or set forth elsewhere in this Resolution, when referred to in this section are the regulations in the "R-1" Single-Family Residential District. The purpose of this district is to provide for single-family residential development of relatively more spacious character together with such public buildings, schools, churches, public recreational facilities accessory uses, as may be necessary or are normally compatible with residential surroundings. The district is located to protect existing development of high character and contains vacant land considered appropriate for such development in the future.

12-308-2. USE REGULATIONS
A building or premises shall be used only for the following purposes:

12-308-2.01. Farm, truck garden, orchard, or nursery for growing or propagation of plants, trees, and shrubs, including temporary stands for seasonal sales of products raised on the premises, but not including the raising for sale of birds, bees, rabbits, or other animals, fish, or other creatures to such an extent as to be objectionable to surrounding residences by reason of odor, dust, noise, or other factors, and provided no retail or wholesale business office or store is permanently maintained on the premises.

12-308-2.02. Single-family dwellings.

12-308-2.03. Residential-design manufactured homes, provided the following standards apply:
   a. minimum dimensions of body width shall be 22 feet;
   b. minimum roof pitch shall be 2.5" in height to 12 running inches;
   c. siding material shall be wood, masonry, composition board or finished aluminum lap siding or other materials normally found on site built homes;
   d. roofing materials shall be wood shingles, composition shingles or fiberglass shingles, asphalt shingles, clay or concrete tile or slate;
   e. on level sites the main floor shall be no greater than 20" above finished grade at the foundation. On sloping or irregular sites the side closest to grade level shall not be greater than 20" above finished grade at the foundation.
   f. the home shall be permanently mounted on a foundation or basement which meets the provisions of the Building Code.

12-308-2.04. Churches and parish halls, temples, convents, and monasteries, provided that churches or temples erected after the date of passage of this resolution shall have their principal means of access from a major thoroughfare or collector street and shall be located on a lot of at least 30,000 square feet in area.

12-308-2.05. Colleges and schools, public or private, having a curriculum and conditions under which teaching is conducted equivalent to a public school, and institutions of higher learning.

12-308-2.06. Rural Home occupations, subject to the provisions of section 12-319-6.01; and Transitional Home Occupations, subject to the provisions of section 12-319-6.03.

12-308-2.07. Nonprofit libraries or museums, art galleries, utility installations for sewer, water,
gas, electric and telephone mains and incidental appurtenances.

**12-308-2.08.** Public parks, playgrounds, golf courses (public or private except miniature golf courses, putting greens, driving ranges and similar activities operated as a business), nonprofit, non-governmental public recreation, and community buildings.

**12-308-2.09.** Railroad rights-of-way, including a strip of land with tracks and auxiliary facilities for track operations, but not including passenger stations, freight terminals, switching and classification yards, repair shops, roundhouses, power houses, interlocking towers, and fueling, sanding, and watering stations.

**12-308-2.10.** Temporary buildings, the uses of which are incidental to construction operations or sale of lots during development being conducted on the same or adjoining tract or subdivision and which shall be removed upon completion or abandonment of such construction, or upon the expiration of a period of two years from the time of erection of such temporary buildings, whichever is sooner.

**12-308-2.11.** Temporary signs pertaining to the lease, hire, or sale of a building or premises on which such sign is located.

**12-308-2.12.** Accessory buildings and uses including, but not limited to accessory private garages, servants' quarters, guest houses, swimming pools, home barbecue grills, customary church bulletin boards or identification signs not exceeding 30 square feet in area for permitted public and semi-public uses, accessory storage, and accessory off-street parking and loading spaces.

**12-308-2.13.** Child care home - occupant primary provider.

**12-308-2.14.** Child care home - non-occupant primary provider, subject to conditions in section 12-319-1.

**12-308-2.15.** Child care center, subject to conditions in section 12-319-1.

**12-308-3. PARKING REGULATIONS**
The parking regulations for permitted uses are contained in section 12-316 of this Resolution.

**12-308-4. OFF-STREET LOADING REGULATIONS**
The off-street loading regulations for permitted uses are contained in section 12-317.

**12-308-5. HEIGHT, AREA, AND BULK REGULATIONS**
Height, area, and bulk requirements shall be as set forth in the chart of Section 12-318, and in addition the following regulations shall apply:

**12-308-5.01.** The minimum side yard requirement for any church, temple, college building, school, library, museum, art gallery or any public building or any main building other than a single-family dwelling shall be twenty-five feet.

**12-308-6.** Supplementary use regulations are contained in section 12-319.

**12-308-7.** Supplementary height, area, and bulk regulations are contained in section 12-321.

12-309-2.14. A retail fireworks stand only as authorized by permit issued and operated pursuant to applicable resolutions of the Board of County Commissioners.

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Section 309A “B-3” LIMITED BUSINESS DISTRICT REGULATIONS

12-309A-1. The regulations set forth in this section, or set forth elsewhere in this Resolution, when referred to in this section are the regulations in the "B-3", Limited Business District. This district is designed to permit and encourage the grouping, in areas defined by comprehensive plans, of certain retail activities and services intended primarily to serve, and dependent upon, the motoring public.

12-309A-2. USE REGULATIONS
A building or premises shall be used only for the following purposes:

12-309A-2.01. Automobile Service Stations, excluding bodywork, painting or major engine repair.

12-309A-2.02. Antique Sales.

12-309A-2.03. Art Supplies.

12-309A-2.04. Bicycle Sales, Rental, or Repair.

12-309A-2.05. Boat and Equipment Sales and Repair.

12-309A-2.06. Boat Storage, open or enclosed.

12-309A-2.07. Camera or Photographic Supply Sales.

12-309A-2.08. Drug Store.

Z-04-12-11: Rezoning 2.9 acres from A to B-1
North of 650 Road & East of 1250 Road

Lawrence-Douglas County Planning Office
June 2011
12-309-1. The regulations set forth in this section, or set forth elsewhere in this Resolution, when referred to in this section, are the regulations in the "B-1" Neighborhood Business District. This district provides primarily for retail shopping and personal service uses to be developed either as a unit or in individual parcels to serve the needs of nearby residential neighborhoods.

12-309-2. **USE REGULATIONS**
A building or premises shall be used only for the following purposes:

**12-309-2.01.** Any use permitted in the "R-1" Single-Family Residential District.

**12-309-2.02.** Automobile parking lots and storage garages.

**12-309-2.03.** Display room for merchandise to be sold on order where merchandise sold is stored elsewhere.

**12-309-2.04.** Dressmaking, tailoring, decorating, shoe repairing, repair of household appliances and bicycles, dry cleaning and pressing and bakery, with sale of bakery products on the premises and other uses of a similar character; provided that no use permitted in this item shall occupy more than 2,500 square feet of floor area.

**12-309-2.05.** Filling stations, so long as bulk storage of inflammable liquids is underground.

**12-309-2.06.** Frozen food lockers for individual or family use.

**12-309-2.07.** Hospital or clinic for large or small animals, such as cattle, horses, dogs, cats, birds and the like, provided that such hospital or clinic and any treatment rooms, cages, pens or kennels be maintained within a completely enclosed building with soundproof walls and that such hospital or clinic be operated in such a way as to produce no objectionable odors outside its walls and located on a sewer.

**12-309-2.08.** Offices and office buildings, including clinics.

**12-309-2.09.** Outdoor advertising structure or non-flashing sign pertaining only to a use conducted within the building, and any sign or display in excess of 30 square feet in area shall be attached flat against a wall of the building, and in no case shall any sign or display attached to a building project above the roof line. The permitted 30 square feet of sign area for projecting or free-standing signs may be in one sign or the aggregate area of several signs.

**12-309-2.10.** Personal service uses including barber shops, banks, beauty parlors, photographic or artists' studios, messengers, taxicabs, newspaper or telegraphic service stations, dry cleaning receiving stations, restaurants, (but not drive-in restaurants), taverns, undertaking establishments and other personal service uses of a similar character.

**12-309-2.11.** Retail stores, including florist shops and greenhouses in connection with such shops, but there shall be no slaughtering of animals or poultry on the premises of any retail store.

**12-309-2.12.** Self-service laundry or self-service dry cleaning establishment.

12-309-2.14. A retail fireworks stand only as authorized by permit issued and operated pursuant to applicable resolutions of the Board of County Commissioners.

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12-309A-2.07. Camera or Photographic Supply Sales.

12-309A-2.08. Drug Store.

Revisions to Article 10 and 17 to include ‘Synthetic Turf’ as a landscaping material

June 22, 2011
Planning Commission
Landscape Note 4.3

ALL TURF AREAS TO BE SEEDED WITH DROUGHT TOLERANT GRASS, EXCEPT FOR AREAS BEHIND THE CARPORTS AND GARAGES WHICH WILL BE LANDSCAPED WITH NON-TURF PERVERIOUS MATERIALS.
REVIEW CRITERIA FOR TEXT AMENDMENT
Section 20-1302(f)

1. Whether the amendment corrects an error or inconsistency in the Development Code or meets the challenge of a changing conditions; and

2. Whether the amendment is consistent with the comprehensive plan and the stated purpose of the Development Code.
Compliance with *Horizon 2020*

“Encourage the use of high quality materials in the construction of screening and landscape areas to decrease long-term maintenance costs”.

- high quality construction materials
“Natural vegetation and large mature trees in residential areas add greatly to the appearance of the community as a whole and should be maintained”. (Policy 5.1, page 5-19)

“Site design and building features shall be reflective of the quality and character of the overall community and incorporate elements familiar to the local landscape”. (page 6-2)
“To maintain the City’s quality, heritage and character by enhancing its visual appearance.”

“To enhance environmental conditions by providing shade, air purification, oxygen regeneration, groundwater recharge, filtering of stormwater runoff, abatement of noise, glare and heat.”
## Code Requirements for Living or Natural Landscaping

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Landscape Material Standards**                                        | **20-1009 (b) Artificial Plants**  
No artificial plants or vegetation may be used to meet any standards of this section.                                                                                               |
| **Landscape Material Standards**                                        | **20-1009 (e)(3) Grass Seed and Sod**  
Turf areas shall be planted with species suitable as permanent lawns in Lawrence. Turf areas may be sodded or seeded.                                                                 |
| **Installation, Maintenance and Replacement**                           | **20-1010(a)(2)**  
All landscape material, including trees, plant material and structural elements, shall be in place and healthy prior to issuance of a final Certificate of Occupancy. The Planning Director may authorize issuance of a temporary Certificate of Occupancy prior to installation of required landscaping, when seasonal conditions render installation impractical. |
<p>| <strong>20-1701 Definitions Landscape Material</strong>                             | Such living material such as trees, shrubs, ground cover/ vines, turf grasses, and non-living material such as: rocks, pebbles, sand, bark, brick pavers, earthen mounds (excluding pavement), and/or other items of a decorative or embellishing nature such as: fountains, pools, walls, fencing, sculpture, etc. |
| <strong>20-1701 Definitions Landscaping</strong>                                    | Any combination of living plants such as trees, shrubs, plants, vegetative ground cover or turf grasses....                                                                                                                                 |
| <strong>20-1701 Definitions Ground Cover</strong>                                   | Living landscape materials or living low-growing plants other than turf grasses, installed in such a manner so as to provide a continuous cover of the ground surface and which, upon maturity, normally reach an average maximum height of not greater than 24 inches. |</p>
<table>
<thead>
<tr>
<th></th>
<th>Synthetic Turf</th>
<th>Low Maintenance Landscaping</th>
<th>Traditional Lawn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low water usage</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>No Pesticide usage</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>No Fertilizer</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>No mowing</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Pervious</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Filters pollutants</td>
<td></td>
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<tr>
<td>Provides Habitat</td>
<td></td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Provides Oxygen</td>
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<td>✓</td>
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<tr>
<td>Absorbs Carbon Dioxide</td>
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<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Reduces Heat Island</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Adds to Heat Island</td>
<td>✓</td>
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<td></td>
</tr>
</tbody>
</table>
REVIEW CRITERIA FOR TEXT AMENDMENT
Section 20-1302(f)

1. Whether the amendment corrects an error or inconsistency in the Development Code or meets the challenge of a changing conditions; and

2. Whether the amendment is consistent with the comprehensive plan and the stated purpose of the Development Code.
Staff recommends denial of the requested amendment, TA-4-6-11, to allow synthetic turf as a landscape material but recommends that ‘low maintenance’ landscaping be utilized to meet the need for more sustainable landscaping practices.
PLANNING COMMISSION REPORT
Regular Agenda -- Public Hearing Item

PC Staff Report
6/22/11

ITEM NO. 11 TEXT AMENDMENT TO CITY OF LAWRENCE DEVELOPMENT CODE; CHP 20; SYNTHETIC TURF AS LANDSCAPING MATERIAL (MKM)

TA-4-6-11: Consider Text Amendments to the City of Lawrence Land Development Code, Chapter 20, Articles 10 and 17, regarding synthetic turf as landscaping material. Initiated by City Commission on 5/3/11.

RECOMMENDATION:
Staff recommends denial of the amendments to Articles 10 and 17 of the Land Development Code to add synthetic turf as landscaping material based on the analysis provided in the Staff Report.

Reason for Request: “To allow synthetic turf landscaping recently applied to an apartment development to remain”.

RELEVANT FACTOR:
• Conformance with the Comprehensive Plan.

PUBLIC COMMENT RECEIVED PRIOR TO PRINTING
• None to date.

ATTACHMENTS
A. Initiation staff memo
B. LEED 2009 for New Construction and Major Renovations
C. State of New York Health Fact Sheet, including referenced studies
D. 2008 Center for Disease Control and Prevention Health Advisory
E. Connecticut Department of Environmental Protection Report
F. Natural Landscaping and Artificial Turf: Achieving Water Use and Pesticide Reduction
G. Low Maintenance Landscaping, K-State Experiment and Extension Office Report
H. Punta Gorda, FL Application

OVERVIEW OF PROPOSED AMENDMENT
The City Commission initiated consideration of a request to allow the use of synthetic turf as landscaping material at their May 3, 2011 meeting at the request of Paul Werner Architects. The request is being made in order to maintain recently installed synthetic turf at the apartment complex being constructed at the intersection of Trail and Frontier, formerly known as the Boardwalk Apartments. While the site plan was approved with code compliant landscape materials (sod, seed), a routine inspection of the site yielded the installation of the synthetic turf. The owner was informed of the non-compliant installation and was provided options to conform to the code, including installing the approved plant material, seeking a variance, or requesting a text amendment to revise the applicable sections of the code.

The applicant would like the city to consider revising the Development Code to permit the use of synthetic turf in any landscape application.

A similar situation occurred previously with the Oread Inn development. Synthetic turf was installed in a small area, although the approved development plan [FDP-02-03-09] required code compliant landscape materials. The artificial turf was discovered during a site inspection prior to the release of
occupancy permits. The Planning Director made the following statement when approving the use of this limited amount of artificial turf: “While artificial turf is not a normally accepted landscape material, it is appropriate in this specific situation in combination with the natural materials on site.” It is possible that synthetic turf may be appropriate in some locations where traditional or low maintenance landscaping would be difficult to establish or maintain. In these cases, Alternative Compliance can be requested per the requirements in Section 20-1007. Section 20-1007(b) states that, “Alternative Compliance is limited to the specific site under consideration and does not establish precedent for acceptance of alternative compliance plans on other sites.”

The amendment would include ‘synthetic turf’ in the definition of ‘landscape materials’. Standards pertaining to the use of synthetic turf as landscaping material would likely need to be developed to support its use, if found to be appropriate, as discussed later in this report. The use of synthetic turf for athletic fields is not included in this amendment as the synthetic turf is being utilized in this situation as a ‘surfacing’ rather than ‘landscaping’ material.

CONFORMANCE WITH THE COMPREHENSIVE PLAN
A sustainable physical environment is a principal goal of Horizon 2020. Sustainable landscaping practices and materials comply with this goal. The comprehensive plan recommends the use of high quality materials in the construction of landscape areas and recognizes that natural vegetation adds greatly to the appearance of the community as a whole and should be maintained. Horizon 2020 and the Land Development Code emphasize the use of natural and living plant materials. The proposed amendment to allow the use of synthetic landscaping materials is not in conformance with Horizon 2020.

CRITERIA FOR REVIEW AND DECISION-MAKING
Section 20-1302(f) provides review and decision-making criteria on proposed text amendments. It states that review bodies shall consider at least the following factors:

1) **Whether the proposed text amendment corrects an error or inconsistency in the Development Code or meets the challenge of a changing condition; and**

   Applicant Response:
   “The amendment does not correct an error or inconsistency but instead provides an alternative option to turf grass. Synthetic turf is a viable option for turf management in the right location. This text amendment would give the Planning Department the ability to approve it.”

   “With the increased awareness of providing green building options synthetic turf has its benefits which include using no irrigation, fertilizer or pesticides to maintain it. Synthetic turf also reduces emissions since it does not need mowed.”

   **Staff Review:**
   The text amendment is intended to address a changing situation: the need for more sustainable development and greater environmental protection of our natural resources. The applicant indicated that, in the right location, synthetic turf is a viable option to natural turf because it does not require water, fertilizer, pesticide or mowing.

   As a community, we are becoming more conscious of the environmental impacts of our actions and conservation of water is recognized as an important means to protect a non-renewable natural resource. Minimizing the use of fertilizers and pesticides are steps that could reduce negative impacts on our
ground and surface waters. Mowing may result in emissions so reduced mowing could be a factor in sustainable landscaping. In order to reduce the negative impacts and conserve water, landscaping which addresses these concerns is more sustainable and should be encouraged.

This staff report reviews the impact of synthetic turf to determine if the use of synthetic turf meets the challenge of increased sustainability. This review concludes that artificial turf is not a sustainable means of landscaping and does not meet the challenge of changing conditions but that low maintenance natural landscaping does. Staff concludes that there is no error in the Comprehensive Plan or Development Code to correct and that the use of living and natural landscape materials is appropriate.

2) Whether the proposed text amendment is consistent with the Comprehensive Plan and the stated purpose of this Development Code (Sec. 20-104).

Applicant Response:
“Horizon 2020 states on pages 5-22, 5-28, and 6-28, “Encourage the use of high quality materials in the construction of screening and landscape areas to decrease long-term maintenance costs.” Synthetic turf falls into this category because it is a high quality material made of partly recycled materials and has no yearly maintenance cost such as irrigation systems, fertilizers or pesticides.

Staff Review:
As the applicant pointed out, Horizon 2020 recommends the use of high quality materials in the construction of landscape areas to minimize maintenance costs. The comprehensive plan does not recommend the use or synthetic landscaping materials, but in several places emphasizes the importance of natural features and natural vegetation.

- “The Plan proposes the development of neighborhoods in a range of densities to provide a sense of community and to complement and preserve natural features in the area.” (Page 3-1, Background Studies)

- “Natural environmental features within residential areas should be preserved and protected. Natural vegetation and large mature trees in residential areas add greatly to the appearance of the community as a whole and should be maintained. Changes to the natural topography should be minimal.” (Policy 5.1, page 5-19 Residential)

- “Promote the integration of mature trees, natural vegetation, natural and environmentally sensitive areas whenever possible to buffer low-density developments from more intensive land uses. (Policy 6.1(c)(2)(a), page 5-21, Residential)

- “Site design and building features shall be reflective of the quality and character of the overall community and incorporate elements familiar to the local landscape.” (Page 6-2, Commercial)

- “Encourage the use of existing vegetation, such as stands of mature trees, and other natural site features into the landscape design as natural buffers or focal points.” (Policy 3.1(d)(4)(c). Page 7-16 Industrial and Employment)

Horizon 2020 does not specifically address synthetic landscaping materials, but does in several instances recommend the use of natural landscaping materials. The plan states in the residential chapter that natural vegetation ‘adds greatly to the appearance of the community as a whole’. When discussing commercial development it recommends that site design should be reflective of the quality and character of the overall community and should incorporate elements familiar to the local landscape. The type of landscaping material used has an impact on the character of the area.
Introducing synthetic turf into the landscape creates an artificial characteristic that is inconsistent with the natural look of Lawrence today. **The proposed text amendment is not in conformance with the comprehensive plan.**

**GENERAL REVIEW**

The purpose of landscaping, per Section 20-1001 of the Development Code, is to maintain the City's quality, heritage and character by enhancing its visual appearance, and to enhance environmental conditions by providing shade, air purification, oxygen regeneration, groundwater recharge filtering of stormwater runoff, abatement of noise, glare and heat. The review below analyzes synthetic turf in regards to these purposes:

- **to maintain the City's quality, heritage and character by enhancing its visual appearance;**

  It may be a matter of opinion whether synthetic turf would enhance the visual appearance of the City; however, the addition of an artificial component into the landscape would not maintain the City's heritage and character. Figures 1-3 illustrate the installation process for the synthetic turf that was installed in Lawrence and the finished look.

- **to enhance environmental conditions by providing shade, air purification, oxygen regeneration, groundwater recharge filtering of stormwater runoff, abatement of noise, glare and heat;**

  The applicant indicated that synthetic turf would be more environmentally friendly than natural turf because it would not need fertilizer, pesticide, mowing or watering as it is not a growing material. Synthetic turf does not require watering but does require washing, as organic matter does not decompose on synthetic turf and it may require water for cooling in hot temperatures, so the use of water may be reduced; however, it has not been eliminated.

  The following information was taken from “Natural Landscaping and Artificial Turf: Achieving Water Use and Pesticide Reduction”, an article written by Alex Wilson, Executive Editor of Environmental Building News:

  > Kim Sorvig, research associate professor at the University of New Mexico, and co-author of *Sustainable Landscape Construction: A Guide to Green Building Outdoors*, is concerned about the soil conditions under artificial turf. "It blocks both water and sunlight either completely or in very large degree," he said, "and without that, you can't have a living system in the soil." Sorvig thinks it is ironic that artificial turf is heralded as a solution to water shortages, since it diminishes the health of the underlying soil, thereby decreasing its ability to hold water. "When you remove the vegetation from an area so completely," he said, "you're actually, in the long term, contributing to drought."

  Synthetic landscaping materials would not contribute to air purification or oxygen regeneration. Landscaping materials are intended to provide abatement of heat; however, synthetic turf may contribute to the heat island effect.

**Health and Environmental**

The State of New York Health Department prepared a fact sheet on crumb-rubber infilled synthetic turf athletic fields in 2008. The items reviewed were: heat stress, injury, infection, latex allergy, chemical exposure.

**HEAT STRESS:** The fact sheet states that the average surface temperature on a synthetic turf field at Brigham Young University in June 2002 was reported to be 117°F while the average surface
temperature on natural turf and asphalt were 78°F and 110°F respectively. The maximum temperature reported on the turf field was 200°F. Measurements taken at the University of Missouri field had a 138°F air temperature at 'head-level' height on a 98°F day. The surface temperature of the field was reported to be 178°F. A study at BYU found that watering synthetic turf reduced the surface temperature from 174°F to 85°F but the temperature rose to 120°F in five minutes and 164°F in twenty minutes.

INFECTION: The review concluded that synthetic turf surfaces are no more likely to harbor infectious agents than other surfaces.

LATEX ALLERGY: Tire rubber is used in many synthetic turf products as the infill material. Some people are allergic to 'latex allergens' which are substances within the latex in rubber tires. Tests did not find any relation between the crumb rubber used in synthetic turf and latex allergies.

CHEMICAL EXPOSURE: Studies have been conducted on the various chemicals used in synthetic turf and no negative results were obtained with the exception of 'lead'. Some types of synthetic turf fibers contain elevated levels of lead. Degradation of these fibers can form a dust that presents a potential source of lead exposure. The Centers for Disease Control and Prevention addressed the potential for lead exposure in a June 2008 Health Advisory, attached.

The Connecticut Department of Environmental Protection prepared an Artificial Turf Study in 2010 which looked specifically at health impacts and stormwater leaching. The study analyzed the runoff from turf fields and identified zinc as a potential risk to surface waters. Best Management Practices recommended for management of stormwater runoff from turf fields included wet ponds, infiltration structures, filters and bio-filtration structures.

Synthetic turf does not support soil organisms. The grass and these organisms play an ecological role by purifying water as it leaches into the earth.

Many developments in Lawrence are being constructed to LEED standards in order to obtain LEED certification. LEED, Leadership in Energy and Environmental Design, is an internationally recognized green building certification system. LEED offers credit for water efficient landscaping and recommends various options for reducing water requirements. (See pages 23-24 in attached LEED certification booklet.) LEED recommends installing landscaping that does not require permanent irrigation systems, but does not directly recommend synthetic turf or even infer its use. While synthetic turf may qualify for LEED points, it is not listed as a recommended landscaping option.

Some communities, particularly in areas with limited water sources such as California, have encouraged the use of artificial turf to conserve water. Glendale Arizona had once given rebates to residents for installing artificial turf but stopped giving rebates after the issuance of the Centers for Disease Control and Prevention 2008 health advisory.

To summarize, synthetic turf is not, in staff's opinion, an environmentally sustainable form of landscaping because it contributes to the heat island effect, diminishes the health of the underlying soil, has the potential to leach zinc into surface water through stormwater runoff and has potential health consequences related to the levels of lead in some types of synthetic turf fibers.

LOW MAINTENANCE LANDSCAPING: XERISCAPE:
Reducing the use of pesticides and fertilizer is a sound environmental concept and can be achieved with natural landscaping through the use of native species which are adapted to the climate and environment of the area. The following description of low maintenance landscaping was provided in the K-State Agricultural Experiment Station and Cooperative Extension Service Report: “It simply imitates nature’s design: putting hardy, adapted plant materials in the places where they grow best. Once
established, this kind of landscape requires little maintenance because it is designed to work in harmony with nature, not against it.” (page 2) Savings will be realized due to reduced water, pesticide and herbicide usage.

This report stated that turfgrass areas usually require the most water and maintenance in a landscape and recommended that irrigated turfgrass areas be limited to places with high use. Low-maintenance and native grasses are recommended for other areas.

The K-State report also recommends that a development collect runoff and ‘harvest’ water by collecting or redirecting water from the downspouts to areas of the landscape that need it. Different types of irrigation systems, such as drip or trickle, in addition to traditional sprinklers could also help conserve water. Watering slowly, deeply and infrequently will help reduce water usage.

OTHER CONSIDERATIONS

UTILITIES:

- When providing locates for underground utilities the location will more than likely be painted on the turf as flags are difficult to push through the fabric.
- Identifying the responsible party for restoration of the artificial turf should excavation be required to perform repairs/maintenance on existing infrastructure below the artificial turf or on surface structures within the artificial turf area such as meters, manhole, lids, etc, as well as areas that may be damaged adjacent to the work area due to access or storing materials, spoils etc. The Utilities Department does not currently have the expertise or equipment to repair and replace the synthetic turf.
- Establishing the appropriate way to make an excavation; cut the turf or roll the turf back before beginning an excavation.

TURF MAINTENANCE:

- Would need to establish regulations for maintenance of turf and require replacement when it has aged. The City of Punta Gorda, FL included the following requirement in their requirements for synthetic turf: “Artificial turf shall be maintained in a green fadeless condition and shall be maintained free of dirt, mud, stains, weeds, debris, tears, holes and impressions. All edges of the artificial turf shall not be loose, and must be maintained with appropriate edging or stakes.”

PRODUCT SPECIFICATIONS:

- Many companies produce various types of synthetic turf and the quality varies between different brands or types of turf. Standards regulating the quality of synthetic turf would be necessary. The City of Punta Gorda, FL permits the use of synthetic turf with a Special Exception. A copy of the application is included with this report. Features considered are the minimum tufted weight, minimum permeability, color, and warranty. In addition, information on the anchoring system is required to ensure the turf will withstand the effects of wind.

While there may be solutions to some of these concerns, the effort necessary to accommodate synthetic turf does not appear to be justified when natural alternatives exist and have been in practice for decades without major issue.

Staff Recommendation

Staff recommends denial of the requested amendment to Articles 10 and 17 of the Land Development Code to permit synthetic turf as a landscape material. ‘Low maintenance’ landscaping can and should be utilized to meet the need for more sustainable landscaping practices.
Figure 1. Prepared Base

Figure 2. Installation
### LANDSCAPING PRACTICES COMPARISON CHART:

<table>
<thead>
<tr>
<th></th>
<th>Synthetic Turf</th>
<th>Low Maintenance Landscaping</th>
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<tr>
<td>Low water usage</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
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<tr>
<td>No Pesticide usage</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>No Fertilizer</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>No mowing</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Pervious</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
</tr>
<tr>
<td>Filters pollutants</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
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<tr>
<td>Provides Habitat</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
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<tr>
<td>Provides Oxygen</td>
<td>✔️</td>
<td>✔️</td>
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<tr>
<td>Absorbs Carbon Dioxide</td>
<td>✔️</td>
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<tr>
<td>Reduces Heat Island</td>
<td></td>
<td>✔️</td>
<td>✔️</td>
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<tr>
<td>Adds to Heat Island</td>
<td></td>
<td>❌</td>
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A request was made by Paul Werner Architects to initiate a text amendment to the Land Development Code to include ‘synthetic turf’ in the list of landscape materials that may be used to meet the landscape requirements in Article 10 and to revise the definition of ‘Landscaping’ in Article 17 to include ‘synthetic turf’. The request is being made in order to maintain recently installed synthetic turf at the apartment complex being constructed at the intersection of Trail and Frontier, formerly known as the Boardwalk Apartments. While the site plan was approved with code compliant landscape materials (sod, seed), a routine inspection of the site yielded the installation of the synthetic turf. The owner was informed of the non-compliant installation and was provided options to conform to the code, including installing the approved plant material, seeking a variance, or requesting a text amendment to revise the applicable sections of the code. The applicant would like the city to consider revising the Development Code to permit the use of synthetic turf for this and potentially future projects.

The code emphasizes the use of living landscape materials and states the following about landscaping (non-exclusive list):

Section 20-1009 Landscape Material Standards – (b) Artificial Plants – No artificial plants or vegetation may be used to meet any standards of this section.

Section 20-1009 Landscape Material Standards – (e) Grass Seed and Sod – Turf areas shall be planted with species suitable as permanent lawns in Lawrence. Turf areas may be sodded or seeded.

Section 20-1010(a)(2) – All Landscape Material, including trees, plant material and structural elements, shall be in place and healthy prior to issuance of a final Certificate of Occupancy. The Planning Director may authorize issuance of a temporary Certificate
of Occupancy prior to installation of required Landscaping, when seasonal conditions render installation impractical...

Section 20-1701 Definitions
Landscape Material – Such living material such as trees, Shrubs, Ground Cover/vines, turf grasses, and non-living material such as: ricks, pebbles, sand, bark, brick pavers, earthen mounds (excluding pavement), and/or other items of a decorative or embellishing nature such as: fountains, pools, walls, fencing, sculpture, etc.

Landscaping – Any combination of living plants such as trees, Shrubs, plants, vegetative Ground Cover or turf grasses...

Ground Cover – Living Landscape Materials or living low-growing plants other than turf grasses, installed in such a manner so as to provide a continuous cover of the ground surface and which, upon maturity, normally reach an average maximum Height of not greater than 24 inches.

The application noted that synthetic turf is low maintenance and may be appropriate in some locations. The application also identified synthetic turf as a ‘green building option’ as it does not require watering, mowing, or the use of fertilizers or pesticides. The application is attached for your reference.

If the text amendment is approved, it will be necessary to revise the Community Design Manual as well for landscaping requirements within the Commercial and Industrial Zoning Districts for consistency.

Staff recommends that the Commission initiate the amendment so that careful consideration can be given to the request and so that the pros and cons of using synthetic turf to meet the values of landscaping requirements can be discussed by the community stakeholders.

**Action requested:** Initiate a text amendment to Article 10 and Article 17 of the Land Development Code – Code of the City of Lawrence, Kansas regarding landscaping and landscape materials and associated revisions to the Community Design Manual, if appropriate.
REQUEST FOR INITIATION of a TEXT AMENDMENT

APPLICATION FORM

APPLICANT/AGENT INFORMATION

Contact: Joy Rhea

Company: Paul Werner Architects

Address: 1918 Edgelea Road

City: Lawrence State: KS ZIP: 66044

Phone: (785) 832-0804 Fax: (785) 832-0890

E-mail: joyr@paulwernerarchitects.com Mobile/Pager: 

Pre-Application Meeting Date: 4-1-11 Planner: Scott McCullough

Are you submitting any other applications? If so, please state which one(s).

Please identify the section of the Development Code or Subdivision Regulations proposed to be amended.

20-1003(e), 20-1009 (b), 20-1009(e)(4), 20-1701

Please provide proposed amendment. (Attach additional sheets if needed)

20-1003(e) In addition to required Shade Trees and Shrubs, landscape areas within the interior of off-street Parking Areas shall be planted with turf which can be synthetic or natural, Ground Cover, Ornamental Trees, or Shrubs.

20-1009(b) No artificial plants or vegetation other than synthetic turf may be used to meet any standards of this section.

ADD TO DEV CODE 20-1009(e)(4) Synthetic turf areas shall be installed per the manufacturers specification as permanent lawns in Lawrence.

20-1701 - Landscaping: Such living material as trees, Shrubs, Ground Cover/vines, turf grasses, and non-living material such as: rocks, pebbles, sand, bark, brick pavers, earthen mounds (excluding pavement), synthetic turf and/or other items of a decorative or embellishing nature such as: fountains, pools, walls, fencing, sculpture, etc.

Application Form                  Page 4 of 6
Request for Initiation of a Text Amendment

5/5/2009
Please respond to the following questions to the best of your knowledge. In reviewing and making decisions on proposed text amendments review bodies shall consider the following factors. (Attach additional sheets if needed.)

1. **Does the proposed text amendment correct an error or inconsistency in the Development Code or Subdivision Regulations?** If so, please provide the specific error found and/or reference the specific section of the Development Code that is inconsistent with the section identified to be amended above. The amendment does not correct an error or inconsistency but instead provides an alternative option to turf grass. Synthetic turf is a viable option for turf management in the right location. This text amendment would give the Planning Department the ability to approve it.

2. **Does the proposed amendment meet the challenge of a changing condition?**
   If so, please explain.
   With the increased awareness of providing green building options synthetic turf has its benefits which include using no irrigation, fertilizer or pesticides to maintain it. Synthetic turf also reduces emissions since it does not need mowed.

3. **Is the proposed amendment consistent with Horizon 2020? Please explain.**
   Horizon 2020 states on pages 5-22, 5-28 and 6-28, "Encourage the use of high quality materials in the construction of screening and landscape areas to decrease long-term maintenance costs." Synthetic turf falls into this category because it is a high quality material made of partly recycled materials and has no yearly maintenance cost such as irrigation systems, fertilizers or pesticides.

4. **Is the proposed amendment consistent with the stated purpose of the Development Code? See Sec. 20-104 of the Development Code for the stated purpose.**
   This amendment in no way endangers the health, safety and welfare of the public.
SIGNATURE

By execution of my/our signature, I/we do hereby officially apply to request initiation of the proposed text amendment as indicated above.

Signature(s): __________________________ Date 4-18-11

______________________________ Date ____________________

______________________________ Date ____________________

STAFF USE ONLY

Application No. __________________________

Date Received __________________________

Planning Commission Date __________________________

Fee $ __________________________

Date Fee Paid __________________________
LETTER OF TRANSMITTAL

FROM : Joy Rhea
TO : Scott McCullough
DATE : April 18, 2011
RE : Text Amendment for synthetic turf

We are Sending :

____ Attached  ____ Per your request  ____ For your files

Items Transmitted Via :

____ US Mail  ____ Overnight  ____ Courier  XOther

Items Transmitted are For Your :

____ Information  ____ Use  ____ Approval  ____ Review

Items Transmitted are :

____ X Originals  ____ Disk (s)  ____ Shop Drawings  ____ Blueprints
____ Specifications  ____ Samples  ____ Other __________________

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REMARKS :

_________________________________________________________________________
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The built environment has a profound impact on our natural environment, economy, health, and productivity. Breakthroughs in building science, technology, and operations are now available to designers, builders, operators, and owners who want to build green and maximize both economic and environmental performance.

Through the LEED® green building certification program, the U.S. Green Building Council (USGBC) is transforming the built environment. The green building movement offers an unprecedented opportunity to respond to the most important challenges of our time, including global climate change, dependence on non sustainable and expensive sources of energy, and threats to human health. The work of innovative building professionals is a fundamental driving force in the green building moment. Such leadership is a critical component to achieving USGBC’s mission of a sustainable built environment for all within a generation.

USGBC MEMBERSHIP

USGBC’s greatest strength is the diversity of our membership. USGBC is a balanced, consensus based nonprofit with more than 18,000 member companies and organizations representing the entire building industry. Since its inception in 1993, USGBC has played a vital role in providing a leadership forum and a unique, integrating force for the building industry. USGBC’s programs have three distinguishing characteristics:

Committee-based

The heart of this effective coalition is our committee structure, in which volunteer members design strategies that are implemented by staff and expert consultants. Our committees provide a forum for members to resolve differences, build alliances, and forge cooperative solutions for influencing change in all sectors of the building industry.

Member-driven

Membership is open and balanced and provides a comprehensive platform for carrying out important programs and activities. We target the issues identified by our members as the highest priority. We conduct an annual review of achievements that allows us to set policy, revise strategies, and devise work plans based on members’ needs.

Consensus-focused

We work together to promote green buildings, and in doing so, we help foster greater economic vitality and environmental health at lower costs. We work to bridge ideological gaps between industry segments and develop balanced policies that benefit the entire industry.

Contact the U.S. Green Building Council
2101 L Street, NW
Suite 500
Washington, DC 20037
(800) 795-1747 Office
(202) 828-5110 Fax
www.usgbc.org
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U.S. Green Building Council
2101 L Street, NW
Suite 500
Washington, DC 20037

TRADEMARKS

ACKNOWLEDGMENTS

The LEED 2009 Rating System has been made possible only through the efforts of many dedicated volunteers, staff members, and others in the USGBC community. The Rating System improvement work was managed and implemented by USGBC staff and included review and input by many Technical Advisory Group (TAG) members with oversight by the LEED Steering Committee. We extend our deepest gratitude to all of our LEED committee members who participated in the development of this rating system, for their tireless volunteer efforts and constant support of USGBC’s mission:

**LEED Steering Committee**

Scot Horst, Chair, LSC  Horst, Inc  
Joel Ann Todd, Vice-Chair, LSC  Joel Ann Todd  
Muscoe Martin  M2 Architecture  
Stuart Carron  JohnsonDiversey, Inc.  
Holley Henderson  H2 Ecodesign, LLC  
Christine Magar  Greenform  
Kristin Shewfelt  Architectural Energy Corporation  
Jessica Millman  Agora DC  
Bryna Dunn  Moseley Architects  
Neal Billetdeaux  JJR  
Greg Kats  Managing Good Energies  
Mark Webster  Simpson Gumpertz & Heger  
Bob Thompson  EPA Indoor Environment Management Branch  
Malcolm Lewis  Constructive Technologies Group, Inc.  
John Boecker  7Group  
Sara O’Mara  Choate Construction Company  
Alex Zimmerman  Rep Canada Green Building Council  
Ian Theaker  Rep Canada Green Building Council

**Sustainable Sites TAG**

Bryna Dunn, Chair  Moseley Architects  
Stewart Comstock, Vice-Chair  Maryland Department of the Environment  
Michele Adams  Cahill Associates  
Gina Baker  Burt Hill  
Ted Bardacke  Global Green USA  
Stephen Benz  Sasaki  
Mark Brumbaugh  Brumbaugh & Associates  
Laura Case  Emory University Campus Services  
Zach Christeson  the HOK Planning Group  
Jay Enck  Commissioning & Green Building Services  
Ron Hand  E/FECT. Sustainable Design Solutions  
Richard Heinisch  Acuity Lighting Group  
Michael Lane  Lighting Design Lab  
Marita Roos  HNTB  
Zolna Russell  Hord Coplan Macht, Inc.  
Alfred Vick  Ecos Environmental Design, Inc.
### Water Efficiency TAG

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<tr>
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<td>Alliance for Water Efficiency</td>
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<tr>
<td>David Carlson</td>
<td>Columbia University</td>
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<tr>
<td>Bill Hoffman</td>
<td>H.W. Hoffman and Associates, LLC</td>
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<tr>
<td>Geoff Nara</td>
<td>Civil &amp; Environmental Consultants</td>
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<tr>
<td>Stephanie Tanner</td>
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<td>David Bracciano</td>
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### Energy & Atmosphere TAG

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### Materials & Resources TAG

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LEED 2009 for New Construction and Major Renovations

Nancy Malone Siegel & Strain Architects
Kirsten Ritchie Gensler
Wayne Trusty Athena Sustainable Materials Institute
Denise Van Valkenburg MASCO Retail Cabinet Group
Gabe Wing Herman Miller, Inc.

Indoor Environmental Quality TAG
Bob Thompson, Chair EPA Indoor Environment Management Branch
Steve Taylor, Vice-Chair Taylor Engineering
Nancy Clanton Clanton and Associates
Alexis Kurtz Ove Arup & Partners
George Loisos Loisos+ Ubelohde
Prasad Vaidya The Weidt Group
Daniel Bruck BRC Acoustics & Tech.
David Lubman David Lubman & Associates
Charles Salter Salter Associates
Ozgem Ornetekin DMJM Harris
Jude Anders Shoreline Concepts, LLC
Brian Cloward Mithun Architects+Designers+Planners
Larry Dykhuis Herman Miller, Inc
Francis (Bud) Offerman Indoor Environmental Engineering
Christopher Schaffner The Green Engineer
Dennis Stanke Trane Company

The LEED 2009 for New Construction Rating System builds on the work of those who helped create previous versions:

LEED for New Construction Version 2.2 Core Committee
James H. Goldman, Chair Turner Construction
Tom Scarola, Vice-Chair Tishman Speyer Properties
Lee Burgett Trane Company
Craig Kneeland NYSETRA
Joe Higgins Fidelity Real Estate Company
Harry Gordon Burt Hill Kosar Rittelmann Associates
Muscoe Martin Wallace Roberts & Todd, LLC
Chris Dixon Mithun
Bill Odell HOK Architects
Chris Schaffner The Green Engineer
Wayne Trusty Athena Sustainable Materials Institute
Jerry Yudelson Greenway Consulting Group, LLC
Charlotte Matthews Bovis Lend Lease
John McFarland WorkingBuildings LLC
Prasad Vaidya The Weidt Group
Aalok Deshmuk The Rocky Mountain Institute
## LEED 2009 for New Construction and Major Renovations Project Checklist

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### Water Efficiency

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<tr>
<td>Water Use Reduction</td>
<td>Water Efficient Landscaping</td>
<td>Innovative Wastewater Technologies</td>
<td>Water Use Reduction</td>
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<td>Materials Reuse</td>
<td>Recycled Content</td>
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**26 Possible Points**

**10 Possible Points**

**35 Possible Points**

**14 Possible Points**
LEED 2009 for New Construction and Major Renovations

- Credit 5  Regional Materials    1-2
- Credit 6  Rapidly Renewable Materials    1
- Credit 7  Certified Wood    1

**Indoor Environmental Quality**  15 Possible Points

- Prerequisite 1  Minimum Indoor Air Quality Performance Required
- Prerequisite 2  Environmental Tobacco Smoke (ETS) Control Required
- Credit 1  Outdoor Air Delivery Monitoring    1
- Credit 2  Increased Ventilation    1
- Credit 3.1  Construction Indoor Air Quality Management Plan—During Construction    1
- Credit 3.2  Construction Indoor Air Quality Management Plan—Before Occupancy    1
- Credit 4.1  Low-Emitting Materials—Adhesives and Sealants    1
- Credit 4.2  Low-Emitting Materials—Paints and Coatings    1
- Credit 4.3  Low-Emitting Materials—Flooring Systems    1
- Credit 4.4  Low-Emitting Materials—Composite Wood and Agrifiber Products    1
- Credit 5  Indoor Chemical and Pollutant Source Control    1
- Credit 6.1  Controllability of Systems—Lighting    1
- Credit 6.2  Controllability of Systems—Thermal Comfort    1
- Credit 7.1  Thermal Comfort—Design    1
- Credit 7.2  Thermal Comfort—Verification    1
- Credit 8.1  Daylight and Views—Daylight    1
- Credit 8.2  Daylight and Views—Views    1

**Innovation in Design**  6 Possible Points

- Credit 1  Innovation in Design    1-5
- Credit 2  LEED Accredited Professional    1

**Regional Priority**  4  Possible Points

- Credit 1  Regional Priority    1-4

**LEED 2009 for New Construction and Major Renovations**

100 base points; 6 possible Innovation in Design and 4 Regional Priority points

- Certified  40–49 points
- Silver  50–59 points
- Gold  60–79 points
- Platinum  80 points and above
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I. LEED® GREEN BUILDING RATING SYSTEM

Background on LEED®
Following the formation of the U.S. Green Building Council (USGBC) in 1993, the organization’s members quickly realized that the sustainable building industry needed a system to define and measure “green buildings.” USGBC began to research existing green building metrics and rating systems. Less than a year after formation, the members acted on the initial findings by establishing a committee to focus solely on this topic. The composition of the committee was diverse; it included architects, real estate agents, a building owner, a lawyer, an environmentalist, and industry representatives. This cross section of people and professions added a richness and depth both to the process and to the ultimate product.

The first LEED Pilot Project Program, also referred to as LEED Version 1.0, was launched at the USGBC Membership Summit in August 1998. After extensive modifications, LEED Green Building Rating System Version 2.0 was released in March 2000, with LEED Version 2.1 following in 2002 and LEED Version 2.2 following in 2005.

As LEED has evolved and matured, the program has undertaken new initiatives. In addition to a rating system specifically devoted to building operational and maintenance issues (LEED for Existing Buildings: Operations & Maintenance), LEED addresses the different project development and delivery processes that exist in the U.S. building design and construction market, through rating systems for specific building typologies, sectors, and project scopes: LEED for Core & Shell, LEED for New Construction, LEED for Schools, LEED for Neighborhood Development, LEED for Retail, LEED for Healthcare, LEED for Homes, and LEED for Commercial Interiors.

Project teams interact with the Green Building Certification Institute (GBCI) for project registration and certification. GBCI was established in 2008 as a separately incorporated entity with the support of the U.S. Green Building Council. GBCI administers credentialing and certification programs related to green building practice. These programs support the application of proven strategies for increasing and measuring the performance of buildings and communities as defined by industry systems such as LEED.

The green building field is growing and changing daily. New technologies and products are being introduced into the marketplace, and innovative designs and practices are proving their effectiveness. The LEED rating systems and reference guides will evolve as well. Project teams must comply with the version of the rating system that is current at the time of their registration.

USGBC will highlight new developments on its website on a continual basis at www.usgbc.org.

Features of LEED®
The LEED Green Building Rating Systems are voluntary, consensus-based, and market-driven. Based on existing and proven technology, they evaluate environmental performance from a whole building perspective over a building’s life cycle, providing a definitive standard for what constitutes a green building in design, construction, and operation.

The LEED rating systems are designed for rating new and existing commercial, institutional, and residential buildings. They are based on accepted energy and environmental principles and strike a balance between known, established practices and emerging concepts. Each rating system is organized into 5 environmental categories:
Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, and Indoor Environmental Quality. An additional category, Innovation in Design, addresses sustainable building expertise as well as design measures not covered under the 5 environmental categories. Regional bonus points are another feature of LEED and acknowledge the importance of local conditions in determining best environmental design and construction practices.

The LEED Credit Weightings

In LEED 2009, the allocation of points between credits is based on the potential environmental impacts and human benefits of each credit with respect to a set of impact categories. The impacts are defined as the environmental or human effect of the design, construction, operation, and maintenance of the building, such as greenhouse gas emissions, fossil fuel use, toxins and carcinogens, air and water pollutants, indoor environmental conditions. A combination of approaches, including energy modeling, life-cycle assessment, and transportation analysis, is used to quantify each type of impact. The resulting allocation of points among credits is called credit weighting.

LEED 2009 uses the U.S. Environmental Protection Agency's TRACI environmental impact categories as the basis for weighting each credit. TRACI was developed to assist with impact evaluation for life-cycle assessment, industrial ecology, process design, and pollution prevention.

LEED 2009 also takes into consideration the weightings developed by the National Institute of Standards and Technology (NIST); these compare impact categories with one another and assign a relative weight to each. Together, the 2 approaches provide a solid foundation for determining the point value of each credit in LEED 2009.

The LEED 2009 credit weightings process is based on the following parameters, which maintain consistency and usability across rating systems:

- All LEED credits are worth a minimum of 1 point.
- All LEED credits are positive, whole numbers; there are no fractions or negative values.
- All LEED credits receive a single, static weight in each rating system; there are no individualized scorecards based on project location.
- All LEED rating systems have 100 base points; Innovation in Design (or Operations) and Regional Priority credits provide opportunities for up to 10 bonus points.

Given the above criteria, the LEED 2009 credit weightings process involves 3 steps:

1. A reference building is used to estimate the environmental impacts in 13 categories associated with a typical building pursuing LEED certification.
2. The relative importance of building impacts in each category are set to reflect values based on the NIST weightings.²
3. Data that quantify building impacts on environmental and human health are used to assign points to individual credits.

Each credit is allocated points based on the relative importance of the building-related impacts that it addresses. The result is a weighted average that combines building impacts and the relative value of the impact categories. Credits that most directly address the most important impacts are given the greatest weight, subject to the system design parameters described above. Credit weights also reflect a decision by LEED to recognize the market implications of point allocation. The result is a significant change in allocation of points compared with previous LEED rating systems. Overall, the changes increase the relative emphasis on the reduction of energy consumption and greenhouse gas emissions associated with building systems, transportation, the embodied energy of water, the embodied energy of materials, and where applicable, solid waste.
The details of the weightings process vary slightly among individual rating systems. For example, LEED for Existing Buildings: Operations & Maintenance includes credits related to solid waste management but LEED for New Construction does not. This results in a difference in the portion of the environmental footprint addressed by each rating system and the relative allocation of points. The weightings process for each rating system is fully documented in a weightings workbook.

The credit weightings process will be reevaluated over time to incorporate changes in values ascribed to different building impacts and building types, based on both market reality and evolving scientific knowledge related to buildings. A complete explanation of the LEED credit weightings system is available on the USGBC website, at www.usgbc.org.

Regional Priority Credits
To provide incentive to address geographically specific environmental issues, USGBC regional councils and chapters have identified 6 credits per rating system that are of particular importance to specific areas. Each regional priority credit is worth an additional 1 point, and a total of 4 regional priority points may be earned. Upon project registration, LEED Online automatically determines a project’s regional priority credits based on its zip code. If the project achieves more than 4 regional priority credits, the team can choose the credits for which these points will apply. The USGBC website also contains a searchable database of regional priority credits.

II. OVERVIEW AND PROCESS
The LEED 2009 Green Building Rating System for New Construction and Major Renovations is a set of performance standards for certifying the design and construction of commercial or institutional buildings and high-rise residential buildings of all sizes, both public and private. The intent is to promote healthful, durable, affordable, and environmentally sound practices in building design and construction.

Prerequisites and credits in the LEED 2009 for New Construction and Major Renovations addresses 7 topics:

- Sustainable Sites (SS)
- Water Efficiency (WE)
- Energy and Atmosphere (EA)
- Materials and Resources (MR)
- Indoor Environmental Quality (IEQ)
- Innovation in Design (ID)
- Regional Priority (RP)

LEED 2009 for New Construction and Major Renovations certifications are awarded according to the following scale:

- Certified  40–49 points
- Silver      50–59 points
- Gold       60–79 points
- Platinum   80 points and above

GBCI will recognize buildings that achieve 1 of these rating levels with a formal letter of certification.
When to Use LEED 2009 for New Construction

LEED for New Construction was designed primarily for new commercial office buildings, but it has been applied to many other building types by LEED practitioners. All commercial buildings, as defined by standard building codes, are eligible for certification as LEED for New Construction buildings. Examples of commercial occupancies include offices, institutional buildings (libraries, museums, churches, etc.), hotels, and residential buildings of 4 or more habitable stories.

LEED for New Construction addresses design and construction activities for both new buildings and major renovations of existing buildings. If the project scope does not involve significant design and construction activities and focuses more on operations and maintenance activities, LEED for Existing Buildings: Operations & Maintenance is more appropriate because it addresses operational and maintenance issues of working buildings.

Please see the Rating System Selection Policy, located in the LEED resources section of www.usgbc.org, for more information about choosing a rating system.

Registration

Project teams interested in earning LEED certification for their buildings must first register the project with GBCI. Projects can be registered on the GBCI website (www.gbcic.org). The website also has information on registration costs for USGBC national members as well as nonmembers. Registration is an important step that establishes contact with GBCI and provides access to software tools, errata, critical communications, and other essential information.

Certification

To earn LEED certification, the applicant project must satisfy all the prerequisites and qualify for a minimum number of points to attain the established project ratings as listed below. Having satisfied the basic prerequisites of the program, applicant projects are then rated according to their degree of compliance within the rating system.

LEED 2009 for New Construction provides the option of splitting a certification application into two phases: design and construction. Documentation for design phase credits, identified in LEED-Online, can be submitted for review at the end of the design phase; the submittals for these credits can be fully evaluated based on documentation available during this phase of the project. For example, if a project site meets the requirements of LEED for New Construction SS Credit 3, Brownfield Redevelopment, the likelihood of credit achievement can be assessed before construction is complete. The LEED credit itself, however, is not awarded at the design review stage.


III. MINIMUM PROGRAM REQUIREMENTS

The LEED 2009 Minimum Program Requirements (MPRs) define the minimum characteristics that a project must possess in order to be eligible for certification under LEED 2009. These requirements define the categories of buildings that the LEED rating systems were designed to evaluate, and taken together serve three goals: to give clear guidance to customers, to protect the integrity of the LEED program, and to reduce challenges that occur during the LEED certification process. It is expected that MPRs will evolve over time along with LEED rating system improvements. The requirements will apply only to those projects registering under LEED 2009.

To view the MPRs and the MPR Supplemental Guidance, visit the LEED Resources and Tools section of www.usgbc.org/projecttools.
IV. EXEMPLARY PERFORMANCE STRATEGIES

Exemplary performance strategies result in performance that greatly exceeds the performance level or expands the scope required by an existing LEED 2009 for New Construction credit. To earn exemplary performance credits, teams must meet the performance level defined by the next step in the threshold progression. For credits with more than 1 compliance path, an Innovation in Design point can be earned by satisfying more than 1 compliance path if their benefits are additive.

The credits for which exemplary performance points are available through expanded performance or scope are noted in the LEED Reference Guide for Green Design & Construction, 2009 Edition and in LEED Online.

Endnotes


SS Prerequisite 1: Construction Activity Pollution Prevention

Required

Intent
To reduce pollution from construction activities by controlling soil erosion, waterway sedimentation and airborne dust generation.

Requirements
Create and implement an erosion and sedimentation control plan for all construction activities associated with the project. The plan must conform to the erosion and sedimentation requirements of the 2003 EPA Construction General Permit OR local standards and codes, whichever is more stringent. The plan must describe the measures implemented to accomplish the following objectives:

- To prevent loss of soil during construction by stormwater runoff and/or wind erosion, including protecting topsoil by stockpiling for reuse.
- To prevent sedimentation of storm sewers or receiving streams.
- To prevent pollution of the air with dust and particulate matter.

The EPA’s construction general permit outlines the provisions necessary to comply with Phase I and Phase II of the National Pollutant Discharge Elimination System (NPDES) program. While the permit only applies to construction sites greater than 1 acre, the requirements are applied to all projects for the purposes of this prerequisite. Information on the EPA construction general permit is available at http://cfpub.epa.gov/npdes/stormwater/cgp.cfm.

Potential Technologies & Strategies
Create an erosion and sedimentation control plan during the design phase of the project. Consider employing strategies such as temporary and permanent seeding, mulching, earthen dikes, silt fencing, sediment traps and sediment basins.
SS Credit 1: Site Selection

1 Point

Intent
To avoid the development of inappropriate sites and reduce the environmental impact from the location of a building on a site.

Requirements
Do not develop buildings, hardscape, roads or parking areas on portions of sites that meet any of the following criteria:

- Prime farmland as defined by the U.S. Department of Agriculture in the United States Code of Federal Regulations, Title 7, Volume 6, Parts 400 to 699, Section 657.5 (citation 7CFR657.5)
- Previously undeveloped land whose elevation is lower than 5 feet above the elevation of the 100-year flood as defined by the Federal Emergency Management Agency (FEMA)
- Land specifically identified as habitat for any species on federal or state threatened or endangered lists
- Land within 100 feet of any wetlands as defined by the U.S. Code of Federal Regulations 40 CFR, Parts 230-233 and Part 22, and isolated wetlands or areas of special concern identified by state or local rule, OR within setback distances from wetlands prescribed in state or local regulations, as defined by local or state rule or law, whichever is more stringent
- Previously undeveloped land that is within 50 feet of a water body, defined as seas, lakes, rivers, streams and tributaries that support or could support fish, recreation or industrial use, consistent with the terminology of the Clean Water Act
- Land that prior to acquisition for the project was public parkland, unless land of equal or greater value as parkland is accepted in trade by the public landowner (park authority projects are exempt).

Potential Technologies & Strategies
During the site selection process, give preference to sites that do not include sensitive elements or restrictive land types. Select a suitable building location and design the building with a minimal footprint to minimize disruption of the environmentally sensitive areas identified above.
SS Credit 2: Development Density and Community Connectivity

5 Points

Intent
To channel development to urban areas with existing infrastructure, protect greenfields, and preserve habitat and natural resources.

Requirements

OPTION 1. Development Density
Construct or renovate a building on a previously developed site AND in a community with a minimum density of 60,000 square feet per acre net. The density calculation is based on a typical two-story downtown development and must include the area of the project being built.

OR

OPTION 2. Community Connectivity
Construct or renovate a building on a site that meets the following criteria:

- Is located on a previously developed site
- Is within 1/2 mile of a residential area or neighborhood with an average density of 10 units per acre net
- Is within 1/2 mile of at least 10 basic services
- Has pedestrian access between the building and the services

For mixed-use projects, no more than 1 service within the project boundary may be counted as 1 of the 10 basic services, provided it is open to the public. No more than 2 of the 10 services required may be anticipated (i.e., at least 8 must be existing and operational). In addition, the anticipated services must demonstrate that they will be operational in the locations indicated within 1 year of occupation of the applicant project.

Examples of basic services include the following:

- Bank
- Place of Worship
- Convenience Grocery
- Day Care Center
- Cleaners
- Fire Station
- Beauty Salon
- Hardware
- Laundry
- Library
- Medical or Dental Office
- Senior Care Facility
- Park
- Pharmacy
- Post Office
- Restaurant
- School
- Supermarket
- Theater
- Community Center
- Fitness Center
- Museum
Proximity is determined by drawing a 1/2-mile radius around a main building entrance on a site map and counting the services within that radius.

**Potential Technologies & Strategies**

During the site selection process, give preference to urban sites with pedestrian access to a variety of services.
SS Credit 3: Brownfield Redevelopment

1 Point

Intent
To rehabilitate damaged sites where development is complicated by environmental contamination and to reduce pressure on undeveloped land.

Requirements
OPTION 1
Develop on a site documented as contaminated (by means of an ASTM E1903-97 Phase II Environmental Site Assessment or a local voluntary cleanup program).

OR

OPTION 2
Develop on a site defined as a brownfield by a local, state, or federal government agency.

For projects where asbestos is found and remediated also earn this credit. Testing should be done in accordance with EPA Reg 40CFR part 763, when applicable.

Potential Technologies & Strategies
During the site selection process, give preference to brownfield sites. Identify tax incentives and property cost savings. Coordinate site development plans with remediation activity, as appropriate.
SS Credit 4.1: Alternative Transportation—Public Transportation Access

6 Points

Intent
To reduce pollution and land development impacts from automobile use.

Requirements

OPTION 1. Rail Station Proximity
Locate the project within 1/2-mile walking distance (measured from a main building entrance) of an existing or planned and funded commuter rail, light rail or subway station.

OR

OPTION 2. Bus Stop Proximity
Locate the project within 1/4-mile walking distance (measured from a main building entrance) of 1 or more stops for 2 or more public, campus, or private bus lines usable by building occupants.

Potential Technologies & Strategies
Perform a transportation survey of future building occupants to identify transportation needs. Locate the building near mass transit.
SS Credit 4.2: Alternative Transportation—Bicycle Storage and Changing Rooms
1 Point

Intent
To reduce pollution and land development impacts from automobile use.

Requirements

CASE 1. Commercial or Institutional Projects
   Provide secure bicycle racks and/or storage within 200 yards of a building entrance for 5% or more of all building
   users (measured at peak periods)
   Provide shower and changing facilities in the building, or within 200 yards of a building entrance, for 0.5% of full-
   time equivalent (FTE) occupants.

CASE 2. Residential Projects
   Provide covered storage facilities for securing bicycles for 15% or more of building occupants.

Potential Technologies & Strategies
Design the building with transportation amenities such as bicycle racks and shower/changing facilities.
SS Credit 4.3: Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles

3 Points

Intent
To reduce pollution and land development impacts from automobile use.

Requirements

OPTION 1
Provide preferred parking\(^1\) for low-emitting and fuel-efficient vehicles\(^2\) for 5% of the total vehicle parking capacity of the site. Providing a discounted parking rate is an acceptable substitute for preferred parking for low-emitting/fuel-efficient vehicles. To establish a meaningful incentive in all potential markets, the parking rate must be discounted at least 20%. The discounted rate must be available to all customers (i.e., not limited to the number of customers equal to 5% of the vehicle parking capacity), publicly posted at the entrance of the parking area and available for a minimum of 2 years.

OR

OPTION 2
Install alternative-fuel fueling stations for 3% of the total vehicle parking capacity of the site. Liquid or gaseous fueling facilities must be separately ventilated or located outdoors.

OR

OPTION 3
Provide low-emitting and fuel-efficient vehicles\(^2\) for 3% of full-time equivalent (FTE) occupants. Provide preferred parking\(^1\) for these vehicles.

OR

OPTION 4
Provide building occupants access to a low-emitting or fuel-efficient vehicle-sharing program. The following requirements must be met:

- One low-emitting or fuel-efficient vehicle must be provided per 3% of FTE occupants, assuming that 1 shared vehicle can carry 8 persons (i.e., 1 vehicle per 267 FTE occupants). For buildings with fewer than 267 FTE occupants, at least 1 low emitting or fuel-efficient vehicle must be provided.
- A vehicle-sharing contract must be provided that has an agreement of at least 2 years.

\(^1\) For the purposes of this credit “preferred parking” refers to the parking spots that are closest to the main entrance of the project (exclusive of spaces designated for handicapped persons) or parking passes provided at a discounted price.

\(^2\) For the purposes of this credit, low-emitting and fuel-efficient vehicles are defined as vehicles that are either classified as Zero Emission Vehicles (ZEV) by the California Air Resources Board or have achieved a minimum green score of 40 on the American Council for an Energy Efficient Economy (ACEEE) annual vehicle rating guide.
The estimated number of customers served per vehicle must be supported by documentation.

A narrative explaining the vehicle-sharing program and its administration must be submitted.

Parking for low-emitting and fuel-efficient vehicles must be located in the nearest available spaces in the nearest available parking area. Provide a site plan or area map clearly highlighting the walking path from the parking area to the project site and noting the distance.

**Potential Technologies & Strategies**

Provide transportation amenities such as alternative-fuel refueling stations. Consider sharing the costs and benefits of refueling stations with neighbors.
SS Credit 4.4: Alternative Transportation—Parking Capacity

2 Points

**Intent**
To reduce pollution and land development impacts from automobile use.

**Requirements**

**CASE 1. Non-Residential Projects**

**OPTION 1**
Size parking capacity to meet but not exceed minimum local zoning requirements.
Provide preferred parking for carpool or vanpool vehicles for 5% of the total parking spaces.

**OR**

**OPTION 2**
For projects that provide parking for less than 5% of full-time equivalent (FTE) building occupants:
Provide preferred parking for carpool or vanpool vehicles, marked as such, for 5% of total parking spaces. Providing a discounted parking rate is an acceptable substitute for preferred parking for carpool or vanpool vehicles. To establish a meaningful incentive in all potential markets, the parking rate must be discounted at least 20%. The discounted rate must be available to all customers (i.e., not limited to the number of customers equal to 5% of the vehicle parking capacity), publicly posted at the entrance of the parking area, and available for a minimum of 2 years.

**OR**

**OPTION 3**
Provide no new parking.

**OR**

**OPTION 4**
For projects that have no minimum local zoning requirements, provide 25% fewer parking spaces than the applicable standard listed in the 2003 Institute of Transportation Engineers (ITE) “Parking Generation” study at http://www.ite.org.

**CASE 2. Residential Projects**

**OPTION 1**
Size parking capacity to meet but not exceed minimum local zoning requirements
Provide infrastructure and support programs to facilitate shared vehicle use such as carpool drop-off areas, designated parking for vanpools, car-share services, ride boards and shuttle services to mass transit.

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1 For the purposes of this credit “preferred parking” refers to the parking spots that are closest to the main entrance of the project (exclusive of spaces designated for handicapped persons) or parking passes provided at a discounted price.
OR

OPTION 2

Provide no new parking.

CASE 3. Mixed Use (Residential with Commercial/Retail) Projects

OPTION 1

Mixed-use buildings with less than 10% commercial area must be considered residential and adhere to the residential requirements in Case 2. For mixed-use buildings with more than 10% commercial area, the commercial space must adhere to non-residential requirements in Case 1 and the residential component must adhere to residential requirements in Case 2.

OR

OPTION 2

Provide no new parking.

Potential Technologies & Strategies

Minimize parking lot/garage size. Consider sharing parking facilities with adjacent buildings. Consider alternatives that will limit the use of single occupancy vehicles.
SS Credit 5.1: Site Development—Protect or Restore Habitat

1 Point

Intent
To conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.

Requirements

CASE 1. Greenfield Sites
Limit all site disturbance to the following parameters:
- 40 feet beyond the building perimeter;
- 10 feet beyond surface walkways, patios, surface parking and utilities less than 12 inches in diameter;
- 15 feet beyond primary roadway curbs and main utility branch trenches;
- 25 feet beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater detention facilities and playing fields) that require additional staging areas to limit compaction in the constructed area.

CASE 2. Previously Developed Areas or Graded Sites
Restore or protect a minimum of 50% of the site (excluding the building footprint) or 20% of the total site area (including building footprint), whichever is greater, with native or adapted vegetation. Projects earning SS Credit 2: Development Density and Community Connectivity may include vegetated roof surface in this calculation if the plants are native or adapted, provide habitat, and promote biodiversity.

Projects with limited landscape opportunities may also donate offsite land in perpetuity, equal to 60% of the previously developed area (including the building footprint), to a land trust within the same EPA Level III Ecoregion identified for the project site. The land trust must adhere to the Land Trust Alliance ‘Land Trust Standards and Practices’ 2004 Revision.

Potential Technologies & Strategies
Survey greenfield sites to identify site elements and adopt a master plan for developing the project site. Carefully site the building to minimize disruption to existing ecosystems and design the building to minimize its footprint. Strategies include stacking the building program, tuck-under parking and sharing parking facilities with neighbors. Establish clearly-marked construction boundaries to minimize disturbance of the existing site and restore previously degraded areas to their natural state. For previously developed sites, use local and regional governmental agencies, consultants, educational facilities and native plant societies as resources for the selection of appropriate native or adapted plants. Prohibit plants listed as invasive or noxious weed species. Once established, native/adapted plants require minimal or no irrigation; do not require active maintenance such as mowing or chemical inputs such as fertilizers, pesticides or herbicides; and provide habitat value and promote biodiversity through avoidance of monoculture plantings.

1 Greenfield sites are those that are not previously developed or graded and remain in a natural state.
2 Previously developed areas are those that previously contained buildings, roadways, parking lots or were graded or altered by direct human activities.
3 Native or adapted plants are plants indigenous to a locality or cultivars of native plants that are adapted to the local climate and are not considered invasive species or noxious weeds.
SS Credit 5.2: Site Development—Maximize Open Space

1 Point

Intent
To promote biodiversity by providing a high ratio of open space to development footprint.

Requirements

CASE 1. Sites with Local Zoning Open Space Requirements
Reduce the development footprint1 and/or provide vegetated open space within the project boundary such that the amount of open space exceeds local zoning requirements by 25%.

CASE 2. Sites with No Local Zoning Requirements (e.g. some university campuses, military bases)
Provide a vegetated open space area adjacent to the building that is equal in area to the building footprint.

CASE 3. Sites with Zoning Ordinances but No Open Space Requirements
Provide vegetated open space equal to 20% of the project site area.

ALL CASES
For projects in urban areas that earn SS Credit 2: Development Density and Community Connectivity, vegetated roof areas can contribute to credit compliance.

For projects in urban areas that earn SS Credit 2: Development Density and Community Connectivity, pedestrian-oriented hardscape areas can contribute to credit compliance. For such projects, a minimum of 25% of the open space counted must be vegetated.

Wetlands or naturally designed ponds may count as open space and the side slope gradients average 1:4 (vertical: horizontal) or less and are vegetated.

Potential Technologies & Strategies
Perform a site survey to identify site elements and adopt a master plan for developing the project site. Select a suitable building location and design the building footprint to minimize site disruption. Strategies include stacking the building program, tuck-under parking and sharing parking facilities with neighbors to maximize the amount of open space on the site.

1 Development footprint is defined as the total area of the building footprint, hardscape, access roads and parking.
SS Credit 6.1: Stormwater Design—Quantity Control

1 Point

Intent
To limit disruption of natural hydrology by reducing impervious cover, increasing on-site infiltration, reducing or eliminating pollution from stormwater runoff and eliminating contaminants.

Requirements
CASE 1. Sites with Existing Imperviousness 50% or Less

OPTION 1
Implement a stormwater management plan that prevents the postdevelopment peak discharge rate and quantity from exceeding the predevelopment peak discharge rate and quantity for the 1- and 2-year 24-hour design storms.

OR

OPTION 2
Implement a stormwater management plan that protects receiving stream channels from excessive erosion. The stormwater management plan must include stream channel protection and quantity control strategies.

CASE 2. Sites with Existing Imperviousness Greater Than 50%
Implement a stormwater management plan that results in a 25% decrease in the volume of stormwater runoff from the 2-year 24-hour design storm.

Potential Technologies & Strategies
Design the project site to maintain natural stormwater flows by promoting infiltration. Specify vegetated roofs, pervious paving and other measures to minimize impervious surfaces. Reuse stormwater for non-potable uses such as landscape irrigation, toilet and urinal flushing, and custodial uses.
SS Credit 6.2: Stormwater Design—Quality Control

1 Point

Intent
To limit disruption and pollution of natural water flows by managing stormwater runoff.

Requirements
Implement a stormwater management plan that reduces impervious cover, promotes infiltration and captures and treats the stormwater runoff from 90% of the average annual rainfall\(^1\) using acceptable best management practices (BMPs).

BMPs used to treat runoff must be capable of removing 80% of the average annual postdevelopment total suspended solids (TSS) load based on existing monitoring reports. BMPs are considered to meet these criteria if:

- They are designed in accordance with standards and specifications from a state or local program that has adopted these performance standards,

  OR

- There exists infield performance monitoring data demonstrating compliance with the criteria. Data must conform to accepted protocol (e.g., Technology Acceptance Reciprocity Partnership [TARP], Washington State Department of Ecology) for BMP monitoring.

Potential Technologies & Strategies
Use alternative surfaces (e.g., vegetated roofs, pervious pavement, grid pavers) and nonstructural techniques (e.g., rain gardens, vegetated swales, disconnection of imperviousness, rainwater recycling) to reduce imperviousness and promote infiltration and thereby reduce pollutant loadings.

Use sustainable design strategies (e.g., low-impact development, environmentally sensitive design) to create integrated natural and mechanical treatment systems such as constructed wetlands, vegetated filters and open channels to treat stormwater runoff.

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\(^1\) There are 3 distinct climates in the United States that influence the nature and amount of annual rainfall. Humid watersheds are defined as those that receive at least 40 inches of rainfall each year. Semiarid watersheds receive between 20 and 40 inches of rainfall per year, and arid watersheds receive less than 20 inches of rainfall per year. For this credit, 90% of the average annual rainfall is equivalent to treating the runoff from the following (based on climate):

- Humid Watersheds — 1 inch of rainfall
- Semiarid Watersheds — 0.75 inches of rainfall
- Arid Watersheds — 0.5 inches of rainfall
SS Credit 7.1: Heat Island Effect—Nonroof

1 Point

Intent
To reduce heat islands¹ to minimize impacts on microclimates and human and wildlife habitats.

Requirements

OPTION 1

- Use any combination of the following strategies for 50% of the site hardscape (including roads, sidewalks, courtyards and parking lots):
  - Provide shade from the existing tree canopy or within 5 years of landscape installation. Landscaping (trees) must be in place at the time of occupancy.
  - Provide shade from structures covered by solar panels that produce energy used to offset some nonrenewable resource use.
  - Provide shade from architectural devices or structures that have a solar reflectance index² (SRI) of at least 29.
  - Use hardscape materials with an SRI of at least 29.
  - Use an open-grid pavement system (at least 50% pervious).

OR

OPTION 2

- Place a minimum of 50% of parking spaces under cover³. Any roof used to shade or cover parking must have an SRI of at least 29, be a vegetated green roof or be covered by solar panels that produce energy used to offset some nonrenewable resource use.

Potential Technologies & Strategies

Employ strategies, materials and landscaping techniques that reduce the heat absorption of exterior materials. Use shade (calculated on June 21, noon solar time) from native or adapted trees and large shrubs, vegetated trellises or other exterior structures supporting vegetation. Consider using new coatings and integral colorants for asphalt to achieve light-colored surfaces instead of blacktop. Position photovoltaic cells to shade impervious surfaces.

Consider replacing constructed surfaces (e.g., roof, roads, sidewalks, etc.) with vegetated surfaces such as vegetated roofs and open grid paving or specify high-albedo materials, such as concrete, to reduce heat absorption.

¹ Heat islands are defined as thermal gradient differences between developed and undeveloped areas.
² The solar reflectance index (SRI) is a measure of the constructed surface’s ability to reflect solar heat, as shown by a small temperature rise. It is defined so that a standard black surface (reflectance 0.05, emittance 0.90) is 0 and a standard white surface (reflectance 0.80, emittance 0.90) is 100. To calculate the SRI for a given material, obtain the reflectance value and emittance value for the material. SRI is calculated according to ASTM E 1980. Reflectance is measured according to ASTM E 903, ASTM E 1918, or ASTM C 1549. Emittance is measured according to ASTM E 408 or ASTM C 1371.
³ For the purposes of this credit, under cover parking is defined as parking underground, under deck, under roof, or under a building.
SS Credit 7.2: Heat Island Effect—Roof

1 Point

Intent
To reduce heat islands’ to minimize impacts on microclimates and human and wildlife habitats.

Requirements

OPTION 1
Use roofing materials with a solar reflectance index (SRI) equal to or greater than the values in the table below for a minimum of 75% of the roof surface.

Roofing materials having a lower SRI value than those listed below may be used if the weighted rooftop SRI average meets the following criteria:

<table>
<thead>
<tr>
<th>Roof Type</th>
<th>SRI</th>
<th>Area Roof Meeting Minimum SRI × SRI of Installed Roof</th>
<th>≥ 75%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-sloped roof</td>
<td>78</td>
<td>0.75 x SRI of Installed Roof</td>
<td></td>
</tr>
<tr>
<td>Steep-sloped roof</td>
<td>29</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OR

OPTION 2
Install a vegetated roof that covers at least 50% of the roof area.

OR

OPTION 3
Install high-albedo and vegetated roof surfaces that, in combination, meet the following criteria:

<table>
<thead>
<tr>
<th>Roof Type</th>
<th>SRI</th>
<th>Area Roof Meeting Minimum SRI + Area of Vegetated Roof</th>
<th>≥ Total Roof Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-sloped roof</td>
<td>78</td>
<td>0.75 + Area of Vegetated Roof</td>
<td></td>
</tr>
<tr>
<td>Steep-sloped roof</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Heat islands are defined as thermal gradient differences between developed and undeveloped areas.
2 The solar reflectance index (SRI) is a measure of the constructed surface’s ability to reflect solar heat, as shown by a small temperature rise. It is defined so that a standard black surface (reflectance 0.05, emittance 0.90) is 0 and a standard white surface (reflectance 0.80, emittance 0.90) is 100. To calculate the SRI for a given material, obtain the reflectance value and emittance value for the material. SRI is calculated according to ASTM E 1980. Reflectance is measured according to ASTM E 903, ASTM E 1918 or ASTM C 1549. Emittance is measured according to ASTM E 408 or ASTM C 1371.
Potential Technologies & Strategies
SS Credit 8: Light Pollution Reduction

1 Point

Intent
To minimize light trespass from the building and site, reduce sky-glow to increase night sky access, improve nighttime visibility through glare reduction and reduce development impact from lighting on nocturnal environments.

Requirements
Project teams must comply with 1 of the 2 options for interior lighting AND the requirement for exterior lighting.

For Interior Lighting

OPTION 1
Reduce the input power (by automatic device) of all nonemergency interior luminaires with a direct line of sight to any openings in the envelope (translucent or transparent) by at least 50% between 11 p.m. and 5 a.m. After-hours override may be provided by a manual or occupant-sensing device provided the override lasts no more than 30 minutes.

OR

OPTION 2
All openings in the envelope (translucent or transparent) with a direct line of sight to any nonemergency luminaires must have shielding (controlled/closed by automatic device for a resultant transmittance of less than 10% between 11 p.m. and 5 a.m.).

For Exterior Lighting

Light areas only as required for safety and comfort. Exterior lighting power densities shall not exceed those specified in ANSI/ASHRAE/IESNA Standard 90.1-2007 with Addenda 1 for the documented lighting zone. Justification shall be provided for the selected lighting zone. Lighting controls for all exterior lighting shall comply with section 9.4.1.3 of ANSI/ASHRAE/IESNA Standard 90.1-2007, without amendments.

Classify the project under 1 of the following zones, as defined in IESNA RP-33, and follow all the requirements for that zone:

LZ1: Dark (developed areas within national parks, state parks, forest land and rural areas)
Design exterior lighting so that all site and building-mounted luminaires produce a maximum initial illuminance value no greater than 0.01 horizontal and vertical footcandles at the site boundary and beyond. Document that 0% of the total initial designed fixture lumens (sum total of all fixtures on site) are emitted at an angle of 90 degrees or higher from nadir (straight down).

1 The requirement to use ASHRAE Addenda I is unique to this credit and does not obligate Project teams to use ASHRAE approved addenda for other credits.
**LZ2: Low** *(primarily residential zones, neighborhood business districts, light industrial areas with limited nighttime use and residential mixed-use areas)*
Design exterior lighting so that all site and building-mounted luminaires produce a maximum initial illuminance value no greater than 0.10 horizontal and vertical footcandles at the site boundary and no greater than 0.01 horizontal footcandles 10 feet beyond the site boundary. Document that no more than 2% of the total initial designed fixture lumens (sum total of all fixtures on site) are emitted at an angle of 90 degrees or higher from nadir (straight down).

**LZ3: Medium** *(all other areas not included in LZ1, LZ2 or LZ4, such as commercial/industrial, and high-density residential)*
Design exterior lighting so that all site and building-mounted luminaires produce a maximum initial illuminance value no greater than 0.20 horizontal and vertical footcandles at the site boundary and no greater than 0.01 horizontal footcandles 15 feet beyond the site. Document that no more than 5% of the total initial designed fixture lumens (sum total of all fixtures on site) are emitted at an angle of 90 degrees or higher from nadir (straight down).

**LZ4: High** *(high-activity commercial districts in major metropolitan areas)*
Design exterior lighting so that all site and building-mounted luminaires produce a maximum initial illuminance value no greater than 0.60 horizontal and vertical footcandles at the site boundary and no greater than 0.01 horizontal footcandles 15 feet beyond the site. Document that no more than 10% of the total initial designed fixture lumens (sum total of all fixtures on site) are emitted at an angle of 90 degrees or higher from nadir (straight down).

**LZ2, LZ3 and LZ4** - For site boundaries that abut public rights-of-way, light trespass requirements may be met relative to the curb line instead of the site boundary.

**For All Zones**
Illuminance generated from a single luminaire placed at the intersection of a private vehicular driveway and public roadway accessing the site is allowed to use the centerline of the public roadway as the site boundary for a length of 2 times the driveway width centered at the centerline of the driveway.

**Potential Technologies & Strategies**
Adopt site lighting criteria to maintain safe light levels while avoiding off-site lighting and night sky pollution. Minimize site lighting where possible, and use computer software to model the site lighting. Technologies to reduce light pollution include full cutoff luminaires, low-reflectance surfaces and low-angle spotlights.

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2 To be LZ4, the area must be so designated by an organization with local jurisdiction, such as the local zoning authority.
WE Prerequisite 1: Water Use Reduction
**Required**

**Intent**
To increase water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.

**Requirements**
Employ strategies that in aggregate use 20% less water than the water use baseline calculated for the building (not including irrigation).

Calculate the baseline according to the commercial and/or residential baselines outlined below. Calculations are based on estimated occupant usage and must include only the following fixtures and fixture fittings (as applicable to the project scope): water closets, urinals, lavatory faucets, showers, kitchen sink faucets and prerinse spray valves.

### Commercial Fixtures, Fittings, and Appliances Current Baseline

<table>
<thead>
<tr>
<th>Fixture Type</th>
<th>Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial toilets</td>
<td>1.6 gallons per flush (gpf)*&lt;br&gt;Except blow-out fixtures: 3.5 (gpf)</td>
</tr>
<tr>
<td>Commercial urinals</td>
<td>1.0 (gpf)</td>
</tr>
<tr>
<td>Commercial lavatory (restroom) faucets</td>
<td>2.2 gallons per minute (gpm) at 60 pounds per square inch (psi), private applications only (hotel or motel guest rooms, hospital patient rooms)&lt;br&gt;0.5 (gpm) at 60 (psi)** all others except private applications&lt;br&gt;0.25 gallons per cycle for metering faucets</td>
</tr>
<tr>
<td>Commercial prerinse spray valves (for food service applications)</td>
<td>Flow rate ≤ 1.6 (gpm)&lt;br&gt;(no pressure specified; no performance requirement)</td>
</tr>
</tbody>
</table>

### Residential Fixtures, Fittings, and Appliances Current Baseline

<table>
<thead>
<tr>
<th>Fixture Type</th>
<th>Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential toilets</td>
<td>1.6 (gpf)***</td>
</tr>
<tr>
<td>Residential lavatory (bathroom) faucets</td>
<td>2.2 (gpm) at 60 psi</td>
</tr>
<tr>
<td>Residential kitchen faucet</td>
<td>2.5 (gpm) at 80 (psi) per shower stall****</td>
</tr>
<tr>
<td>Residential showerheads</td>
<td>2.5 (gpm) at 80 (psi) per shower stall****</td>
</tr>
</tbody>
</table>

* EPAct 1992 standard for toilets applies to both commercial and residential models.
** In addition to EPAct requirements, the American Society of Mechanical Engineers standard for public lavatory faucets is 0.5 gpm at 60 psi (ASME A112.18.1-2005). This maximum has been incorporated into the national Uniform Plumbing Code and the International Plumbing Code.
*** EPAct 1992 standard for toilets applies to both commercial and residential models.
**** Residential shower compartment (stall) in dwelling units: The total allowable flow rate from all flowing showerheads at any given time, including rain systems, waterfalls, bodysprays, bodyspas and jets, must be limited to the allowable showerhead flow rate as specified above (2.5 gpm) per shower compartment, where the floor area of the shower compartment is less than 2,500 square inches. For each increment of 2,500 square inches of floor area thereafter or part thereof, an additional showerhead with total allowable flow rate from all flowing devices equal to or less than the allowable flow rate as specified above must be allowed. Exception: Showers that emit recirculated nonpotable water originating from within the shower compartment while operating are allowed to exceed the maximum as long as the total potable water flow does not exceed the flow rate as specified above.

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1 Tables adapted from information developed and summarized by the U.S. Environmental Protection Agency (EPA) Office of Water based on requirements of the Energy Policy Act (EPAct) of 1992 and subsequent rulings by the Department of Energy, requirements of the EPAct of 2005, and the plumbing code requirements as stated in the 2006 editions of the Uniform Plumbing Code or International Plumbing Code pertaining to fixture performance.
The following fixtures, fittings and appliances are outside the scope of the water use reduction calculation:

- Commercial Steam Cookers
- Commercial Dishwashers
- Automatic Commercial Ice Makers
- Commercial (family sized) Clothes Washers
- Residential Clothes Washers
- Standard and Compact Residential Dishwashers

**Potential Technologies & Strategies**

WaterSense-certified fixtures and fixture fittings should be used where available. Use high-efficiency fixtures (e.g., water closets and urinals) and dry fixtures, such as toilets attached to composting systems, to reduce potable water demand. Consider using alternative on-site sources of water (e.g., rainwater, stormwater, and air conditioner condensate) and graywater for nonpotable applications such as custodial uses and toilet and urinal flushing. The quality of any alternative source of water used must be taken into consideration based on its application or use.
WE Credit 1: Water Efficient Landscaping

2–4 Points

Intent
To limit or eliminate the use of potable water or other natural surface or subsurface water resources available on or near the project site for landscape irrigation.

Requirements

OPTION 1. Reduce by 50% (2 points)
Reduce potable water consumption for irrigation by 50% from a calculated midsummer baseline case.

Reductions must be attributed to any combination of the following items:

- Plant species, density and microclimate factor
- Irrigation efficiency
- Use of captured rainwater
- Use of recycled wastewater
- Use of water treated and conveyed by a public agency specifically for nonpotable uses

Groundwater seepage that is pumped away from the immediate vicinity of building slabs and foundations may be used for landscape irrigation to meet the intent of this credit. However, the project team must demonstrate that doing so does not affect site stormwater management systems.

OR

OPTION 2. No Potable Water Use or Irrigation1 (4 points)
Meet the requirements for Option 1.

AND

PATH 1
Use only captured rainwater, recycled wastewater, recycled graywater or water treated and conveyed by a public agency specifically for nonpotable uses for irrigation.

OR

PATH 2
Install landscaping that does not require permanent irrigation systems. Temporary irrigation systems used for plant establishment are allowed only if removed within a period not to exceed 18 months of installation.

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1 If the percent reduction of potable water is 100% AND the percent reduction of total water is equal to or greater than 50%, then Option 2 is earned, for a total of 4 points.
Potential Technologies & Strategies
Perform a soil/climate analysis to determine appropriate plant material and design the landscape with native or adapted plants to reduce or eliminate irrigation requirements. Where irrigation is required, use high-efficiency equipment and/or climate-based controllers.
WE Credit 2: Innovative Wastewater Technologies

2 Points

Interrupt
To reduce wastewater generation and potable water demand while increasing the local aquifer recharge.

Requirements

OPTION 1
Reduce potable water use for building sewage conveyance by 50% through the use of water-conserving fixtures (e.g., water closets, urinals) or nonpotable water (e.g., captured rainwater, recycled graywater, on-site or municipally treated wastewater).

OR

OPTION 2
Treat 50% of wastewater on-site to tertiary standards. Treated water must be infiltrated or used on-site.

Potential Technologies & Strategies
Specify high-efficiency fixtures and dry fixtures (e.g., composting toilet systems, nonwater-using urinals) to reduce wastewater volumes. Consider reusing stormwater or graywater for sewage conveyance or on-site mechanical and/or natural wastewater treatment systems. Options for on-site wastewater treatment include packaged biological nutrient removal systems, constructed wetlands and high-efficiency filtration systems.
WE Credit 3: Water Use Reduction
2–4 Points

**Intent**
To further increase water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.

**Requirements**
Employ strategies that in aggregate use less water than the water use baseline calculated for the building (not including irrigation). The minimum water savings percentage for each point threshold is as follows:

<table>
<thead>
<tr>
<th>Percentage Reduction</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>30%</td>
<td>2</td>
</tr>
<tr>
<td>35%</td>
<td>3</td>
</tr>
<tr>
<td>40%</td>
<td>4</td>
</tr>
</tbody>
</table>

Calculate the baseline according to the commercial and/or residential baselines outlined below. Calculations are based on estimated occupant usage and must include only the following fixtures and fixture fittings (as applicable to the project scope): water closets, urinals, lavatory faucets, showers, kitchen sink faucets and pre-rinse spray valves.

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<td>2.2 gallons per minute (gpm) at 60 pounds per square inch (psi), private applications only (hotel or motel guest rooms, hospital patient rooms)&lt;br&gt;0.5 (gpm) at 60 (psi)** all others except private applications&lt;br&gt;0.25 gallons per cycle for metering faucets</td>
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<th>Residential Fixtures, Fittings, and Appliances</th>
<th>Current Baseline</th>
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<tbody>
<tr>
<td>Residential toilets</td>
<td>1.6 (gpf)***</td>
</tr>
<tr>
<td>Residential lavatory (bathroom) faucets</td>
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<tr>
<td>Residential kitchen faucet</td>
<td></td>
</tr>
<tr>
<td>Residential showerheads</td>
<td>2.5 (gpm) at 80 (psi) per shower stall****</td>
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* EPAct 1992 standard for toilets applies to both commercial and residential models.
** In addition to EPAct requirements, the American Society of Mechanical Engineers standard for public lavatory faucets is 0.5 gpm at 60 psi (ASME A112.18.1-2005). This maximum has been incorporated into the national Uniform Plumbing Code and the International Plumbing Code.
*** EPAct 1992 standard for toilets applies to both commercial and residential models.
**** Residential shower compartment (stall) in dwelling units: The total allowable flow rate from all flowing showerheads at any given time, including rain systems, waterfalls, bodysprays, bodyspas and jets, must be limited to the allowable showerhead flow rate as specified above (2.5 gpm) per shower compartment, where the floor area of the shower compartment is less than 2,500 square inches. For each increment of 2,500 square inches of floor area thereafter or part thereof, an additional showerhead with total allowable flow rate from all flowing devices equal to or less than the allowable flow rate as specified above must be allowed. Exception: Showers that emit recirculated nonpotable water originating from within the shower compartment while operating are allowed to exceed the maximum as long as the total potable water flow does not exceed the flow rate as specified above.

1 Tables adapted from information developed and summarized by the U.S. Environmental Protection Agency (EPA) Office of Water based on requirements of the Energy Policy Act (EPAct) of 1992 and subsequent rulings by the Department of Energy, requirements of the EPAct of 2005, and the plumbing code requirements as stated in the 2006 editions of the Uniform Plumbing Code or International Plumbing Code pertaining to fixture performance.
The following fixtures, fittings and appliances are outside the scope of the water use reduction calculation:

- Commercial Steam Cookers
- Commercial Dishwashers
- Automatic Commercial Ice Makers
- Commercial (family-sized) Clothes Washers
- Residential Clothes Washers
- Standard and Compact Residential Dishwashers

**Potential Technologies & Strategies**

Use WaterSense-certified fixtures and fixture fittings where available. Use high-efficiency fixtures (e.g., water closets and urinals) and dry fixtures, such as toilets attached to composting systems, to reduce the potable water demand. Consider using alternative on-site sources of water (e.g., rainwater, stormwater, and air conditioner condensate, graywater) for nonpotable applications (e.g., toilet and urinal flushing, custodial uses). The quality of any alternative source of water being used must be taken into consideration based on its application or use.
EA Prerequisite 1: Fundamental Commissioning of Building Energy Systems

Required

Intent
To verify that the project’s energy-related systems are installed, and calibrated to perform according to the owner’s project requirements, basis of design and construction documents.

Benefits of commissioning include reduced energy use, lower operating costs, fewer contractor callbacks, better building documentation, improved occupant productivity and verification that the systems perform in accordance with the owner’s project requirements.

Requirements
The following commissioning process activities must be completed by the project team:

- Designate an individual as the commissioning authority (CxA) to lead, review and oversee the completion of the commissioning process activities.
  - The CxA must have documented commissioning authority experience in at least 2 building projects.
  - The individual serving as the CxA must be independent of the project design and construction management, though the CxA may be an employee of any firm providing those services. The CxA may be a qualified employee or consultant of the owner.
  - The CxA must report results, findings and recommendations directly to the owner.
  - For projects smaller than 50,000 gross square feet, the CxA may be a qualified person on the design or construction team who has the required experience.

- The owner must document the owner’s project requirements. The design team must develop the basis of design. The CxA must review these documents for clarity and completeness. The owner and design team must be responsible for updates to their respective documents.

- Develop and incorporate commissioning requirements into the construction documents.

- Develop and implement a commissioning plan.

- Verify the installation and performance of the systems to be commissioned.

- Complete a summary commissioning report.

Commissioned Systems
Commissioning process activities must be completed for the following energy-related systems, at a minimum:

- Heating, ventilating, air conditioning and refrigeration (HVAC&R) systems (mechanical and passive) and associated controls
- Lighting and daylighting controls
- Domestic hot water systems
- Renewable energy systems (e.g., wind, solar)
Potential Technologies & Strategies

Engage a CxA as early as possible in the design process. Determine the owner’s project requirements, develop and maintain a commissioning plan for use during design and construction and incorporate commissioning requirements in bid documents. Assemble the commissioning team, and prior to occupancy verify the performance of energy consuming systems. Complete the commissioning reports with recommendations prior to accepting the commissioned systems.

Owners are encouraged to seek out qualified individuals to lead the commissioning process. Qualified individuals are identified as those who possess a high level of experience in the following areas:

- Energy systems design, installation and operation
- Commissioning planning and process management
- Hands-on field experience with energy systems performance, interaction, start-up, balancing, testing, troubleshooting, operation and maintenance procedures
- Energy systems automation control knowledge

Owners are encouraged to consider including water-using systems, building envelope systems, and other systems in the scope of the commissioning plan as appropriate. The building envelope is an important component of a facility that impacts energy consumption, occupant comfort and indoor air quality. While this prerequisite does not require building envelope commissioning, an owner can achieve significant financial savings and reduce risk of poor indoor air quality by including it in the commissioning process.

The LEED Reference Guide for Green Building Design and Construction, 2009 Edition provides guidance on the rigor expected for this prerequisite for the following:

- Owner’s project requirements
- Basis of design
- Commissioning plan
- Commissioning specification
- Performance verification documentation
- Commissioning report
EA Prerequisite 2: Minimum Energy Performance

Required

Intent
To establish the minimum level of energy efficiency for the proposed building and systems to reduce environmental and economic impacts associated with excessive energy use.

Requirements

OPTION 1. Whole Building Energy Simulation

Demonstrate a 10% improvement in the proposed building performance rating for new buildings, or a 5% improvement in the proposed building performance rating for major renovations to existing buildings, compared with the baseline building performance rating.

Calculate the baseline building performance rating according to the building performance rating method in Appendix G of ANSI/ASHRAE/IESNA Standard 90.1-2007 (with errata but without addenda) using a computer simulation model for the whole building project.

Appendix G of Standard 90.1-2007 requires that the energy analysis done for the building performance rating method include all energy costs associated with the building project. To achieve points using this credit, the proposed design must meet the following criteria:

- Comply with the mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) in Standard 90.1-2007 (with errata but without addenda).
- Include all energy costs associated with the building project.
- Compare against a baseline building that complies with Appendix G of Standard 90.1-2007 (with errata but without addenda). The default process energy cost is 25% of the total energy cost for the baseline building. If the building's process energy cost is less than 25% of the baseline building energy cost, the LEED submittal must include documentation substantiating that process energy inputs are appropriate.

For the purpose of this analysis, process energy is considered to include, but is not limited to, office and general miscellaneous equipment, computers, elevators and escalators, kitchen cooking and refrigeration, laundry washing and drying, lighting exempt from the lighting power allowance (e.g., lighting integral to medical equipment) and other (e.g., waterfall pumps).

Regulated (non-process) energy includes lighting (for the interior, parking garage, surface parking, façade, or building grounds, etc. except as noted above), heating, ventilation and air conditioning (HVAC) (for space heating, space cooling, fans, pumps, toilet exhaust, parking garage ventilation, kitchen hood exhaust, etc.), and service water heating for domestic or space heating purposes.

Process loads must be identical for both the baseline building performance rating and the proposed building performance rating. However, project teams may follow the exceptional calculation method (ANSI/ASHRAE/IESNA Standard 90.1-2007 G2.5) to document measures that reduce process loads. Documentation of process loads must be identical for both the baseline building performance rating and the proposed building performance rating.

Project teams wishing to use ASHRAE approved addenda for the purposes of this credit may do so at their discretion. Addenda must be applied consistently across all LEED credits.
load energy savings must include a list of the assumptions made for both the base and the proposed design, and theoretical or empirical information supporting these assumptions.


OR

Comply with the prescriptive measures of the ASHRAE Advanced Energy Design Guide appropriate to the project scope, outlined below. Project teams must comply with all applicable criteria as established in the Advanced Energy Design Guide for the climate zone in which the building is located.

The building must meet the following requirements:
- Less than 20,000 square feet.
- Office occupancy.

The building must meet the following requirements:
- Less than 20,000 square feet.
- Retail occupancy.

The building must meet the following requirements:
- Less than 50,000 square feet.
- Warehouse or self-storage occupancy.

OR

Comply with the prescriptive measures identified in the Advanced Buildings™ Core Performance™ Guide developed by the New Buildings Institute. The building must meet the following requirements:
- Less than 100,000 square feet.
- Comply with Section 1: Design Process Strategies, and Section 2: Core Performance Requirements.
- Health care, warehouse and laboratory projects are ineligible for this path.
Potential Technologies & Strategies
Design the building envelope and systems to meet baseline requirements. Use a computer simulation model to assess the energy performance and identify the most cost-effective energy efficiency measures. Quantify energy performance compared with a baseline building.

If local code has demonstrated quantitative and textual equivalence following, at a minimum, the U.S. Department of Energy (DOE) standard process for commercial energy code determination, then the results of that analysis may be used to correlate local code performance with ANSI/ASHRAE/IESNA Standard 90.1-2007. Details on the DOE process for commercial energy code determination can be found at http://www.energycodes.gov/implement/determinations_com.stm.
EA Prerequisite 3: Fundamental Refrigerant Management

Required

Intent
To reduce stratospheric ozone depletion.

Requirements
Zero use of chlorofluorocarbon (CFC)-based refrigerants in new base building heating, ventilating, air conditioning and refrigeration (HVAC&R) systems. When reusing existing base building HVAC equipment, complete a comprehensive CFC phase-out conversion prior to project completion. Phase-out plans extending beyond the project completion date will be considered on their merits.

Existing small HVAC units (defined as containing less than 0.5 pounds of refrigerant) and other equipment, such as standard refrigerators, small water coolers and any other equipment that contains less than 0.5 pounds of refrigerant, are not considered part of the base building system and are not subject to the requirements of this prerequisite.

Potential Technologies & Strategies
When reusing existing HVAC systems, conduct an inventory to identify equipment that uses CFC-based refrigerants and provide a replacement schedule for these refrigerants. For new buildings, specify new HVAC equipment in the base building that uses no CFC-based refrigerants.
EA Credit 1: Optimize Energy Performance
1–19 Points

Intent
To achieve increasing levels of energy performance beyond the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use.

Requirements
Select 1 of the 3 compliance path options described below. Project teams documenting achievement using any of the 3 options are assumed to be in compliance with EA Prerequisite 2: Minimum Energy Performance.

OPTION 1. Whole Building Energy Simulation (1–19 points)
Demonstrate a percentage improvement in the proposed building performance rating compared with the baseline building performance rating. Calculate the baseline building performance according to Appendix G of ANSI/ASHRAE/IESNA Standard 90.1-2007 (with errata but without addenda) using a computer simulation model for the whole building project. The minimum energy cost savings percentage for each point threshold is as follows:

<table>
<thead>
<tr>
<th>New Buildings</th>
<th>Existing Building Renovations</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>12%</td>
<td>8%</td>
<td>1</td>
</tr>
<tr>
<td>14%</td>
<td>10%</td>
<td>2</td>
</tr>
<tr>
<td>16%</td>
<td>12%</td>
<td>3</td>
</tr>
<tr>
<td>18%</td>
<td>14%</td>
<td>4</td>
</tr>
<tr>
<td>20%</td>
<td>16%</td>
<td>5</td>
</tr>
<tr>
<td>22%</td>
<td>18%</td>
<td>6</td>
</tr>
<tr>
<td>24%</td>
<td>20%</td>
<td>7</td>
</tr>
<tr>
<td>26%</td>
<td>22%</td>
<td>8</td>
</tr>
<tr>
<td>28%</td>
<td>24%</td>
<td>9</td>
</tr>
<tr>
<td>30%</td>
<td>26%</td>
<td>10</td>
</tr>
<tr>
<td>32%</td>
<td>28%</td>
<td>11</td>
</tr>
<tr>
<td>34%</td>
<td>30%</td>
<td>12</td>
</tr>
<tr>
<td>36%</td>
<td>32%</td>
<td>13</td>
</tr>
<tr>
<td>38%</td>
<td>34%</td>
<td>14</td>
</tr>
<tr>
<td>40%</td>
<td>36%</td>
<td>15</td>
</tr>
<tr>
<td>42%</td>
<td>38%</td>
<td>16</td>
</tr>
<tr>
<td>44%</td>
<td>40%</td>
<td>17</td>
</tr>
<tr>
<td>46%</td>
<td>42%</td>
<td>18</td>
</tr>
<tr>
<td>48%</td>
<td>44%</td>
<td>19</td>
</tr>
</tbody>
</table>

1 Project teams wishing to use ASHRAE approved addenda for the purposes of this credit may do so at their discretion. Addenda must be applied consistently across all LEED credits.
Appendix G of Standard 90.1-2007 requires that the energy analysis done for the building performance rating method include all the energy costs associated with the building project. To achieve points under this credit, the proposed design must meet the following criteria:

- Compliance with the mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) in Standard 90.1-2007 (with errata but without addenda).
- Inclusion of all the energy costs within and associated with the building project.
- Comparison against a baseline building that complies with Appendix G of Standard 90.1-2007 (with errata but without addenda). The default process energy cost is 25% of the total energy cost for the baseline building. If the building’s process energy cost is less than 25% of the baseline building energy cost, the LEED submittal must include documentation substantiating that process energy inputs are appropriate.

For the purpose of this analysis, process energy is considered to include, but is not limited to, office and general miscellaneous equipment, computers, elevators and escalators, kitchen cooking and refrigeration, laundry washing and drying, lighting exempt from the lighting power allowance (e.g., lighting integral to medical equipment) and other (e.g., waterfall pumps).

Regulated (non-process) energy includes lighting (e.g., for the interior, parking garage, surface parking, façade, or building grounds, etc. except as noted above), heating, ventilating, and air conditioning (HVAC) (e.g., for space heating, space cooling, fans, pumps, toilet exhaust, parking garage ventilation, kitchen hood exhaust, etc.), and service water heating for domestic or space heating purposes.

For this credit, process loads must be identical for both the baseline building performance rating and the proposed building performance rating. However, project teams may follow the exceptional calculation method (ANSI/ASHRAE/IESNA Standard 90.1-2007 G2.5) to document measures that reduce process loads. Documentation of process load energy savings must include a list of the assumptions made for both the base and proposed design, and theoretical or empirical information supporting these assumptions.


OR

OPTION 2. Prescriptive Compliance Path: ASHRAE Advanced Energy Design Guide (1 point)
Comply with the prescriptive measures of the ASHRAE Advanced Energy Design Guide appropriate to the project scope, outlined below. Project teams must comply with all applicable criteria as established in the Advanced Energy Design Guide for the climate zone in which the building is located.

The building must meet the following requirements:
- Less than 20,000 square feet.
- Office occupancy.

The building must meet the following requirements:
- Less than 20,000 square feet.
- Retail occupancy.

The building must meet the following requirements:

- Less than 50,000 square feet.
- Warehouse or self-storage occupancy.

OR


Comply with the prescriptive measures identified in the Advanced Buildings™ Core Performance™ Guide developed by the New Buildings Institute. The building must meet the following requirements:

- Less than 100,000 square feet.
- Comply with Section 1: Design Process Strategies, and Section 2: Core Performance Requirements.
- Health care, warehouse or laboratory projects are ineligible for this path.

Points achieved under Option 3 (1 point):

- 1 point is available for all projects (office, school, public assembly, and retail projects) less than 100,000 square feet that comply with Sections 1 and 2 of the Core Performance Guide.
- Up to 2 additional points are available to projects that implement performance strategies listed in Section 3, Enhanced Performance. For every 3 strategies implemented from this section, 1 point is available.
- The following strategies are addressed by other aspects of LEED and are not eligible for additional points under EA Credit 1:
  - 3.1 — Cool Roofs
  - 3.8 — Night Venting
  - 3.13 — Additional Commissioning

Potential Technologies & Strategies

Design the building envelope and systems to maximize energy performance. Use a computer simulation model to assess the energy performance and identify the most cost-effective energy efficiency measures. Quantify energy performance compared with a baseline building.

If local code has demonstrated quantitative and textual equivalence following, at a minimum, the U.S. Department of Energy (DOE) standard process for commercial energy code determination, the results of that analysis may be used to correlate local code performance with ANSI/ASHRAE/IESNA Standard 90.1-2007. Details on the DOE process for commercial energy code determination can be found at http://www.energycodes.gov/implement/determinations_com stm.
EA Credit 2: On-site Renewable Energy

1–7 Points

Intent
To encourage and recognize increasing levels of on-site renewable energy self-supply to reduce environmental and economic impacts associated with fossil fuel energy use.

Requirements
Use on-site renewable energy systems to offset building energy costs. Calculate project performance by expressing the energy produced by the renewable systems as a percentage of the building's annual energy cost and use the table below to determine the number of points achieved.

Use the building annual energy cost calculated in EA Credit 1: Optimize Energy Performance or the U.S. Department of Energy's Commercial Buildings Energy Consumption Survey database to determine the estimated electricity use.

The minimum renewable energy percentage for each point threshold is as follows:

<table>
<thead>
<tr>
<th>Percentage Renewable Energy</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1%</td>
<td>1</td>
</tr>
<tr>
<td>3%</td>
<td>2</td>
</tr>
<tr>
<td>5%</td>
<td>3</td>
</tr>
<tr>
<td>7%</td>
<td>4</td>
</tr>
<tr>
<td>9%</td>
<td>5</td>
</tr>
<tr>
<td>11%</td>
<td>6</td>
</tr>
<tr>
<td>13%</td>
<td>7</td>
</tr>
</tbody>
</table>

Potential Technologies & Strategies
Assess the project for nonpolluting and renewable energy potential including solar, wind, geothermal, low-impact hydro, biomass and bio-gas strategies. When applying these strategies, take advantage of net metering with the local utility.
EA Credit 3: Enhanced Commissioning

2 Points

Intent
To begin the commissioning process early in the design process and execute additional activities after systems performance verification is completed.

Requirements
Implement, or have a contract in place to implement, the following additional commissioning process activities in addition to the requirements of EA Prerequisite 1: Fundamental Commissioning of Building Energy Systems and in accordance with the LEED Reference Guide for Green Building Design and Construction, 2009 Edition:

- Prior to the start of the construction documents phase, designate an independent commissioning authority (CxA) to lead, review and oversee the completion of all commissioning process activities.
  - The CxA must have documented commissioning authority experience in at least 2 building projects.
  - The individual serving as the CxA:
    - Must be independent of the work of design and construction.
    - Must not be an employee of the design firm, though he or she may be contracted through them.
    - Must not be an employee of, or contracted through, a contractor or construction manager holding construction contracts.
    - May be a qualified employee or consultant of the owner.
  - The CxA must report results, findings and recommendations directly to the owner.

- The CxA must conduct, at a minimum, 1 commissioning design review of the owner’s project requirements basis of design, and design documents prior to the mid-construction documents phase and back-check the review comments in the subsequent design submission.

- The CxA must review contractor submittals applicable to systems being commissioned for compliance with the owner’s project requirements and basis of design. This review must be concurrent with the review of the architect or engineer of record and submitted to the design team and the owner.

- The CxA or other project team members must develop a systems manual that gives future operating staff the information needed to understand and optimally operate the commissioned systems.

- The CxA or other project team members must verify that the requirements for training operating personnel and building occupants have been completed.

- The CxA must be involved in reviewing the operation of the building with operations and maintenance (O&M) staff and occupants within 10 months after substantial completion. A plan for resolving outstanding commissioning-related issues must be included.
Potential Technologies & Strategies
Although it is preferable that the CxA be contracted by the owner, for the enhanced commissioning credit the CxA may also be contracted through the design firms or construction management firms not holding construction contracts.

The LEED Reference Guide for Green Building Design and Construction, 2009 Edition provides detailed guidance on the rigor expected for the following process activities:

- Commissioning design review
- Commissioning submittal review
- Systems manual.
EA Credit 4: Enhanced Refrigerant Management

2 Points

Intent
To reduce ozone depletion and support early compliance with the Montreal Protocol while minimizing direct contributions to climate change.

Requirements

OPTION 1
Do not use refrigerants.

OR

OPTION 2
Select refrigerants and heating, ventilation, air conditioning and refrigeration (HVAC&R) equipment that minimize or eliminate the emission of compounds that contribute to ozone depletion and climate change. The base building HVAC&R equipment must comply with the following formula, which sets a maximum threshold for the combined contributions to ozone depletion and global warming potential:

\[
\text{LCGWP} + \text{LCODP} \times 10^3 \leq 100
\]

Calculation definitions for \( \text{LCGWP} + \text{LCODP} \times 10^3 \leq 100 \)

- \( \text{LCODP} \): Lifecycle Ozone Depletion Potential (lb CFC 11/Ton-Year)
- \( \text{LCGWP} \): Lifecycle Direct Global Warming Potential (lb CO\(_2\)/Ton-Year)
- \( \text{GWP} \): Global Warming Potential of Refrigerant (0 to 12,000 lb CO\(_2\)/lbr)
- \( \text{ODP} \): Ozone Depletion Potential of Refrigerant (0 to 0.2 lb CFC 11/lbr)
- \( \text{L} \): Refrigerant Leakage Rate (0.5% to 2.0%; default of 2% unless otherwise demonstrated)
- \( \text{M} \): End-of-life Refrigerant Loss (2% to 10%; default of 10% unless otherwise demonstrated)
- \( \text{R} \): Refrigerant Charge (0.5 to 5.0 lbs of refrigerant per ton of gross ARI rated cooling capacity)
- \( \text{Life} \): Equipment Life (10 years; default based on equipment type, unless otherwise demonstrated)

For multiple types of equipment, a weighted average of all base building HVAC&R equipment must be calculated using the following formula:

\[
\sum \left( \frac{\text{LCGWP} + \text{LCODP} \times 10^3}{\text{Qunit}} \right) \times \text{Qunit} \leq 100
\]

\[
\text{Qtotal}
\]
Calculation definitions for \[ \frac{\sum (LCGWP + LCODP \times 10^9) \times Q_{unit}}{Q_{total}} \times 100 \]

- \( Q_{unit} \): Gross ARI rated cooling capacity of an individual HVAC or refrigeration unit (Tons)
- \( Q_{total} \): Total gross ARI rated cooling capacity of all HVAC or refrigeration units

Small HVAC units (defined as containing less than 0.5 pounds of refrigerant) and other equipment, such as standard refrigerators, small water coolers and any other cooling equipment that contains less than 0.5 pounds of refrigerant, are not considered part of the base building system and are not subject to the requirements of this credit.

Do not operate or install fire suppression systems that contain ozone-depleting substances such as CFCs, hydrochlorofluorocarbons (HCFCs) or halons.

**Potential Technologies & Strategies**

Design and operate the facility without mechanical cooling and refrigeration equipment. Where mechanical cooling is used, utilize base building HVAC&R systems for the refrigeration cycle that minimize direct impact on ozone depletion and global climate change. Select HVAC&R equipment with reduced refrigerant charge and increased equipment life. Maintain equipment to prevent leakage of refrigerant to the atmosphere. Use fire suppression systems that do not contain HCFCs or halons.
EA Credit 5: Measurement and Verification

3 Points

Intent
To provide for the ongoing accountability of building energy consumption over time.

Requirements

OPTION 1

The M&V period must cover at least 1 year of post-construction occupancy.

Provide a process for corrective action if the results of the M&V plan indicate that energy savings are not being achieved.

OR

OPTION 2

The M&V period must cover at least 1 year of post-construction occupancy.

Provide a process for corrective action if the results of the M&V plan indicate that energy savings are not being achieved.

OR

OPTION 3 (1 point)
Meet MPR 6 through compliance Option: Energy and Water Data Release Form. Projects must register an account in ENERGY STAR's Portfolio Manager tool and share the project file with the USGBC master account.

Potential Technologies & Strategies
Develop an M&V plan to evaluate building and/or energy system performance. Characterize the building and/or energy systems through energy simulation or engineering analysis. Install the necessary metering equipment to measure energy use. Track performance by comparing predicted performance to actual performance, broken down by component or system as appropriate. Evaluate energy efficiency by comparing actual performance to baseline performance.
While the IPMVP describes specific actions for verifying savings associated with energy conservation measures (ECMs) and strategies, this LEED credit expands upon typical IPMVP M&V objectives. Measurement & verification activities should not necessarily be confined to energy systems where ECMs or energy conservation strategies have been implemented. The IPMVP provides guidance on M&V strategies and their appropriate applications for various situations. These strategies should be used in conjunction with monitoring and trend logging of significant energy systems to provide for the ongoing accountability of building energy performance.

For the corrective action process, consider installing diagnostics within the control system to alert the staff when equipment is not being optimally operated. Conditions that might warrant alarms to alert staff could include:

- Leaking valves in the cooling and heating coils within air handling units;
- Missed economizer opportunities (e.g., faulty economizer damper controls);
- Software and manual overrides allowing equipment to operate 24 hours a day/7 days a week;
- Equipment operation during unusual circumstances (e.g., boiler on when outside air temperature is above 65 °F).

Besides control diagnostics, consider employing retro-commissioning services or dedicating staff to investigate increases in energy usage (such a staff member is usually a resource conservation manager — see http://www.energy.state.or.us/rcm/rcmhm.htm for additional information).
EA Credit 6: Green Power

2 Points

**Intent**
To encourage the development and use of grid-source, renewable energy technologies on a net zero pollution basis.

**Requirements**
Engage in at least a 2-year renewable energy contract to provide at least 35% of the building's electricity from renewable sources, as defined by the Center for Resource Solutions' Green-e Energy product certification requirements.

All purchases of green power shall be based on the quantity of energy consumed, not the cost.

**OPTION 1. Determine Baseline Electricity Use**
Use the annual electricity consumption from the results of EA Credit 1: Optimize Energy Performance.

**OR**

**OPTION 2. Estimate Baseline Electricity Use**
Use the U.S. Department of Energy’s Commercial Buildings Energy Consumption Survey database to determine the estimated electricity use.

**Potential Technologies & Strategies**
Determine the energy needs of the building and investigate opportunities to engage in a green power contract. Green power is derived from solar, wind, geothermal, biomass or low-impact hydro sources. Visit [http://www.green-e.org/energy](http://www.green-e.org/energy) for details about the Green-e Energy program. The green power product purchased to comply with credit requirements need not be Green-e Energy certified. Other sources of green power are eligible if they satisfy the Green-e Energy program’s technical requirements. Renewable energy certificates (RECs), tradable renewable certificates (TRCs), green tags and other forms of green power that comply with the technical requirements of the Green-e Energy program may be used to document compliance with this credit.
MR Prerequisite 1: Storage and Collection of Recyclables

Required

**Intent**
To facilitate the reduction of waste generated by building occupants that is hauled to and disposed of in landfills.

**Requirements**
Provide an easily-accessible dedicated area or areas for the collection and storage of materials for recycling for the entire building. Materials must include, at a minimum: paper, corrugated cardboard, glass, plastics and metals.

**Potential Technologies & Strategies**
Designate an area for recyclable collection and storage that is appropriately sized and located in a convenient area. Identify local waste handlers and buyers for glass, plastic, metals, office paper, newspaper, cardboard and organic wastes. Instruct occupants on recycling procedures. Consider employing cardboard balers, aluminum can crushers, recycling chutes and other waste management strategies to further enhance the recycling program.
MR Credit 1.1: Building Reuse—Maintain Existing Walls, Floors and Roof
1–3 Points

Intent
To extend the lifecycle of existing building stock, conserve resources, retain cultural resources, reduce waste and reduce environmental impacts of new buildings as they relate to materials manufacturing and transport.

Requirements
Maintain the existing building structure (including structural floor and roof decking) and envelope (the exterior skin and framing, excluding window assemblies and non-structural roofing material). The minimum percentage building reuse for each point threshold is as follows:

<table>
<thead>
<tr>
<th>Building Reuse</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>55%</td>
<td>1</td>
</tr>
<tr>
<td>75%</td>
<td>2</td>
</tr>
<tr>
<td>95%</td>
<td>3</td>
</tr>
</tbody>
</table>

Hazardous materials that are remediated as a part of the project must be excluded from the calculation of the percentage maintained. If the project includes an addition that is more than 2 times the square footage of the existing building, this credit is not applicable.

Potential Technologies & Strategies
Consider reusing existing, previously-occupied building structures, envelopes and elements. Remove elements that pose a contamination risk to building occupants and upgrade components that would improve energy and water efficiency such as windows, mechanical systems and plumbing fixtures.
MR Credit 1.2: Building Reuse—Maintain Interior Nonstructural Elements

1 Point

Intent
To extend the lifecycle of existing building stock, conserve resources, retain cultural resources, reduce waste and reduce environmental impacts of new buildings as they relate to materials manufacturing and transport.

Requirements
Use existing interior nonstructural elements (e.g., interior walls, doors, floor coverings and ceiling systems) in at least 50% (by area) of the completed building, including additions. If the project includes an addition with square footage more than 2 times the square footage of the existing building, this credit is not applicable.

Potential Technologies & Strategies
Consider reusing existing building structures, envelopes and interior nonstructural elements. Remove elements that pose a contamination risk to building occupants, and upgrade components that would improve energy and water efficiency such as mechanical systems and plumbing fixtures. Quantify the extent of building reuse.
**MR Credit 2: Construction Waste Management**

**1–2 Points**

**Intent**
To divert construction and demolition debris from disposal in landfills and incineration facilities. Redirect recyclable recovered resources back to the manufacturing process and reusable materials to appropriate sites.

**Requirements**
Recycle and/or salvage nonhazardous construction and demolition debris. Develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether the materials will be sorted on-site or comingled. Excavated soil and land-clearing debris do not contribute to this credit. Calculations can be done by weight or volume, but must be consistent throughout. The minimum percentage debris to be recycled or salvaged for each point threshold is as follows:

<table>
<thead>
<tr>
<th>Recycled or Salvaged</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%</td>
<td>1</td>
</tr>
<tr>
<td>75%</td>
<td>2</td>
</tr>
</tbody>
</table>

**Potential Technologies & Strategies**
Establish goals for diversion from disposal in landfills and incineration facilities and adopt a construction waste management plan to achieve these goals. Consider recycling cardboard, metal, brick, mineral fiber panel, concrete, plastic, clean wood, glass, gypsum wallboard, carpet and insulation. Construction debris processed into a recycled content commodity that has an open market value (e.g., wood derived fuel [WDF], alternative daily cover material, etc.) may be applied to the construction waste calculation. Designate a specific area(s) on the construction site for segregated or comingled collection of recyclable materials, and track recycling efforts throughout the construction process. Identify construction haulers and recyclers to handle the designated materials. Note that diversion may include donation of materials to charitable organizations and salvage of materials on-site.
MR Credit 3: Materials Reuse

1–2 Points

Intent
To reuse building materials and products to reduce demand for virgin materials and reduce waste, thereby lessening impacts associated with the extraction and processing of virgin resources.

Requirements
Use salvaged, refurbished or reused materials, the sum of which constitutes at least 5% or 10%, based on cost, of the total value of materials on the project. The minimum percentage materials reused for each point threshold is as follows:

<table>
<thead>
<tr>
<th>Reused Materials</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>5%</td>
<td>1</td>
</tr>
<tr>
<td>10%</td>
<td>2</td>
</tr>
</tbody>
</table>

Mechanical, electrical and plumbing components and specialty items such as elevators and equipment cannot be included in this calculation. Include only materials permanently installed in the project. Furniture may be included if it is included consistently in MR Credit 3: Materials Reuse through MR Credit 7: Certified Wood.

Potential Technologies & Strategies
Identify opportunities to incorporate salvaged materials into the building design, and research potential material suppliers. Consider salvaged materials such as beams and posts, flooring, paneling, doors and frames, cabinetry and furniture, brick, and decorative items.
MR Credit 4: Recycled Content
1–2 Points

**Intent**
To increase demand for building products that incorporate recycled content materials, thereby reducing impacts resulting from extraction and processing of virgin materials.

**Requirements**
Use materials with recycled content\(^1\) such that the sum of postconsumer\(^2\) recycled content plus 1/2 of the preconsumer\(^3\) content constitutes at least 10% or 20%, based on cost, of the total value of the materials in the project. The minimum percentage materials recycled for each point threshold is as follows:

<table>
<thead>
<tr>
<th>Recycled Content</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>1</td>
</tr>
<tr>
<td>20%</td>
<td>2</td>
</tr>
</tbody>
</table>

The recycled content value of a material assembly is determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

Mechanical, electrical and plumbing components and specialty items such as elevators cannot be included in this calculation. Include only materials permanently installed in the project. Furniture may be included if it is included consistently in MR Credit 3: Materials Reuse through MR Credit 7: Certified Wood.

**Potential Technologies & Strategies**
Establish a project goal for recycled content materials, and identify material suppliers that can achieve this goal. During construction, ensure that the specified recycled content materials are installed. Consider a range of environmental, economic and performance attributes when selecting products and materials.

---

1. Recycled content is defined in accordance with the International Organization of Standards document, ISO 14021 — Environmental labels and declarations — Self-declared environmental claims (Type II environmental labeling).
2. Postconsumer material is defined as waste material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product, which can no longer be used for its intended purpose.
3. Preconsumer material is defined as material diverted from the waste stream during the manufacturing process. Reutilization of materials (i.e., rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it) is excluded.
MR Credit 5: Regional Materials

1–2 Points

Intent
To increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting from transportation.

Requirements
Use building materials or products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site for a minimum of 10% or 20%, based on cost, of the total materials value. If only a fraction of a product or material is extracted, harvested, or recovered and manufactured locally, then only that percentage (by weight) can contribute to the regional value. The minimum percentage regional materials for each point threshold is as follows:

<table>
<thead>
<tr>
<th>Regional Materials</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>1</td>
</tr>
<tr>
<td>20%</td>
<td>2</td>
</tr>
</tbody>
</table>

Mechanical, electrical and plumbing components and specialty items such as elevators and equipment must not be included in this calculation. Include only materials permanently installed in the project. Furniture may be included if it is included consistently in MR Credit 3: Materials Reuse through MR Credit 7: Certified Wood.

Potential Technologies & Strategies
Establish a project goal for locally sourced materials, and identify materials and material suppliers that can achieve this goal. During construction, ensure that the specified local materials are installed, and quantify the total percentage of local materials installed. Consider a range of environmental, economic and performance attributes when selecting products and materials.
MR Credit 6: Rapidly Renewable Materials

1 Point

**Intent**
To reduce the use and depletion of finite raw materials and long-cycle renewable materials by replacing them with rapidly renewable materials.

**Requirements**
Use rapidly renewable building materials and products for 2.5% of the total value of all building materials and products used in the project, based on cost. Rapidly renewable building materials and products are made from plants that are typically harvested within a 10-year or shorter cycle.

**Potential Technologies & Strategies**
Establish a project goal for rapidly renewable materials, and identify products and suppliers that can support achievement of this goal. Consider materials such as bamboo, wool, cotton insulation, agrifiber, linoleum, wheatboard, strawboard and cork. During construction, ensure that the specified renewable materials are installed.
MR Credit 7: Certified Wood

1 Point

Intent
To encourage environmentally responsible forest management.

Requirements
Use a minimum of 50% (based on cost) of wood-based materials and products that are certified in accordance with the Forest Stewardship Council’s principles and criteria, for wood building components. These components include at a minimum, structural framing and general dimensional framing, flooring, sub-flooring, wood doors and finishes.

Include only materials permanently installed in the project. Wood products purchased for temporary use on the project (e.g., formwork, bracing, scaffolding, sidewalk protection, and guard rails) may be included in the calculation at the project team’s discretion. If any such materials are included, all such materials must be included in the calculation. If such materials are purchased for use on multiple projects, the applicant may include these materials for only one project, at its discretion. Furniture may be included if it is included consistently in MR Credits 3, Materials Reuse, through MR Credit 7, Certified Wood.

Potential Technologies & Strategies
Establish a project goal for FSC-certified wood products and identify suppliers that can achieve this goal. During construction, ensure that the FSC-certified wood products are installed and quantify the total percentage of FSC-certified wood products installed.
IEQ Prerequisite 1: Minimum Indoor Air Quality Performance

Required

Intent
To establish minimum indoor air quality (IAQ) performance to enhance indoor air quality in buildings, thus contributing to the comfort and well-being of the occupants.

Requirements
Meet the minimum requirements of Sections 4 through 7 of ASHRAE Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality (with errata but without addenda1).

AND

CASE 1. Mechanically Ventilated Spaces
   Mechanical ventilation systems must be designed using the ventilation rate procedure or the applicable local code, whichever is more stringent.

CASE 2. Naturally Ventilated Spaces
   Naturally ventilated buildings must comply with ASHRAE Standard 62.1-2007, Paragraph 5.1 (with errata but without addenda1).

Potential Technologies & Strategies
Design ventilation systems to meet or exceed the minimum outdoor air ventilation rates as described in the ASHRAE standard. Balance the impacts of ventilation rates on energy use and indoor air quality to optimize for energy efficiency and occupant comfort. Use the ASHRAE Standard 62.1-2007 Users Manual (with errata but without addenda1) for detailed guidance on meeting the referenced requirements.

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1 Project teams wishing to use ASHRAE approved addenda for the purposes of this prerequisite may do so at their discretion. Addenda must be applied consistently across all LEED credits.
IEQ Prerequisite 2: Environmental Tobacco Smoke (ETS) Control

Required

Intent
To prevent or minimize exposure of building occupants, indoor surfaces and ventilation air distribution systems to environmental tobacco smoke (ETS).

Requirements

OPTION 1
Prohibit smoking in the building.
Prohibit on-property smoking within 25 feet of entries, outdoor air intakes and operable windows. Provide signage to allow smoking in designated areas, prohibit smoking in designated areas or prohibit smoking on the entire property.

OR

OPTION 2

CASE 1. Non-Residential Projects
Prohibit smoking in the building except in designated smoking areas.
Prohibit on-property smoking within 25 feet of entries, outdoor air intakes and operable windows. Provide signage to allow smoking in designated areas, prohibit smoking in designated areas or prohibit smoking on the entire property.

Provide designated smoking rooms designed to contain, capture and remove ETS from the building. At a minimum, the smoking room must be directly exhausted to the outdoors, away from air intakes and building entry paths, with no recirculation of ETS-containing air to nonsmoking areas and enclosed with impermeable deck-to-deck partitions. Operate exhaust sufficient to create a negative pressure differential with the surrounding spaces of at least an average of 5 Pascals (Pa) (0.02 inches of water gauge) and a minimum of 1 Pa (0.004 inches of water gauge) when the doors to the smoking rooms are closed.

Verify performance of the smoking rooms' differential air pressures by conducting 15 minutes of measurement, with a minimum of 1 measurement every 10 seconds, of the differential pressure in the smoking room with respect to each adjacent area and in each adjacent vertical chase with the doors to the smoking room closed. Conduct the testing with each space configured for worst-case conditions of transport of air from the smoking rooms (with closed doors) to adjacent spaces.
CASE 2. Residential and Hospitality Projects

Prohibit smoking in all common areas of the building.

Locate any exterior designated smoking areas, including balconies where smoking is permitted, at least 25 feet from entries, outdoor air intakes and operable windows opening to common areas.

Prohibit on-property smoking within 25 feet of entries, outdoor air intakes and operable windows. Provide signage to allow smoking in designated areas, prohibit smoking in designated areas or prohibit smoking on the entire property.

Weather-strip all exterior doors and operable windows in the residential units to minimize leakage from outdoors.

Minimize uncontrolled pathways for ETS transfer between individual residential units by sealing penetrations in walls, ceilings and floors in the residential units and by sealing vertical chases adjacent to the units.

Weather-strip all doors in the residential units leading to common hallways to minimize air leakage into the hallway.

Demonstrate acceptable sealing of residential units by a blower door test conducted in accordance with ANSI/ASTM-E779-03, Standard Test Method for Determining Air Leakage Rate By Fan Pressurization.

Use the progressive sampling methodology defined in Chapter 4 (Compliance Through Quality Construction) of the Residential Manual for Compliance with California’s 2001 Energy Efficiency Standards. Residential units must demonstrate less than 1.25 square inches leakage area per 100 square feet of enclosure area (i.e., sum of all wall, ceiling and floor areas).

Potential Technologies & Strategies

Prohibit smoking in commercial buildings or effectively control the ventilation air in smoking rooms. For residential buildings, prohibit smoking in common areas and design building envelope and systems to minimize ETS transfer among dwelling units.

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1 If the common hallways are pressurized with respect to the residential units then doors in the residential units leading to the common hallways need not be weather-stripped provided that the positive differential pressure is demonstrated as in Option 2, Case 1 above, considering the residential unit as the smoking room.
IEQ Credit 1: Outdoor Air Delivery Monitoring

1 Point

Intent
To provide capacity for ventilation system monitoring to help promote occupant comfort and well-being.

Requirements
Install permanent monitoring systems to ensure that ventilation systems maintain design minimum requirements. Configure all monitoring equipment to generate an alarm when airflow values or carbon dioxide (CO2) levels vary by 10% or more from the design values via either a building automation system alarm to the building operator or a visual or audible alert to the building occupants.

AND

CASE 1. Mechanically Ventilated Spaces
Monitor CO2 concentrations within all densely occupied spaces (those with a design occupant density of 25 people or more per 1,000 square feet). CO2 monitors must be between 3 and 6 feet above the floor. Provide a direct outdoor airflow measurement device capable of measuring the minimum outdoor air intake flow with an accuracy of plus or minus 15% of the design minimum outdoor air rate, as defined by ASHRAE 62.1-2007 (with errata but without addenda1) for mechanical ventilation systems where 20% or more of the design supply airflow serves nondensely occupied spaces.

CASE 2. Naturally Ventilated Spaces
Monitor CO2 concentrations within all naturally ventilated spaces. CO2 monitors must be between 3 and 6 feet above the floor. One CO2 sensor may be used to monitor multiple nondensely occupied spaces if the natural ventilation design uses passive stack(s) or other means to induce airflow through those spaces equally and simultaneously without intervention by building occupants.

Potential Technologies & Strategies
Install CO2 and airflow measurement equipment and feed the information to the heating, ventilating and air conditioning (HVAC) system and/or building automation system (BAS) to trigger corrective action, if applicable. If such automatic controls are not feasible with the building systems, use the measurement equipment to trigger alarms that inform building operators or occupants of a possible deficiency in outdoor air delivery.

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1 Project teams wishing to use addenda approved by ASHRAE for the purposes of this credit may do so at their discretion. Addenda must be applied consistently across all LEED credits.
IEQ Credit 2: Increased Ventilation

1 Point

Intent
To provide additional outdoor air ventilation to improve indoor air quality (IAQ) and promote occupant comfort, well-being and productivity.

Requirements

CASE 1. Mechanically Ventilated Spaces
Increase breathing zone outdoor air ventilation rates to all occupied spaces by at least 30% above the minimum rates required by ASHRAE Standard 62.1-2007 (with errata but without addenda) as determined by IEQ Prerequisite 1: Minimum Indoor Air Quality Performance.

CASE 2. Naturally Ventilated Spaces
Determine that natural ventilation is an effective strategy for the project by following the flow diagram process shown in Figure 2.8 of the CIBSE Applications Manual 10: 2005, Natural Ventilation in Non-domestic Buildings.

AND

OPTION 1
Show that the natural ventilation systems design meets the recommendations set forth in the CIBSE manuals appropriate to the project space.

PATH 2. CIBSE AM 13:2000, Mixed Mode Ventilation

OR

OPTION 2
Use a macroscopic, multizone, analytic model to predict that room-by-room airflows will effectively naturally ventilate, defined as providing the minimum ventilation rates required by ASHRAE 62.1-2007 Chapter 6 (with errata but without addenda), for at least 90% of occupied spaces.

Potential Technologies & Strategies
For mechanically ventilated spaces: Use heat recovery, where appropriate, to minimize the additional energy consumption associated with higher ventilation rates.

For naturally ventilated spaces, follow the 8 design steps described in the Carbon Trust Good Practice Guide 237:

- Develop design requirements.
- Plan airflow paths.

1 Project teams wishing to use ASHRAE approved addenda for the purposes of this credit may do so at their discretion. Addenda must be applied consistently across all LEED credits.
- Identify building uses and features that might require special attention.
- Determine ventilation requirements.
- Estimate external driving pressures.
- Select types of ventilation devices.
- Size ventilation devices.
- Analyze the design.

Use public domain software such as NIST’s CONTAM, Multizone Modeling Software, along with LoopDA, Natural Ventilation Sizing Tool, to analytically predict room-by-room airflows.
IEQ Credit 3.1: Construction Indoor Air Quality Management Plan—During Construction

1 Point

Intent
To reduce indoor air quality (IAQ) problems resulting from construction or renovation and promote the comfort and well-being of construction workers and building occupants.

Requirements
Develop and implement an IAQ management plan for the construction and preoccupancy phases of the building as follows:

- During construction, meet or exceed the recommended control measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines For Occupied Buildings Under Construction, 2nd Edition 2007, ANSI/SMACNA 008-2008 (Chapter 3).
- Protect stored on-site and installed absorptive materials from moisture damage.
- If permanently installed air handlers are used during construction, filtration media with a minimum efficiency reporting value (MERV) of 8 must be used at each return air grille, as determined by ASHRAE Standard 52.2-1999 (with errata but without addenda¹). Replace all filtration media immediately prior to occupancy.

Potential Technologies & Strategies
Adopt an IAQ management plan to protect the heating, ventilating and air conditioning (HVAC) system during construction, control pollutant sources and interrupt contamination pathways. Sequence the installation of materials to avoid contamination of absorptive materials, such as insulation, carpeting, ceiling tile and gypsum wallboard. Coordinate with IEQ Credit 3.2: Construction IAQ Management Plan — Before Occupancy and IEQ Credit 5: Indoor Chemical & Pollutant Source Control to determine the appropriate specifications and schedules for filtration media.

If possible, avoid using permanently installed air handlers for temporary heating/cooling during construction. Consult the LEED Reference Guide for Green Building Design and Construction, 2009 Edition for more detailed information on how to ensure the well-being of construction workers and building occupants if permanently installed air handlers must be used during construction.

¹ Project teams wishing to use ASHRAE approved addenda for the purposes of this credit may do so at their discretion. Addenda must be applied consistently across all LEED credits.
IEQ Credit 3.2: Construction Indoor Air Quality Management Plan—Before Occupancy

1 Point

Intent
To reduce indoor air quality (IAQ) problems resulting from construction or renovation to promote the comfort and well-being of construction workers and building occupants.

Requirements
Develop an IAQ management plan and implement it after all finishes have been installed and the building has been completely cleaned before occupancy.

OPTION 1. Flush-Out

PATH 1
After construction ends, prior to occupancy and with all interior finishes installed, install new filtration media and, perform a building flush-out by supplying a total air volume of 14,000 cubic feet of outdoor air per square foot of floor area while maintaining an internal temperature of at least 60°F and relative humidity no higher than 60%.

OR

PATH 2
If occupancy is desired prior to completion of the flush-out, the space may be occupied following delivery of a minimum of 3,500 cubic feet of outdoor air per square foot of floor area. Once the space is occupied, it must be ventilated at a minimum rate of 0.30 cubic feet per minute (cfm) per square foot of outside air or the design minimum outside air rate determined in IEQ Prerequisite 1: Minimum Indoor Air Quality Performance, whichever is greater. During each day of the flush-out period, ventilation must begin a minimum of 3 hours prior to occupancy and continue during occupancy. These conditions must be maintained until a total of 14,000 cubic feet per square foot of outside air has been delivered to the space.

OR

OPTION 2. Air Testing
Conduct baseline IAQ testing after construction ends and prior to occupancy using testing protocols consistent with the EPA Compendium of Methods for the Determination of Air Pollutants in Indoor Air or the ISO method listed in the table below. Testing must be done in accordance with one standard; project teams may not mix requirements from the EPA Compendium of Methods with ISO.

1 All finishes must be installed prior to flush-out.
Demonstrate that the contaminant maximum concentration levels listed below are not exceeded:

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>Maximum Concentration</th>
<th>EPA Compendium method</th>
<th>ISO method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formaldehyde</td>
<td>27 parts per billion</td>
<td>IP-6</td>
<td>ISO 16000-3</td>
</tr>
<tr>
<td>Particulates (PM10)</td>
<td>50 micrograms per cubic meter</td>
<td>IP-10</td>
<td>ISO 7708</td>
</tr>
<tr>
<td>Total volatile organic compounds (TVOCs)</td>
<td>500 micrograms per cubic meter</td>
<td>IP-1</td>
<td>ISO 16000-6</td>
</tr>
<tr>
<td>4-Phenylcyclohexene (4-PCH) *</td>
<td>6.5 micrograms per cubic meter</td>
<td>IP-1</td>
<td>ISO 16000-6</td>
</tr>
<tr>
<td>Carbon monoxide (CO)</td>
<td>9 parts per million and no greater than 2 parts per million above outdoor levels</td>
<td>IP-3</td>
<td>ISO 4224</td>
</tr>
</tbody>
</table>

*This test is required only if carpets and fabrics with styrene butadiene rubber (SBR) latex backing are installed as part of the base building systems.

For each sampling point where the maximum concentration limits are exceeded, conduct an additional flush-out with outside air and retest the noncompliant concentrations. Repeat until all requirements are met. When retesting noncompliant building areas, take samples from the same locations as in the first test, although it is not required.

Conduct the air sample testing as follows:

- All measurements must be conducted prior to occupancy, but during normal occupied hours with the building ventilation system started at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the test.
- All interior finishes must be installed, including but not limited to millwork, doors, paint, carpet and acoustic tiles. Movable furnishings such as workstations and partitions should be in place for the testing, although it is not required.
- The number of sampling locations will depend on the size of the building and number of ventilation systems. The number of sampling locations must include the entire building and all representative situations. Include areas with the least ventilation and greatest presumed source strength.
- Air samples must be collected between 3 and 6 feet from the floor to represent the breathing zone of occupants, and over a minimum 4-hour period.

**Potential Technologies & Strategies**

Prior to occupancy, perform a building flush-out or test the air contaminant levels in the building. The flush-out is often used where occupancy is not required immediately upon substantial completion of construction. IAQ testing can minimize schedule impacts but may be more costly. Coordinate with IEQ Credit 3.1: Construction IAQ Management Plan — During Construction and IEQ Credit 5: Indoor Chemical & Pollutant Source Control to determine the appropriate specifications and schedules for filtration media.

The intent of this credit is to eliminate IAQ problems that occur as a result of construction. Architectural finishes used in tenant build-outs constitute a significant source of air pollutants and must be addressed to qualify for this credit.
IEQ Credit 4.1: Low-Emitting Materials—Adhesives and Sealants

1 Point

Intent
To reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.

Requirements
All adhesives and sealants used on the interior of the building (i.e., inside of the weatherproofing system and applied on-site) must comply with the following requirements as applicable to the project scope:

- Adhesives, Sealants and Sealant Primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168. Volatile organic compound (VOC) limits listed in the table below correspond to an effective date of July 1, 2005 and rule amendment date of January 7, 2005.

<table>
<thead>
<tr>
<th>Architectural Applications</th>
<th>VOC Limit (g/L less water)</th>
<th>Specialty Applications</th>
<th>VOC Limit (g/L less water)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indoor carpet adhesives</td>
<td>50</td>
<td>PVC welding</td>
<td>510</td>
</tr>
<tr>
<td>Carpet pad adhesives</td>
<td>50</td>
<td>CPVC welding</td>
<td>490</td>
</tr>
<tr>
<td>Wood flooring adhesives</td>
<td>100</td>
<td>ABS welding</td>
<td>325</td>
</tr>
<tr>
<td>Rubber floor adhesives</td>
<td>60</td>
<td>Plastic cement welding</td>
<td>250</td>
</tr>
<tr>
<td>Subfloor adhesives</td>
<td>50</td>
<td>Adhesive primer for plastic</td>
<td>550</td>
</tr>
<tr>
<td>Ceramic tile adhesives</td>
<td>65</td>
<td>Contact adhesive</td>
<td>80</td>
</tr>
<tr>
<td>VCT and asphalt adhesives</td>
<td>50</td>
<td>Special purpose contact adhesive</td>
<td>250</td>
</tr>
<tr>
<td>Drywall and panel adhesives</td>
<td>50</td>
<td>Structural wood member adhesive</td>
<td>140</td>
</tr>
<tr>
<td>Cove base adhesives</td>
<td>50</td>
<td>Sheet applied rubber lining operations</td>
<td>850</td>
</tr>
<tr>
<td>Multipurpose construction adhesives</td>
<td>70</td>
<td>Top and trim adhesive</td>
<td>250</td>
</tr>
<tr>
<td>Structural glazing adhesives</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Substrate Specific Applications</th>
<th>VOC Limit (g/L less water)</th>
<th>Sealants</th>
<th>VOC Limit (g/L less water)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal to metal</td>
<td>30</td>
<td>Architectural</td>
<td>250</td>
</tr>
<tr>
<td>Plastic foams</td>
<td>50</td>
<td>Roadway</td>
<td>250</td>
</tr>
<tr>
<td>Porous material (except wood)</td>
<td>50</td>
<td>Other</td>
<td>420</td>
</tr>
<tr>
<td>Wood</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiberglass</td>
<td>80</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sealant Primers</th>
<th>VOC Limit (g/L less water)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architectural, nonporous</td>
<td>250</td>
</tr>
<tr>
<td>Architectural, porous</td>
<td>775</td>
</tr>
<tr>
<td>Other</td>
<td>750</td>
</tr>
</tbody>
</table>

This table excludes adhesives and sealants integral to the water-proofing system or that are not building related.

1 The use of a VOC budget is permissible for compliance with this credit.

<table>
<thead>
<tr>
<th>Aerosol Adhesives</th>
<th>VOC Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>General purpose mist spray</td>
<td>65% VOCs by weight</td>
</tr>
<tr>
<td>General purpose web spray</td>
<td>55% VOCs by weight</td>
</tr>
<tr>
<td>Special purpose aerosol adhesives (all types)</td>
<td>70% VOCs by weight</td>
</tr>
</tbody>
</table>

**Potential Technologies & Strategies**

Specify low-VOC materials in construction documents. Ensure that VOC limits are clearly stated in each section of the specifications where adhesives and sealants are addressed. Common products to evaluate include general construction adhesives, flooring adhesives, fire-stopping sealants, caulking, duct sealants, plumbing adhesives and cove base adhesives. Review product cut sheets, material safety data (MSD) sheets, signed attestations or other official literature from the manufacturer clearly identifying the VOC contents or compliance with referenced standards.
IEQ Credit 4.2: Low-Emitting Materials—Paints and Coatings

1 Point

Intent
To reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.

Requirements
Paints and coatings used on the interior of the building (i.e., inside of the weatherproofing system and applied on-site) must comply with the following criteria as applicable to the project scope:

- Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates must not exceed the VOC content limit of 250 g/L established in Green Seal Standard GC-03, Anti-Corrosive Paints, 2nd Edition, January 7, 1997.
- Clear wood finishes, floor coatings, stains, primers, sealers, and shellacs applied to interior elements must not exceed the VOC content limits established in South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, rules in effect on January 1, 2004.

Potential Technologies & Strategies
Specify low-VOC paints and coatings in construction documents. Ensure that VOC limits are clearly stated in each section of the specifications where paints and coatings are addressed. Track the VOC content of all interior paints and coatings during construction.

1 The use of a VOC budget is permissible for compliance with this credit.
IEQ Credit 4.3: Low-Emitting Materials—Flooring Systems

1 Point

Intent
To reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.

Requirements

OPTION 1
All flooring must comply with the following as applicable to the project scope:

- All carpet installed in the building interior must meet the testing and product requirements of the Carpet and Rug Institute Green Label Plus1 program.
- All carpet cushion installed in the building interior must meet the requirements of the Carpet and Rug Institute Green Label program.
- All carpet adhesive must meet the requirements of IEQ Credit 4.1: Adhesives and Sealants, which includes a volatile organic compound (VOC) limit of 50 g/L.
- All hard surface flooring must meet the requirements of the FloorScore 2 standard (current as of the date of this rating system, or more stringent version) as shown with testing by an independent third-party. Mineral-based finish flooring products such as tile, masonry, terrazzo, and cut stone without integral organic-based coatings and sealants and unfinished/untreated solid wood flooring qualify for credit without any IAQ testing requirements. However, associated site-applied adhesives, grouts, finishes and sealers must be compliant for a mineral-based or unfinished/untreated solid wood flooring system to qualify for credit.
- Concrete, wood, bamboo and cork floor finishes such as sealer, stain and finish must meet the requirements of South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, rules in effect on January 1, 2004.
- Tile setting adhesives and grout must meet South Coast Air Quality Management District (SCAQMD) Rule 1168. VOC limits correspond to an effective date of July 1, 2005 and rule amendment date of January 7, 2005.

OR

OPTION 2
All flooring elements installed in the building interior must meet the testing and product requirements of the California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions

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1 The Green Label Plus program for carpets and its associated VOC emission criteria in micrograms per square meter per hour, along with information on testing method and sample collection developed by the Carpet & Rug Institute (CRI) in coordination with California’s Sustainable Building Task Force and the California Department of Public Health, are described in Section 9, Acceptable Emissions Testing for Carpet, DHS Standard Practice CA/DHS/EHLB/R-174, dated 07/15/04. This document is available at http://www.dhs.ca.gov/ps/deode/ehlb/ijag/VOCS/Section01350_7_15_2004_FINAL_PLUS_ADDENDUM-2004-01.pdf (also published as Section 01350 Section 9 [dated 2004] by the Collaborative for High Performance Schools [http://www.chps.net]).

2 FloorScore is a voluntary, independent certification program that tests and certifies hard surface flooring and associated products for compliance with criteria adopted in California for indoor air emissions of VOCs with potential health effects. The program uses a small-scale chamber test protocol and incorporates VOC emissions criteria, which are widely known as Section 1350, developed by the California Department of Health Services.
from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda. Mineral-based finish flooring products such as tile, masonry, terrazzo, and cut stone without integral organic-based coatings and sealants and unfinished/untreated solid wood flooring qualify for credit without any IAQ testing requirements. However, associated site-applied adhesives, grouts, finishes and sealers must be compliant for a mineral-based or unfinished/untreated solid wood flooring system to qualify for credit.

**Potential Technologies & Strategies**

Clearly specify requirements for product testing and/or certification in the construction documents. Select products that are either certified under the Green Label Plus program or for which testing has been done by qualified independent laboratories in accordance with the appropriate requirements.
IEQ Credit 4.4: Low-Emitting Materials—Composite Wood and Agrifiber Products

1 Point

Intent
To reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.

Requirements
Composite wood and agrifiber products used on the interior of the building (i.e., inside the weatherproofing system) must contain no added urea-formaldehyde resins. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies must not contain added urea-formaldehyde resins.

Composite wood and agrifiber products are defined as particleboard, medium density fiberboard (MDF), plywood, wheatboard, strawboard, panel substrates and door cores. Materials considered fixtures, furniture and equipment (FF&E) are not considered base building elements and are not included.

Potential Technologies & Strategies
Specify wood and agrifiber products that contain no added urea-formaldehyde resins. Specify laminating adhesives for field and shop-applied assemblies that contain no added urea-formaldehyde resins. Review product cut sheets, material safety data (MSD) sheets, signed attestations or other official literature from the manufacturer.
IEQ Credit 5: Indoor Chemical and Pollutant Source Control

1 Point

**Intent**
To minimize building occupant exposure to potentially hazardous particulates and chemical pollutants.

**Requirements**
Design to minimize and control the entry of pollutants into buildings and later cross-contamination of regularly occupied areas through the following strategies:

- Employ permanent entryway systems at least 10 feet long in the primary direction of travel to capture dirt and particulates entering the building at regularly used exterior entrances. Acceptable entryway systems include permanently installed grates, grills and slotted systems that allow for cleaning underneath. Roll-out mats are acceptable only when maintained on a weekly basis by a contracted service organization.

- Sufficiently exhaust each space where hazardous gases or chemicals may be present or used (e.g., garages, housekeeping and laundry areas, copying and printing rooms) to create negative pressure with respect to adjacent spaces when the doors to the room are closed. For each of these spaces, provide self-closing doors and deck-to-deck partitions or a hard-lid ceiling. The exhaust rate must be at least 0.50 cubic feet per minute (cfm) per square foot with no air recirculation. The pressure differential with the surrounding spaces must be at least 5 Pascals (Pa) (0.02 inches of water gauge) on average and 1 Pa (0.004 inches of water) at a minimum when the doors to the rooms are closed.

- In mechanically ventilated buildings, each ventilation system that supplies outdoor air shall comply with the following:
  - Particle filters or air cleaning devices shall be provided to clean the outdoor air at any location prior to its introduction to occupied spaces.
  - These filters or devices shall be rated a minimum efficiency reporting value (MERV) of 13 or higher in accordance with ASHRAE Standard 52.2.
  - Clean air Filtration media shall be installed in all air systems after completion of construction and prior to occupancy.

**Potential Technologies & Strategies**
Design facility cleaning and maintenance areas with isolated exhaust systems for contaminants. Maintain physical isolation from the rest of the regularly occupied areas of the building. Install permanent architectural entryway systems such as grills or grates to prevent occupant-borne contaminants from entering the building. Install high-level filtration systems in air handling units processing outside supply air. Ensure that air handling units can accommodate required filter sizes and pressure drops.
IEQ Credit 6.1: Controllability of Systems—Lighting

1 Point

Intent
To provide a high level of lighting system control by individual occupants or groups in multi-occupant spaces (e.g., classrooms and conference areas) and promote their productivity, comfort and well-being.

Requirements
Provide individual lighting controls for 90% (minimum) of the building occupants to enable adjustments to suit individual task needs and preferences
Provide lighting system controls for all shared multi-occupant spaces to enable adjustments that meet group needs and preferences.

Potential Technologies & Strategies
Design the building with occupant controls for lighting. Strategies to consider include lighting controls and task lighting. Integrate lighting systems controllability into the overall lighting design, providing ambient and task lighting while managing the overall energy use of the building.
IEQ Credit 6.2: Controllability of Systems—Thermal Comfort

1 Point

Intent
To provide a high level of thermal comfort system control by individual occupants or groups in multi-occupant spaces (e.g., classrooms or conference areas) and promote their productivity, comfort and well-being.

Requirements
Provide individual comfort controls for 50% (minimum) of the building occupants to enable adjustments to meet individual needs and preferences. Operable windows may be used in lieu of controls for occupants located 20 feet inside and 10 feet to either side of the operable part of a window. The areas of operable window must meet the requirements of ASHRAE Standard 62.1-2007 paragraph 5.1 Natural Ventilation (with errata but without addenda). Provide comfort system controls for all shared multi-occupant spaces to enable adjustments that meet group needs and preferences.

Conditions for thermal comfort are described in ASHRAE Standard 55-2004 (with errata but without addenda) and include the primary factors of air temperature, radiant temperature, air speed and humidity.

Potential Technologies & Strategies
Design the building and systems with comfort controls to allow adjustments to suit individual needs or those of groups in shared spaces. ASHRAE Standard 55-2004 (with errata but without addenda) identifies the factors of thermal comfort and a process for developing comfort criteria for building spaces that suit the needs of the occupants involved in their daily activities. Control strategies can be developed to expand on the comfort criteria and enable individuals to make adjustments to suit their needs and preferences. These strategies may involve system designs incorporating operable windows, hybrid systems integrating operable windows and mechanical systems, or mechanical systems alone. Individual adjustments may involve individual thermostat controls, local diffusers at floor, desk or overhead levels, control of individual radiant panels or other means integrated into the overall building, thermal comfort systems and energy systems design. Designers should evaluate the closely tied interactions between thermal comfort as required by ASHRAE Standard 55-2004 (with errata but without addenda) and acceptable indoor air quality as required by ASHRAE Standard 62.1-2007 (with errata but without addenda), whether natural or mechanical ventilation.

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1 For the purposes of this credit, comfort system control is defined as control over at least 1 of the following primary factors in the occupant’s vicinity: air temperature, radiant temperature, air speed and humidity.
2 Project teams wishing to use ASHRAE approved addenda for the purposes of this credit may do so at their discretion. Addenda must be applied consistently across all LEED credits.
IEQ Credit 7.1: Thermal Comfort—Design

1 Point

Intent
To provide a comfortable thermal environment that promotes occupant productivity and well-being.

Requirements
Design heating, ventilating and air conditioning (HVAC) systems and the building envelope to meet the requirements of ASHRAE Standard 55-2004, Thermal Comfort Conditions for Human Occupancy (with errata but without addenda). Demonstrate design compliance in accordance with the Section 6.1.1 documentation.

Potential Technologies & Strategies
Establish comfort criteria according to ASHRAE 55-2004 (with errata but without addenda) that support the desired quality and occupant satisfaction with building performance. Design the building envelope and systems with the capability to meet the comfort criteria under expected environmental and use conditions. Evaluate air temperature, radiant temperature, air speed and relative humidity in an integrated fashion, and coordinate these criteria with IEQ Prerequisite 1: Minimum IAQ Performance, IEQ Credit 1: Outdoor Air Delivery Monitoring, and IEQ Credit 2: Increased Ventilation.

1 Project teams wishing to use ASHRAE approved addenda for the purposes of this credit may do so at their discretion. Addenda must be applied consistently across all LEED credits.
IEQ Credit 7.2: Thermal Comfort—Verification
1 point in addition to IEQ credit 7.1

Intent
To provide for the assessment of building occupant thermal comfort over time.

Requirements
Achieve IEQ Credit 7.1: Thermal Comfort—Design

Provide a permanent monitoring system to ensure that building performance meets the desired comfort criteria as determined by IEQ Credit 7.1: Thermal Comfort—Design.

Agree to conduct a thermal comfort survey of building occupants within 6 to 18 months after occupancy. This survey should collect anonymous responses about thermal comfort in the building, including an assessment of overall satisfaction with thermal performance and identification of thermal comfort-related problems. Agree to develop a plan for corrective action if the survey results indicate that more than 20% of occupants are dissatisfied with thermal comfort in the building. This plan should include measurement of relevant environmental variables in problem areas in accordance with ASHRAE Standard 55-2004 (with errata but without addenda1).

Residential projects are not eligible for this credit.

Potential Technologies & Strategies
ASHRAE 55-2004 provides guidance for establishing thermal comfort criteria and documenting and validating building performance to the criteria. While the standard is not intended for purposes of continuous monitoring and maintenance of the thermal environment, the principles expressed in the standard provide a basis for the design of monitoring and corrective action systems.

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1 Project teams wishing to use ASHRAE approved addenda for the purposes of this credit may do so at their discretion. Addenda must be applied consistently across all LEED credits.
IEQ Credit 8.1: Daylight and Views—Daylight

1 Point

Intent
To provide for the building occupants with a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.

Requirements
Through 1 of the 4 options, achieve daylighting in at least the following spaces1:

<table>
<thead>
<tr>
<th>Regularly Occupied Spaces</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>75%</td>
<td>1</td>
</tr>
</tbody>
</table>

OPTION 1. Simulation
Demonstrate through computer simulations that the applicable spaces achieve daylight illuminance levels of a minimum of 10 footcandles (fc) and a maximum of 500 fc in a clear sky condition on September 21 at 9 a.m. and 3 p.m.

Provide glare control devices to avoid high-contrast situations that could impede visual tasks. However, designs that incorporate view-preserving automated shades for glare control may demonstrate compliance for only the minimum 10 fc illuminance level.

OR

OPTION 2. Prescriptive
For side-lighting zones:

- Achieve a value, calculated as the product of the visible light transmittance (VLT) and window-to-floor area ratio (WFR) between 0.150 and 0.180.

\[
0.150 < \text{VLT} \times \text{WFR} < 0.180
\]

- The window area included in the calculation must be at least 30 inches above the floor.

- In section, the ceiling must not obstruct a line that extends from the window-head to a point on the floor that is located twice the height of the window-head from the exterior wall as measured perpendicular to the glass (see diagram on next page).

1 Exceptions for areas where tasks would be hindered by the use of daylight will be considered on their merits.
Provide glare control devices to avoid high-contrast situations that could impede visual tasks. However, designs that incorporate view-preserving automated shades for glare control may demonstrate compliance for only the minimum 0.150 value.

For top-lighting zones:

- The top-lighting zone under a skylight is the outline of the opening beneath the skylight, plus in each direction the lesser of (see diagram below):
  - 70% of the ceiling height,
  - 1/2 the distance to the edge of the nearest skylight,
  - The distance to any permanent partition that is closer than 70% of the distance between the top of the partition and the ceiling.
Achieve skylight coverage for the applicable space (containing the top-lighting zone) between 3% and 6% of the total floor area.

- The skylight must have a minimum 0.5 VLT.
- A skylight diffuser, if used, must have a measured haze value of greater than 90% when tested according to ASTM D1003.

OR

OPTION 3. Measurement

Demonstrate through records of indoor light measurements that a minimum daylight illumination level of 10 fc and a maximum of 500 fc has been achieved in the applicable spaces. Measurements must be taken on a 10-foot grid and shall be recorded on building floor plans.

Provide glare control devices to avoid high-contrast situations that could impede visual tasks. However, designs that incorporate view-preserving automated shades for glare control may demonstrate compliance for only the minimum 10 fc illuminance level.

OR

OPTION 4. Combination

Any of the above calculation methods may be combined to document the minimum daylight illumination in the applicable spaces.

Potential Technologies & Strategies

Design the building to maximize interior daylighting. Strategies to consider include building orientation, shallow floor plates, increased building perimeter, exterior and interior permanent shading devices, high-performance glazing, and high-ceiling reflectance values; by, additionally, automatic photocell-based controls can help to reduce energy use. Predict daylight factors via manual calculations or model daylighting strategies with a physical or computer model to assess footcandle levels and daylight factors achieved.
IEQ Credit 8.2: Daylight and Views—Views

1 Point

Intent
To provide building occupants a connection to the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.

Requirements
Achieve a direct line of sight to the outdoor environment via vision glazing between 30 inches and 90 inches above the finish floor for building occupants in 90% of all regularly occupied areas. Determine the area with a direct line of sight by totaling the regularly occupied square footage that meets the following criteria:

- In plan view, the area is within sight lines drawn from perimeter vision glazing.
- In section view, a direct sight line can be drawn from the area to perimeter vision glazing.

The line of sight may be drawn through interior glazing. For private offices, the entire square footage of the office may be counted if 75% or more of the area has a direct line of sight to perimeter vision glazing. For multi-occupant spaces, the actual square footage with a direct line of sight to perimeter vision glazing is counted.

Potential Technologies & Strategies
Design the space to maximize daylighting and view opportunities. Strategies to consider include lower partitions, interior shading devices, interior glazing and automatic photocell-based controls.
ID Credit 1: Innovation in Design

1–5 Points

Intent
To provide design teams and projects the opportunity to achieve exceptional performance above the requirements set by the LEED Green Building Rating System and/or innovative performance in Green Building categories not specifically addressed by the LEED Green Building Rating System.

Requirements
Credit can be achieved through any combination of the Innovation in Design and Exemplary Performance paths as described below:

PATH 1. Innovation in Design (1-5 points)
Achieve significant, measurable environmental performance using a strategy not addressed in the LEED 2009 for New Construction and Major Renovations Rating System.

One point is awarded for each innovation achieved. No more than 5 points under IDc1 may be earned through PATH 1—Innovation in Design.

Identify the following in writing:
- The intent of the proposed innovation credit.
- The proposed requirement for compliance.
- The proposed submittals to demonstrate compliance.
- The design approach (strategies) used to meet the requirements.

PATH 2. Exemplary Performance (1-3 points)
Achieve exemplary performance in an existing LEED 2009 for New Construction and Major Renovations prerequisite or credit that allows exemplary performance as specified in the LEED Reference Guide for Green Building Design & Construction, 2009 Edition. An exemplary performance point may be earned for achieving double the credit requirements and/or achieving the next incremental percentage threshold of an existing credit in LEED.

One point is awarded for each exemplary performance achieved. No more than 3 points under IDc1 may be earned through PATH 2—Exemplary Performance.

PATH 3. Pilot Credit (1-5 points)
Attempt a pilot credit available in the Pilot Credit Library at www.usgbc.org/pilotcreditlibrary. Register as a pilot credit participant and complete the required documentation. Projects may pursue up to 5 Pilot Credits total.

Potential Technologies & Strategies
Substantially exceed a LEED 2009 for New Construction and Major Renovations performance credit such as energy performance or water efficiency. Apply strategies or measures that demonstrate a comprehensive approach and quantifiable environment and/or health benefits.
ID Credit 2: LEED Accredited Professional

1 Point

Intent
To support and encourage the design integration required by LEED to streamline the application and certification process.

Requirements
At least 1 principal participant of the project team shall be a LEED Accredited Professional (AP).

Potential Technologies & Strategies
Educate the project team members about green building design and construction, the LEED requirements and application process early in the life of the project. Consider assigning integrated design and construction process facilitation to the LEED AP.
RP Credit 1: Regional Priority
1–4 Points

Intent
To provide an incentive for the achievement of credits that address geographically-specific environmental priorities.

Requirements
Earn 1-4 of the 6 Regional Priority credits identified by the USGBC regional councils and chapters as having environmental importance for a project’s region. A database of Regional Priority credits and their geographic applicability is available on the USGBC website, http://www.usgbc.org.

One point is awarded for each Regional Priority credit achieved; no more than 4 credits identified as Regional Priority credits may be earned. The USGBC has prioritized credits for projects located in the U.S., Puerto Rico, the U.S. Virgin Islands, and Guam. All other international projects should check the database for eligible Regional Priority credits.

Potential Technologies & Strategies
Determine and pursue the prioritized credits for the project location.
FACT SHEET
Crumb-Rubber Infilled Synthetic Turf Athletic Fields
August 2008

PURPOSE
There are several kinds of synthetic turf surfaces (e.g., surfaces that use a fill material (“infill”) between the blades of artificial grass and those that do not), and synthetic turf may be installed for different uses (e.g., single or multiple sport athletic fields, landscaping, golf applications). The focus of this fact sheet is athletic fields with crumb rubber infilled synthetic turf. This fact sheet was developed to assist people in making decisions about installing or using this kind of synthetic turf athletic field. Considerations related to other kinds of synthetic turf fields are not addressed in this fact sheet.

BACKGROUND
The first well-publicized use of AstroTurf, a synthetic turf for athletic fields, was at the Houston Astrodome in 1966. This first generation of synthetic turf was essentially a short pile carpet with a foam backing. Since then, design changes have resulted in a greater variety of synthetic turf athletic fields. One type of synthetic turf is fabricated using synthetic fibers, manufactured to resemble natural grass, and a base material that stabilizes and cushions the playing surface. The fibers are typically made from nylon, polypropylene or polyethylene and are connected to a backing material. The base material, also called infill, consists of one or more granular materials that are worked in between the fibers during the installation process. Commonly used base materials are granulated crumb rubber (usually from used tires), flexible plastic pellets, sand, and rubber-coated sand. A combination of sand and crumb rubber is often used.

Crumb rubber is produced by grinding used tires. Steel and fiber tire components are removed during the process and the rubber pellets are sorted by size. Pellet sizes ranging from about one-sixteenth to one-quarter inch in diameter are used on synthetic turf. Crumb rubber is typically applied at a rate of two to three pounds per square foot of field surface.

HEALTH AND SAFETY CONSIDERATIONS
Some potential health and safety considerations related to synthetic turf have generated public concern. These include:
- Heat stress
- Injury
- Infection
- Latex allergy
- Chemical exposure
Heat Stress
Synthetic turf fields absorb heat, resulting in surface temperatures that are much higher than the temperatures of the surrounding air. In June 2002 at Brigham Young University (BYU) in Utah, the average surface temperature on a synthetic turf field was reported to be 117°F while the average surface temperatures on natural turf and asphalt were 78°F and 110°F, respectively. A maximum surface temperature of 200°F on the BYU synthetic turf field was reported. A turfgrass specialist at the University of Missouri reported measuring an air temperature of 138°F at “head-level” height on the university’s synthetic turf field on a sunny 98°F day. The surface temperature of the field was reported to be 178°F. A study conducted at Penn State University measured surface temperatures on experimental plots of nine different types of infilled turf. Temperature measurements were made on three occasions. The average air temperatures reported were 79°, 78°, and 85°F. The corresponding average surface temperatures reported for the synthetic turf plots are 120°, 130° and 146°F.

Water can be applied to synthetic turf to reduce the surface temperatures on warm days. A study at BYU found that watering synthetic turf lowered the surface temperature from 174°F to 85°F, but the temperature rose to 120°F in five minutes and to 164°F in twenty minutes. A study conducted by Penn State University on experimental synthetic turf plots examined the effect of watering synthetic turf on surface temperature. Measurements were made on three occasions. For one monitoring period, surface temperatures ranging from about 130° to 160°F were lowered initially to about 75°F, but increased within 30 minutes to temperatures ranging from about 90° to 120°F, where they remained fairly stable for the three-hour monitoring period.

The surface temperatures reported on synthetic turf fields can get high enough to reach levels of discomfort and may contribute to heat stress among users of the fields. While watering synthetic turf may reduce surface temperatures, other factors are likely to influence its effectiveness. At the present time, NYSDOH is unaware of any studies that have examined the role of synthetic turf in contributing to heat stress or that have compared the occurrence of heat stress among athletes playing on natural turf and synthetic turf.

Because of the potential for high temperatures on infilled synthetic turf fields, it is important that people who play or work on the fields be provided with adequate warnings regarding the potential for heat stress. People should also be advised to remain hydrated and to seek relief from the heat in shaded areas. The potential for and frequency of high surface temperatures warrant consideration when making decisions about installing and using a synthetic turf field.

Injury
There is a common perception that there are more sports injuries on synthetic than on natural turf athletic fields. Many factors influence the rate of sports injuries, including the type of playing surface. The many kinds of synthetic turf surfaces and changes in the turf products over the years complicate the assessment of how the playing surface affects injury rates. Other risk factors have been implicated in injury rates among athletes, in addition to the type of playing surface. These risk factors include level of competition, skill level, age, shoe type, previous injury and rehabilitation, and a number of individual physical characteristics. We identified five studies that compared injury (e.g., sprains, lacerations, fractures) rates among athletes when playing on infilled synthetic turf and natural turf fields. Although the ability of the studies to detect differences in the injury rates was limited by the small number of injuries reported, the
studies concluded that there were no major differences in overall injury rates between natural and infilled synthetic turf. Although each study found some differences in specific injury types, there was no consistent pattern across the studies.

The potential for head injuries from contact with the surfaces has been assessed by determining the ability of the surfaces to absorb impacts. Tests have shown that the force of impact on asphalt surfaces is much higher than the level generally accepted to be associated with serious head injury. The force of impact on many types of natural turf and all types of synthetic turf tested are below this level. The force of impact on frozen natural turf is typically above the acceptable level. No data are available for the force of impact on frozen synthetic turf.

The abrasiveness of synthetic turf fibers may contribute to the injury risk among athletes, particularly for abrasions or “turf burns.” The degree of abrasiveness appears to be dependent on the composition and shape of the turf fibers. A study conducted at Penn State University suggests that synthetic turf with nylon fibers is more abrasive than synthetic turf with other types of fibers.

Infection Risk
Some people have expressed concern that infections, including methicillin-resistant *Staphylococcus aureus* (MRSA), may be more common among users of synthetic turf fields than users of natural turf fields. This possibility has not been studied systematically, and no definitive statements can be made about differences in risk between the two surfaces.

At least two questions are important in evaluating the risk of infection. Does skin damage occur more frequently on synthetic turf than natural turf, thus providing a place where infections are more likely to occur? Are there more germs on synthetic turf than natural turf?

While injury studies have not consistently identified differences in abrasion and laceration risks between natural and infilled synthetic turf, some types of synthetic turf may result in more skin abrasions. Although very few tests have been performed, the available data do not suggest the widespread presence of infectious agents, such as MRSA, on synthetic turf fields. Also, the available information indicates that outdoor or indoor synthetic turf surfaces are no more likely to harbor infectious agents than other surfaces in those same environments. Disease outbreak investigations conducted in response to illnesses caused by a variety of germs (e.g., MRSA, *Campylobacter*, meningococcus, echovirus, herpes simplex virus, hepatitis virus, coxsackie virus) have not identified playing fields, either natural or synthetic, as likely to increase the risk of transmitting infections.

Skin cuts and abrasions that may result from contact with athletic fields, including both natural and synthetic fields, are susceptible to infection. Athletes and others developing skin abrasions should clean the wounds and seek prompt medical attention. Athletes should avoid sharing towels (on and off the field), equipment, razors, soap and other objects with others, because sharing these items can spread germs.

Latex Allergy
Latex, a substance found in natural rubber, contains substances called “latex allergens,” which can cause an allergic response in some people. About 6 percent of the general population is allergic to the substances in latex. Tire rubber contains the latex allergen, although at much lower levels than in latex
gloves and other consumer products. People playing on synthetic turf may be exposed to latex allergens through direct contact with the skin (dermal exposure) and inhalation of small rubber particles suspended in the air.

A study conducted for the California Environmental Protection Agency tested samples of tire rubber on the skin of guinea pigs. None of the animals developed any rashes or allergic reactions from contact with the rubber.

Whether crumb rubber can cause an allergic response in people is not known. NYSDOH is unaware of any occurrences of latex allergy associated with contact with crumb rubber or synthetic turf fields.

**Chemical Exposure**

Exposure to a chemical requires contact with it. Contact with a chemical occurs in three ways: swallowing it (ingestion exposure), breathing it (inhalation exposure), and having it come in contact with the skin (dermal exposure) or eyes (ocular exposure). The potential for harmful effects from exposure to a chemical depends on the amount of the chemical a person contacts, how the chemical enters the body (ingestion, inhalation, dermal, or ocular), how often contact occurs, and the toxic properties of the chemical. The ability of a chemical to be released from a substance (e.g., crumb rubber) is an important factor in determining how much exposure actually occurs. Other factors that can influence a person’s risk for adverse health effects from environmental chemicals include age, gender, general health, genetic differences, exposure to other chemicals and lifestyle choices.

Tires are manufactured from natural and synthetic rubbers along with numerous chemical additives, including zinc, sulfur, carbon black, and oils that contain polyaromatic hydrocarbons (PAHs) and volatile organic chemicals. Because crumb rubber is manufactured from used tires, it probably contains the same chemicals as tire rubber.

Studies have been conducted by the California Environmental Protection Agency Office of Environmental Health Hazard Assessment and the Norwegian Institute of Public Health to assess the potential for ingestion exposure to the chemicals in crumb rubber by children playing on synthetic turf. Both studies concluded that health risks to children resulting from the ingestion of crumb rubber are low.

The Norwegian Institute of Public Health also collected data to assess potential health risks resulting from dermal and inhalation exposures to chemicals contained in synthetic turf fields. Health assessments were conducted for adults and children. The researchers concluded that adverse health effects resulting from dermal exposures to crumb rubber or from inhalation exposures to organic chemicals released from the fields are unlikely. No health assessment of the concentrations of rubber particles in the air was made.

A French study measured the concentrations of organic chemicals emitted as gases (known as volatile organic compounds or VOCs) from crumb rubber under laboratory conditions. The data were used by the French National Institute for Industrial Environment and Risks to evaluate possible health effects from inhaling VOCs released from synthetic turf. The study authors concluded that the concentrations of organic compounds emitted did not pose a health concern for athletes, officials or spectators.

Some types of synthetic turf fibers contain elevated levels of lead (e.g., in the range of about 2,000 to 9,000 parts per million). Degradation of these fibers can form a dust that presents a potential source of
lead exposure to users of the fields. The Centers for Disease Control and Prevention and the Agency for Toxic Substances and Disease Registry addressed the potential for lead exposures from synthetic turf fibers in a June 2008 Health Advisory (http://www.cdc.gov/nceh/lead/artificialturf.htm). For new or replacement installations, select synthetic turf products that do not have elevated lead levels.

Our review of the available information on crumb rubber and crumb rubber infilled turf fields indicates that ingestion, dermal or inhalation exposures to chemicals in or released from crumb rubber do not pose a significant public health concern.

OTHER CONSIDERATIONS
A number of other factors may need to be considered when installing and using synthetic turf.

Use: Synthetic turf is more durable than natural turf and can be used without the rest periods that natural turf requires to keep the turf healthy. The New York City Department of Parks and Recreation (NYCDPR) estimates that on an annual basis, permitted use (hours per year) for synthetic turf athletic fields is 28 percent higher than for natural grass fields.

Installation: Installation costs of synthetic turf vary depending on the amount of site preparation required and the specific field design. The installation costs of synthetic turf are generally much higher than the installation costs of natural turf.

Maintenance: The maintenance costs of synthetic turf will vary depending on the field’s use and design, but are typically estimated to be lower than the maintenance costs of natural turf. Natural turf requires regular mowing, fertilizer application, pest control and possibly watering. Synthetic turf requires replacing infill materials, repairing seams and removing weeds and moss. Specialized equipment, which may or may not be included in the field’s purchase price, is required for these activities.

Lifetime: NYCDPR estimates that the lifetime of a natural turf field is on the order of five years. The synthetic turf industry estimates that the lifetime of an infilled synthetic turf athletic field is eight to ten years, depending on care during installation and use. NYCDPR and other New York entities have seen similar lifetimes.
### SUMMARY OF INFORMATION FOR CRUMB-RUBBER INFILLED SYNTHETIC TURF ATHLETIC FIELDS

<table>
<thead>
<tr>
<th>Category</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat stress</td>
<td>Surface temperatures on crumb-rubber infilled synthetic turf fields can reach levels of discomfort and may contribute to heat stress. This warrants consideration when making decisions about installing and using a synthetic turf field. While watering synthetic turf may briefly reduce surface temperatures, a number of factors may influence its effectiveness. People using these fields should be advised to remain hydrated and to seek relief from the heat in shaded areas.</td>
</tr>
<tr>
<td>Injury</td>
<td>Overall, studies have found no consistent differences in injury rates between natural and crumb-rubber infilled synthetic turf.</td>
</tr>
<tr>
<td>Infection</td>
<td>Skin cuts and abrasions that may result from contact with athletic fields (natural and synthetic turf) are susceptible to infection. Athletes and others developing skin abrasions should clean the wounds and seek prompt medical attention. Athletes should avoid sharing equipment, razors, towels, soap and other objects with others, because these items can spread germs.</td>
</tr>
<tr>
<td>Latex allergy</td>
<td>At the present time, NYSDOH is unaware of any occurrences of latex allergy resulting from contact with crumb rubber or synthetic turf fields.</td>
</tr>
<tr>
<td>Chemical exposures</td>
<td>Based on the available information, chemical exposures from crumb rubber in synthetic turf do not pose a public health hazard.</td>
</tr>
</tbody>
</table>
WHERE CAN I GET MORE INFORMATION?

If you have any questions about the information in this fact sheet or would like to know more about in-filled synthetic turf athletic fields, please call the NYSDOH at 1-800-458-1158 or write to the following address:

New York State Department of Health
Bureau of Toxic Substance Assessment
Flanigan Square, 547 River St.
Troy, NY 12180-2216

SOME RELEVANT REFERENCES

Temperature of In-filled Synthetic Turf Athletic Fields

McNitt S., Petrunak D., Evaluation of Playing Surface Characteristics of Various In-filled Systems; Penn State Department of Crop and Soil Sciences; http://cropsoil.psu.edu/mcnitt/infill.cfm

Williams F.C., Pulley G.E.; Synthetic Surface Heat Studies; Brigham Young University; http://cahe.nmsu.edu/programs/turf/documents/brigham-young-study.pdf

Injuries


Infection Risk


McNitt S., Petrunak D.; Evaluation of Playing Surface Characteristics of Various In-Filled Systems; Penn State Department of Crop and Soil Sciences; http://cropsoil.psu.edu/mcnitt/infill.cfm


Latex Allergy


Chemical Exposures


Other Considerations


Synthetic turf surfaces have long been regarded as a lower maintenance alternative to natural turf. However, synthetic surfaces like natural turf have their shortcomings. In the spring of 2002 a Field Turf synthetic surface was installed on one half of Brigham Young University’s Football Practice Field. The other half of the installation is a sand-based natural turf field. Shortly after the Field Turf was installed football camps were started. The coaches noticed the surface of the synthetic turf was very hot. One of the coaches got blisters on the bottom of his feet through his tennis shoes. An investigation was launched to determine the range of the temperatures, the effect water for cooling of the surfaces, and how the temperatures compared to other surfaces.

On June of 2002 preliminary temperatures were taken at five feet and six inches above the surface and at the surface with an infrared thermometer of the synthetic turf, natural turf, bare soil, asphalt and concrete. A soil thermometer was used to measure the temperature at two inches below the surface of the synthetic turf. Also, water was used to cool the surface of the natural and artificial turf. It was determined that the natural turf did not heat up very quickly after the irrigation so only the artificial turf was tracked at five and twenty minutes after wetting. The results of the preliminary study are shocking. The surface temperature of the synthetic turf was 37º F higher than asphalt and 86.5º F hotter than natural turf. Two inches below the synthetic turf surface was 28.5º F hotter than natural turf at the surface. Irrigation of the synthetic turf had a significant result cooling the surface from 174º F to 85º F but after five minutes the temperature rebounded to 120º F. The temperature rebuilt to 164º F after only twenty minutes. These preliminary findings led to a more comprehensive look at the factors involved in heating of the artificial turf.

Three aspects of light were measured along with relative humidity. The synthetic surface was treated as two areas, the soccer field and the football field and the natural turf was one area. Four randomly selected sampling spots were marked with a measuring tape from reference points on the fields so it could be accessed for subsequent data collection. Bare soil, concrete, and asphalt sampling areas were selected and marked in a similar manner. The results are shown in table form below:

Table 1.

<table>
<thead>
<tr>
<th>Surface</th>
<th>Average Surface Temperature between 7:00 AM and 7:00 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soccer</td>
<td>117.38º F high 157º F</td>
</tr>
<tr>
<td>Football</td>
<td>117.04º F high 156º F</td>
</tr>
<tr>
<td>Natural Turf</td>
<td>78.19º F high 88.5º F</td>
</tr>
<tr>
<td>Concrete</td>
<td>94.08º F</td>
</tr>
<tr>
<td>Asphalt</td>
<td>109.62º F</td>
</tr>
<tr>
<td>Bare Soil</td>
<td>98.23º F</td>
</tr>
</tbody>
</table>

Table 2.

<table>
<thead>
<tr>
<th>Two inch depth</th>
<th>Average Soil Temperature between 7:00 AM and 7:00 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soccer</td>
<td>95.33º F high 116º F</td>
</tr>
<tr>
<td>Football</td>
<td>96.48º F high 116.75º F</td>
</tr>
<tr>
<td>Natural Turf</td>
<td>80.42º F high 90.75º F</td>
</tr>
<tr>
<td>Bare Soil</td>
<td>90.08º F</td>
</tr>
</tbody>
</table>
Table 3.

<table>
<thead>
<tr>
<th>Shade</th>
<th>Average Temperature between 9:00 AM and 2:00 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Temperature of Natural Turf</td>
<td>66.35º F high 75º F</td>
</tr>
<tr>
<td>Surface Temperature of Artificial Turf</td>
<td>75.89º F high 99º F</td>
</tr>
<tr>
<td>Average Air Temperature</td>
<td>81.42º F</td>
</tr>
</tbody>
</table>

Surface Temperature of A.T. (Artificial Turf) is significantly higher than air or soil temperature of A.T. The amount of light (electromagnetic radiation) has a greater impact on temperature of A.T. than air temperature. The hottest surface temperature recorded was 200º F on a 98º F day. Even in October the surface temperature reached 112.4º F. This is 32.4º F higher than the air temperature. White lines and shaded areas are less affected because of reflection and intensity of light. Natural grass areas have the lowest surface and subsurface temperatures than other surfaces measured. Cooling with water could be a good strategy but the volume of water needed to dissipate the heat is greatly lessened by poor engineering (infiltration and percolation).

Average air temperature over natural turf in the late afternoon is lower than other surfaces. Soil temperature of A.T. is greater than bare soil and natural turf. Humidity appears to be inversely related to surface and soil temperature. It is likely that energy is absorbed from the sunlight by the water vapor.

The heating characteristics of the A.T. make cooling during events a priority. The Safety Office at B.Y.U. set 120º F as the maximum temperature that the surface could reach. When temperature reaches 122º F it takes less than 10 minutes to cause injury to skin. At this temperature the surface had to be cooled before play was allowed to continue on the surface. The surface is monitored constantly and watered when temperatures reach the maximum. The heat control adds many maintenance dollars to the maintenance budget.

A budget comparison was made using actual dollars spent and for every dollar spent on the A.T. maintenance one dollar and thirty cents was spent on the natural turf (N.T.) practice field. While construction costs are very unbalanced, for every dollar spent on the N.T. eleven dollars and seventy-seven dollars were spent on the A.T.

The area under the carpet of BYU’s installation is designed to move water from the surface and into an extensive drain mat system. This part of the installation is two thirds of the overall cost of the A.T. Thus, for a 2.5 million dollars installation approximately 1.7 million dollars go for the subsurface and drainage. The most interesting thing about this is that the drain mat probably sees little or no water. The surface is hydrophobic and the undersurface is poorly engineered to favor water retention rather than drainage. That seems like a high price to pay for something that does not work!

Artificial turf surfaces have their place in the turf industry. They can work in environments where grass will not grow and are marginal. However, they are costly and not maintenance free. It is important to take all the factors in to consideration before making a large investment. Don’t take the manufacture’s word for the factors of concern i.e. don’t let the fox guard the hen house. The propaganda on BYU’s installation is charts with surface temperatures less than the air temperature and claims for drainage of 60 inches per hour. The question still remains is A.T. 11.47 times better than natural turf?
Synthetic Turf Playing Fields Present Unique Dangers

By Chuck Adamson

Brad Fresenburg made a disturbing discovery when he took surface temperatures of artificial playing turf on a summer afternoon.

The University of Missouri turfgrass expert found that on a 98-degree day at MU's Faurot Field the surface temperature on the synthetic grass was 173 degrees. Nearby natural grass showed a temperature of just 105 degrees.

When Fresenburg took the temperature at head-level height over the faux turf, the thermometer registered 138 degrees.

Fresenburg said there's a national trend toward high schools and municipal recreation departments replacing grass with artificial turf – once the almost exclusive purview of college and professional sports teams – and he wants coaches and parents to know how to keep players safe.

"If they are going to have artificial fields, we need coaches, parents and players to know that temperatures on these fields are going to be anywhere from 150 to 170 degrees on some days," Fresenburg said. "You might as well be sitting in an oven somewhere."

The new generation of synthetic turfs are as safe, even safer in some ways, as natural grass, concluded Michael Meyers, a professor at West Texas A&M University. He has tracked playing field injuries in Texas high schools for eight years now.

Athletes tend to suffer injuries at roughly the same frequency on natural and synthetic turfs, but different surfaces tend to result in different types of injuries, he said.

"There is more torque, more velocity and more traction" on artificial turf, Meyers said.
There is more torque, more velocity and more traction on artificial turf, Meyers said.

That can lead to more muscle strains and spasms.

But natural grass has its own hazards, such as slippery mud or unseen potholes, and possibly in arid areas, harder surfaces. More concussions per games played occurred on natural grass fields.

The newer generation of synthetic turfs is "far superior," said Meyers, to previous types like the former industry standard Astroturf, which he described as basically a carpet and carpet pad laid over concrete. Now fields are built over surfaces in-filled with recycled rubber pellets and other materials that make for softer falls, mimicking natural grass and soil playing conditions.

The drawback, said Fresenburg, is that all those rubber and plastic materials amplify sunlight to cause near unbearable temperatures at certain times of the day.

Rex Sharp, MU's head athletic trainer, said he believes synthetic turf to be just as safe as grass. But he agrees that outdoor fields will get hotter under certain conditions. In his experience the artificial fields get at least 10 to 15 degrees hotter under the afternoon sun, he said.

University staff constantly monitors field temperatures during practices, Sharp said.

Fresenburg suggested that sports teams schedule morning and evening practices, times when playing surfaces are cool. In the hot afternoon hours of August and September he said teams should seek out natural grass alternatives.

Under any workout conditions, hydration of athletes should be closely monitored, he said.

MU has two artificial turf fields, the indoor field in the Devine Pavilion and the outdoor Faurot Field in Memorial Stadium.

The older-generation turf used at Devine Pavilion is more tacky and prone to cause twisting-related injuries, Sharp said. The football players wear special cleats when practicing there. Faurot Field has the newer-generation FieldTurf brand surface. He said players can wear regular grass cleats there, and he believes that the surface is just as safe as natural grass.

Fresenburg is not so sure.

Tests Fresenburg has done show increased potential pressure on joints and bones from the inability of a fully planted cleat-wearing foot to divot or twist out, an action that releases force.

The traction on synthetic turf is much greater, he said.

"Grounds managers prefer artificial turf over natural because when teams play on grass, they leave divots and rip out grass," Fresenburg said. "Most people see those areas as
damaged turf. I like to say those divots are a sign that the field is doing its job – yielding to the athletes' cleats."

Fresenburg tested four turf types, three natural grasses and MU’s Faurot Field using a contraption of cleats, weights to simulate an athlete's weight and a torque wrench-like tool. When a cleat was completely planted in Faurot Field, it needed an average of 110 foot-pounds – a foot-pound is a measured unit of applied force – of torque to twist free. That was compared to 81 to 85 foot-pounds needed on the natural surfaces.

"In some areas of Faurot Field, we maxed out the instrument at 120 foot-pounds," Fresenburg said. "The cleated foot simply wouldn't shear. That's not good."

The good news is that the difference only occurred when a cleat was fully planted in the field. When only a portion of the cleat simulating the ball of a foot was planted, the force needed to twist free was the about the same on all surfaces.

The hidden danger on an artificial field is the threat of bacterial infections, Fresenburg said. He said disinfectant should be sprayed as needed if there's a known infection risk, but Fresenburg said he doesn't know what procedures are necessary to prevent bacterial contamination in the first place.

"Natural grass has a microbial system. It's self-cleaning. These synthetic fields don't have that," Fresenburg said. "There's warmth. There's moisture. Bacteria can thrive in there. There's sweat, spit and blood."

Sharp said players need to immediately report any "turf-burns," abrasions so named for their similarity to rug burns. Turf burns are common on certain types of synthetic turf. They must be immediately washed with soap and water to prevent infection, Sharp said.

Often young athletes are inclined to ignore seemingly minor injuries, Sharp said.

"We have done a good job of educating our students on turf burns," Sharp said. "We've had to educate our kids to let us clean and treat those."

Anyone interested in more tips on turfgrass safety can contact Fresenburg at 573-442-4893.

"Many schools or communities may only look at the maintenance chores of natural grass when deciding to switch to artificial turf," Fresenburg said. "They should look beyond that. They need to look at all the differences between the two surfaces."
Artificial Turf

Recent tests by the New Jersey Department of Health and Senior Services (NJDHSS) of artificial turf playing fields in that state have found these fields contain potentially unhealthy levels of lead dust. The initial tests were conducted on a limited number of playing fields. NJDHSS sampling of additional athletic fields and other related commercial products indicates that artificial turf made of nylon or nylon/polyethylene blend fibers contains levels of lead that pose a potential public health concern. Tests of artificial turf fields made with only polyethylene fibers showed that these fields contained very low levels of lead.

Information provided by NJDHSS to CDC and ATSDR indicates that some of the fields with elevated lead in either dust and/or turf fiber samples were weathered and visibly dusty. Fields that are old, that are used frequently, and that are exposed to the weather break down into dust as the turf fibers are worn or demonstrate progressive signs of weathering, including fibers that are abraded, faded or broken. These factors should be considered when evaluating the potential for harmful lead exposures from a given field.

The risk for harmful lead exposure is low from new fields with elevated lead levels in their turf fibers because the turf fibers are still intact and the lead is unlikely to be available for harmful exposures to occur. As the turf ages and weathers, lead is released in dust that could then be ingested or inhaled, and the risk for harmful exposure increases. If exposures do occur, CDC currently does not know how much lead the body will absorb; however, if enough lead is absorbed, it can cause neurological development symptoms (e.g. deficits in IQ). Additional tests are being performed by NJDHSS to help us better understand the absorption of lead from these products.

Learn About Lead Contamination in Artificial Turf

Potential Exposure to Lead in Artificial Turf
CDC Health Alert Network (HAN) Advisory from June 18, 2008, 16:10 EDT.

New Jersey Artificial Turf Investigation
Additional information about testing, dust suppression measures, and other topics related to New Jersey's artificial turf investigation.

Learn About Lead

CDC's Lead Poisoning Prevention Program
Learn more about the CDC's efforts to eliminate childhood lead poisoning in the United States.

ToxFAQs™
Frequently asked questions from the Agency for Toxic Substances & Disease Registry (ATSDR).

Toxicological Profile
Toxicologic & adverse health effects information from the Agency for Toxic Substances & Disease Registry (ATSDR).
Artificial Turf Field Investigation in Connecticut
Final Report

Prepared By

Nancy Simcox, MS
Anne Bracker, MPH, CIH

John Meyer, MD, MPH
Section of Occupational and Environmental Medicine
University of Connecticut Heath Center

July 27, 2010
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ACKNOWLEDGMENTS

We would like to extend a special appreciation to Tara Kurland, a masters student in Environmental Science and Policy at Clark University, who completed her summer internship with us on this project. We especially thank her for contributing to all aspects of the field sampling. We also thank Paula Schenck, the University of Connecticut Health Center, for careful review of this report. Funding for this project was provided by the Connecticut Department of Environmental Protection.
1.0 Executive Summary

The primary purpose of this project was to characterize the concentrations of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), rubber-related chemicals (e.g. benzothiazole), and particulate matter less than 10 micron (PM$_{10}$) and its constituents in ambient air at selected crumb rubber fields in Connecticut under conditions of active field use.

This project employed a cross-sectional environmental sampling strategy of synthetic crumb rubber turf fields to capture a range of chemical exposures during the summer season when ambient air temperatures are above 75-80°F. Three general types of fields were targeted: outdoor crumb rubber fields, indoor facilities with crumb rubber turf, and an outdoor grass field in a suburban area. Sampling goals were to collect air samples on old and new turf fields during active field use and to collect air samples at background sites upwind and off of each field. A special focus of the design study included personal air sampling of many of the chemicals reported in previous studies (e.g. VOCs and benzothiazole), and other chemicals of potential concern, such as a volatile nitrosamine reported to be part of rubber manufacture. The sampling strategy also included the collection of area air samples for chemicals at different heights on the turf to assess a vertical profile of release. These air samples were collected in areas on the turf field near active play and areas on the turf away from active play. Because crumb rubber includes some amount of dusts and small particles, particulate matter air monitoring was incorporated into the stationary sampling plan (using sampling at a single height only). Bulk samples of turf grass and crumb rubber were also collected, and meteorological data (e.g. air direction, wind speed and ambient air temperature) were recorded.

Industrial hygienists from the Section of Occupational and Environmental Medicine at the University of Connecticut Health Center (OEM UCHC) conducted the field sampling and managed the analytical components of this exposure investigation. This report summarizes the data collected by OEM UCHC. This report identifies and measures chemicals across several synthetic crumb rubber turf fields and background locations. The measurements collected from background locations are necessary to better understand the data because many of these chemicals are present in ambient air as a result of general air pollution.

CT DEP recruited six fields: 4 outdoor turf fields (Fields A-D), 1 indoor turf field (Field K) and 1 outdoor suburban grass area (Field L). Six additional fields were recruited to collect crumb rubber bulk samples only (Fields E-J). Air sampling occurred during July 2009 on crumb rubber fields with polyethylene fibers that were both new (<2 years) and old (>3 years). Algorithms were developed to identify chemicals possibly related to turf. Of the 60 VOCs tested in air, 4 VOCs appear to be associated with turf. Of 22 PAHs, 6 were found in the air on the turf at 2 fold greater concentrations than in background locations on at least two fields. Of the five targeted SVOCs, benzothiazole and butylated hydroxytoluene were the only chemicals detected in the personal and area air samples from outdoor turf fields ranging from <80-1200 ng/m$^3$ and <80-130 ng/m$^3$, respectively. Nitrosamine air levels were below reporting levels. PM$_{10}$ air concentrations were greater in background locations than on the turf at all fields with the exception of Field B. However, the PM$_{10}$ air concentration on turf at Field B, 5.89 ug/m$^3$, was within the range of other PM$_{10}$ background concentrations. All of the composite samples of turf fibers and crumb rubber were below the level EPA considers as presenting a "soil-lead hazard" in play areas (400ppm).

The airborne concentrations of VOCs, targeted SVOCs (e.g. benzothiazole) and miscellaneous SVOCs were highest at the indoor field. These data were collected from only one indoor facility. Higher concentrations of these chemicals at the indoor field likely reflects the lack of air movement relative to outdoor fields. In addition, the air in the indoor field was not influenced by outdoor factors that may degrade and off-gas chemicals, such as sunlight, rain, and other weather conditions. Furthermore, potential point sources were identified in the facility, (electric carts, portable chargers, and maintenance supplies) and the indoor facility did not have its exhaust system operating on the day samples were collected. More research is needed to better understand chemical exposures in indoor facilities.
2.0 Introduction

2.1 Purpose

Crumb rubber fields have been installed or are being proposed in many towns throughout Connecticut, and elsewhere in the United States. Crumb rubber consists of recycled, chipped/pulverized, used automobile tires. The tire crumbs are roughly the size of grains of course sand and generally are spread two to three inches thick over the field surface and packed between ribbons of green plastic used to simulate grass. Crumb rubber granules may release a variety of chemicals typical in rubber, including polycyclic aromatic hydrocarbons (PAHs) and volatile organic chemicals (VOCs). In addition, crumb rubber includes some amount of dusts and small particles, which may be further increased by mechanical abrasion and wear that comes with use of the fields [1]. Health questions continue to arise because exposures and risks to playing on these fields have not been fully characterized [2, 3, 4].

The primary purpose of this project was to characterize the concentrations of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), rubber-related chemicals (e.g. benzothiazole), and particulate matter less than 10 micron concentrations (PM$_{10}$ ) and its constituents in ambient air at selected crumb rubber fields in Connecticut under conditions of active field use. Air monitoring data is needed to characterize exposure patterns of targeted compounds in the breathing zone of children using artificial turf fields. In addition, there is insufficient data on how relevant variables, such as weather conditions, age of field, nature of sporting activities and type of infill, affect exposure to chemical constituents and particulate matter.

In Connecticut, we know of at least 85 crumb rubber fields already in use, and another 30 that have been proposed or are being constructed. Air data collected at selected crumb rubber fields are needed to begin the characterization of potential exposures that could be used in a companion risk assessment of the data generated from this work.

Data from the Connecticut Agricultural Experiment Station (CAES) laboratory head space analyses on manufacturers’ crumb rubber infill were used to guide aspects of the design of this field investigation [5]. We also established collaborative relationships with those doing similar research in New Jersey, New York State, New York City and U.S. EPA to learn of parallel activities and results as this project proceeded [6, 7]. For example, a recent study conducted in New York found that rubber dust was not found in the respirable range, and therefore, PM$_{10}$ was selected for this study [6].

2.2 Field Investigation Objectives

This exposure characterization had the following objectives.

1. Collect personal measurements in the breathing zone of the target population - young children who play on crumb rubber athletic fields.
2. Characterize the concentrations of VOCs, SVOCs, and particulate matter (PM) (and constituents on PM) in air at selected crumb rubber fields in Connecticut under conditions involving active field use in warm weather.
3. Assess airborne concentrations of the targeted chemicals and particulates in areas surrounding and away from the crumb rubber fields. The collection of background samples is a key component as exposure to airborne rubber particles and component gases is not unique to turf fields.

2.3 Sampling Plan

Industrial hygienists from the Section of Occupational and Environmental Medicine at the University of Connecticut Health Center (OEM UCHC) conducted the field sampling and managed the analytical components of this exposure investigation. OEM UCHC provides research, educational programs and training, industrial hygiene consulting, prevention guidance, risk communication and clinical care for occupational and environmental illnesses and problems. Specifically, OEM UCHC personnel performed the collection of air samples, contracted with laboratories for analyses, provided quality control / quality assurance, and reviewed and compiled the data. OEM UCHC sub-contracted laboratory analyses to three AIHA accredited laboratories: Wisconsin Occupational Health Laboratory (WOHL), the Wisconsin State Laboratory of Hygiene (WSLH) and the ESIS Environmental Health Laboratory (EHL) in Cromwell, Connecticut. WOHL is a full service industrial hygiene chemistry laboratory that is part of the Wisconsin State Laboratory of Hygiene (WSLH) at the University of Wisconsin-Madison. WSLH analyzed air samples for VOCs, SVOCs and PM$_{10}$. WOHL analyzed bulk crumb rubber head space for VOCs and targeted SVOCs (e.g. benzothiazole), and air samples for nitrosamines and targeted SVOCs. Additional bulk
samples were analyzed for lead by the ESIS Environmental Health Laboratory (EHL). The EHL has been accredited by the American Industrial Hygiene Association (AIHA) for both industrial hygiene and environmental lead. This report summarizes the data collected by OEM UCHC.

This project employed a cross-sectional environmental sampling strategy of synthetic crumb rubber turf fields to capture a range of chemical exposures during the summer season when ambient air temperatures are above 75-80°F. Three general types of sites were targeted: outdoor crumb rubber fields, indoor facilities with crumb rubber turf, and an outdoor grass field in a suburban area. Sampling goals were to collect air samples on old and new turf fields during active field use and to collect air samples at an upwind site of each field. A special focus of the design included personal air sampling of many of the chemicals reported in previous studies (e.g. VOCs and benzothiazole), and other chemicals of potential concern, such as a nitrosamine. The sampling strategy also included the collection of area air samples for chemicals at different heights on the turf to assess a vertical profile of release. These air samples were collected in areas on the turf field near active play and areas on the turf away from active play. Because crumb rubber includes some amount of dusts and small particles, particulate matter air monitoring was incorporated into the stationary sampling plan (using sampling at a single height only). Bulk samples of turf grass and crumb rubber were also collected, and meteorological data (e.g. air direction, wind speed and ambient air temperature) were recorded.

**Bulk Samples:** Composite bulk samples of green artificial turf fibers and composite bulk samples of crumb rubber were collected from 5 locations on each study field. These samples were analyzed for lead by EHL in Connecticut. Additional bulk samples of crumb rubber were collected at eleven fields. These samples were analyzed for targeted SVOCs, VOCs and other chemicals in a 340 milliliter large volume sample headspace unit (LVSH) by WOHL. CAES collected and analyzed samples of crumb rubber material supplied by several manufacturers [5]. Their crumb rubber samples included material from only two of our outdoor fields (A and D). These two crumb rubber fields were manufactured by two different companies. The results are difficult to compare between the two laboratories (WOHL and CAES) because they used different analytical methods.

**Personal Sampling:** Study team members from the Connecticut Department of Public Health (CT DPH), Connecticut Department of Environmental Protection (CT DEP), and OEM-UCHC simulated a soccer game for the collection of the personal airborne chemicals. Active play among 3-4 players consisted of running and kicking the ball on the turf field, one on one soccer drills and “keep away” soccer games. Duration of play was two hours with one break. Personal air samples were collected at waist height, approximately 3-feet, with sampling equipment worn by 3 players during active play on the field. Personal measurements for nitrosamine, benzothiazole, and VOC were collected from players at each field. Two personal samples were collected for each of the types of measurements. Evacuated 1.4 liter SUMMA canisters were worn by players at hip height to collect VOC samples. Personal sampling pumps fit with absorptive media were worn by players at hip height to collect samples for benzothiazole, nitrosamine, 4-Tert (octyl) phenol, 2-mercaptobenzothiazole, Butylated hydroxyanisole (BHA) and Butylated hydroxytoluene (BHT).

**Area Sampling:**
Area samples were collected for 2 hours to measure VOCs, SVOCs, benzothiazole, and ambient PM$_{10}$ concentrations during active play. Samplers were located at various heights on the field in the immediate vicinity of the simulated soccer game and in an off-turf upwind area to represent background locations. Additional background samples were collected in one suburban community location (non-turf grass field) to help put the field-related results into a larger exposure context. VOCs were measured with 6-liter SUMMA canisters according to EPA Method TO-15 [8]. SVOCs in ambient air were measured with PS-1 Samplers according to EPA Method TO-13A [9]. An additional day of sampling for 6 hours was conducted with the PS-1 Samplers on one field without active play. Specific chemicals (e.g. benzothiazole and nitrosamines) were separately measured using sampling pumps and sorptive media to trap those chemicals according to NIOSH methods [10, 11]. PM$_{10}$ concentrations were measured using Harvard Impactors (Air Diagnostics and Engineering, Inc., Harrison, ME) [12, 13]. OEM-UCHC collected all samples and shipped sampling media to WOHL for analysis. Table 1 provides a general description of the targeted analytes, air sampling and analytical methods for each set of analytes. Appendix A provides a sampling map.
3.0 Methods and Results

3.1 Field Recruitment

CT DEP recruited six fields: 4 outdoor turf fields (Fields A-D), 1 indoor turf field (Field K) and 1 outdoor suburban grass area (Field L). Six additional fields were recruited to collect crumb rubber bulk samples only (Fields E-J). As shown in Table 2, air sampling occurred during July 2009 on crumb rubber fields with polyethylene fibers that were both new (<2 years) and old (>3 years). Fields B, C, and J contained silica sand in the crumb rubber. Sampling dates were chosen to coordinate several factors: sunny and no wind days, rental sampling equipment costs/availability, field accessibility due to school summer programs, and staff availability. Table 2 provides the total number of air samples collected at each field. Fields A-B and K were in located in rural areas and fields C, D and L were in suburban communities with nearby roads with high traffic volume. Field D was also near an interstate highway. Field K, the indoor turf facility, had four exhaust fans at each end of the building. These fans were not operating during sampling. There was an equipment room located inside the facility containing small electric motorized carts (these carts were driven out of the facility minutes before the sampling began). In addition, the room had a portable charger, an ice machine, maintenance supplies (e.g. cans of paints) and other gym equipment.

3.2 Meteorological Sampling

Meteorological conditions for each sampling day were collected by a subcontactor (Air Quality Research and Logistics, LLC) with a Davis Vantage Pro 2 weather station by Air Quality Research and Logistics, Inc. Meteorological parameters included: wind speed, wind direction and air temperature at different heights (near ground level and 3 feet above the ground). Thermometers were enclosed in naturally aspirated radiation shields (Davis Part. No. 7714). Measurement of continuous (15 minute average) ambient air temperature, wind direction and speed were collected. Table 3 provides a summary of the meteorological conditions at each field. Appendix B provides a report by Air Quality Research and Logistics, Inc. On July 28, 2009, meteorological data was not collected during the 6 hour sampling at Field D. Temperature and wind direction data were obtained from Weather Underground (www.wunderground.com).

Table 1. Target Analytes, Air Sampling Equipment and Analytical Methods

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Type</th>
<th>N</th>
<th>Sampling Equipment and Media</th>
<th>Analytical Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volatile Organic Compounds (VOCs)</td>
<td>Personal</td>
<td>10</td>
<td>1.4 L SUMMA</td>
<td>EPA TO-15 (GC/MS)</td>
</tr>
<tr>
<td></td>
<td>Area</td>
<td>16</td>
<td>6.0 L SUMMA</td>
<td></td>
</tr>
<tr>
<td>General Semi-Volatile Organic Compounds (SVOCs) scan</td>
<td>Area</td>
<td>12</td>
<td>PS-1 Sampler PUF and XAD-2</td>
<td>EPA TO-13A (modified) GC/MS</td>
</tr>
<tr>
<td>Targeted SVOCs</td>
<td>Personal</td>
<td>10</td>
<td>Personal Pump Gilair®, SKC Airlite® XAD-2</td>
<td>WOHL Method LC-100 (based upon NIOSH 2550)</td>
</tr>
<tr>
<td>Benzothiazole 2-mercaptobenzothiazole</td>
<td>Area</td>
<td>35</td>
<td>37mm, 2 μm PTFE pre-filter</td>
<td></td>
</tr>
<tr>
<td>4-Tert (octyl)phenol</td>
<td>Personal</td>
<td>10</td>
<td>Personal Pump Gilair®, SKC Airlite® XAD-2</td>
<td>WOHL Method LC-96 (based upon NIOSH 2522)</td>
</tr>
<tr>
<td>Butylated hydroxyanisole Butylated hydroxytoluene</td>
<td>Area</td>
<td>23</td>
<td>Thermosorb/NTM</td>
<td></td>
</tr>
<tr>
<td>Nitrosamines</td>
<td>Personal</td>
<td>10</td>
<td>Personal Pump Gilair®, SKC Airlite® Thermosorb/NTM</td>
<td>CFR Title 40 Part 50 (Appendix L) WP001-03 Gravimetric Analysis</td>
</tr>
<tr>
<td>Particulate Matter (PM₁₀)</td>
<td>Area</td>
<td>12</td>
<td>MS&amp;T Area Sampler 20 L sampling pump 37 mm Teflon Filter 2 μm pore size</td>
<td></td>
</tr>
</tbody>
</table>
Table 2. Total number of air samples collected at each field

<table>
<thead>
<tr>
<th>Compounds/Methods</th>
<th>Location</th>
<th>N</th>
<th>Fields</th>
<th>Sampling Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>VOCs EPA TO-15</td>
<td>Personal</td>
<td>10</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>On Turf Area</td>
<td>10</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Background Area</td>
<td>6</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>SVOCs scan</td>
<td>On Turf Area</td>
<td>6</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Background Area</td>
<td>6</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Targeted SVOCs</td>
<td>Personal</td>
<td>10</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>NIOSH 2550 (modified)</td>
<td>On Turf Area</td>
<td>23</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Background Area</td>
<td>12</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Field Blanks</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Field Spikes</td>
<td>6</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Nitrosamines</td>
<td>Personal</td>
<td>10</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>NIOSH 2522</td>
<td>On Turf Area</td>
<td>12</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Background Area</td>
<td>11</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Field Blanks</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PM$_{10}$</td>
<td>On Turf Area</td>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CFR Title 40 Part 50</td>
<td>Background Area</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Field Blanks</td>
<td>6</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 3. Description of sampling fields and weather conditions during sampling day.

<table>
<thead>
<tr>
<th>Field ID</th>
<th>Surface Age (location)</th>
<th>Sampling Date</th>
<th>Sampling Time of Day</th>
<th>Ambient Temperature On Surface 3 inches</th>
<th>Ambient Temperature On Surface 36 inches</th>
<th>Wind Speed (mph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2 years (outdoor)</td>
<td>7/27/09</td>
<td>12:15-2:15pm</td>
<td>79-89</td>
<td>76-83</td>
<td>0-6</td>
</tr>
<tr>
<td>B</td>
<td>2 years (outdoor)</td>
<td>7/15/09</td>
<td>11:30-1:30pm</td>
<td>83-89</td>
<td>77-80</td>
<td>4-8</td>
</tr>
<tr>
<td>C</td>
<td>5 years (outdoor)</td>
<td>7/20/09</td>
<td>11:30-1:45pm</td>
<td>85-88</td>
<td>81-82</td>
<td>1-2</td>
</tr>
<tr>
<td>D</td>
<td>2 years (outdoor)</td>
<td>7/14/09, 7/28/09</td>
<td>12:35-2:40pm, 9:30-3:30pm</td>
<td>80-88, 68-87*</td>
<td>76-86, 68-87*</td>
<td>1-3, 2-8</td>
</tr>
<tr>
<td>K</td>
<td>3 years (indoor)</td>
<td>7/22/09</td>
<td>3:50-5:50pm</td>
<td>77-79</td>
<td>78-80</td>
<td>1-2</td>
</tr>
<tr>
<td>L</td>
<td>Grass (outdoor)</td>
<td>7/12/09</td>
<td>11:48-1:48pm</td>
<td>NA$^a$</td>
<td>78-80$^b$</td>
<td>1-3</td>
</tr>
</tbody>
</table>

$^a$ Temperature not measured directly. Information collected from Weather Underground.
$^b$NA=Not available. Temperature information was not collected 3 inches above the surface.
3.3 Bulk Samples

_Crumb Rubber Bulk Sampling Methods for Head Space Analysis_: Crumb rubber bulk samples were collected from 11 different fields in June 2009. Table 3 provides the turf surface age for fields A-D, K. The turf surface age of the other six fields were: E (3 yrs), F (9 yrs), G (4 yrs), H (6 yrs), I (1 yr), and J (1 yr). Bulk samples were collected from 5 locations on each field (see Figure 1). At each location, crumb rubber was placed in a pre-cleaned glass jar, covered with foil and placed in a brown paper bag. Five samples per field were collected and shipped to WOHL (n=55).

![Figure 1. Sampling locations for bulk samples.](image)

### 3.3.1 VOC Crumb Rubber Head Space Analysis

WOHL stored the samples in a refrigerator at 4°C. Bulk samples were analyzed for VOCs by WOHL method WG086.2, a method based on OSHA PV2120 for the analysis of volatile organic compounds (VOCs) in air. The samples were analyzed in a 340 milliliter large volume sample headspace unit (LVSH) as follows: The cleaned LVSH was heated to 70°C overnight and then brought to room temperature in a clean room. A 0.5 gram sample was placed in the LVSH and heated in an oven at 70°C for at least 1 hour. Immediately after the LVSH was removed from the oven, a 100 ml sample volume from the LVHS was cryofocused and injected in a gas chromatograph equipped with a mass selective detector and a RTX-624 capillary column. The following precautions were taken for the bulk crumb rubber VOC analysis: 1) bulk crumb rubber samples were stored in teflon lined screw capped jars and were opened only when removing sample for analysis; 2) the 340mL LVSH were baked at 70°C overnight; and 3) one of the LVSH units was analyzed empty with each analytical run as a method blank, and any VOCs detected above reporting limit noted in the analytical report.

VOC identification was conducted by the National Institute of Standards and Technology Library (NIST) search. Laboratory blanks during analyses were below reporting limits for most compounds. Carbon disulfide, silyls, and siloxane-containing VOCs are common contaminants of the analytical system. Therefore, trace amounts of these VOCs reported may not be components of the samples. Trace levels of carbon disulfide were detected in laboratory blanks. All siloxane-containing VOCs were below reporting limits (<20ppb) in laboratory blanks. Because some of the VOC compounds detected in bulk crumb rubber off gassing experiments are commonly used laboratory solvents, a laboratory background VOC sample was also collected in the walk-in cooler/sample storage area and analyzed. The following VOC compounds were reported in the laboratory background sample: 2-methyl-butane (31ppb), acetone (830ppb), benzene (18ppb), methylene chloride (1030ppb), methyl alcohol (790ppb), and pentane (52ppb).
The head space methodology used by WOHL differed from CAES in several areas. WOHL used smaller amount of crumb rubber (0.5 vs. 1 gram), a larger volume head space unit, and different analytical parameters (e.g. cryogenically concentrates head space injection vs. direct injection technique). Appendix C provides a description of the analytical method used by WOHL.

Results: Table 4 provides a list of VOCs identified in crumb rubber samples from the 11 different turf fields. The most commonly found VOCs (range of concentrations in parts per billion-ppbV) include: acetonitrile (60-300ppbV), methylene chloride (20-430ppbV), methyl alcohol (33-270ppbV), and methyl isobutyl ketone (21-150ppbV). Bulk crumb rubber from the newer fields (A, B and D) contained more than ten VOCs. Crumb rubber from other fields contained less than 5 VOCs. Carbon disulfide concentrations were found in the majority of field samples with estimates ranging from 41-141 ppb, and are considered a contaminant of the analytical system and not a turf related VOC. VOCs also found in the laboratory background sample are noted below with the asterisks “c”. Appendix C provides the WOHL analytical laboratory reports of the data.

Table 4. VOCs identified in bulk crumb rubber head space at 11 fields.

<table>
<thead>
<tr>
<th>Volatile Organic Compounds (VOCs)</th>
<th>Fields A-D, K</th>
<th>Fields E-J</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,1,2-Trichloro-1,2,2-trifluoroethane</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>2-methyl-Butane&lt;sup&gt;c&lt;/sup&gt;</td>
<td>A, B, C</td>
<td></td>
</tr>
<tr>
<td>3-methyl-Pentane</td>
<td>A&lt;sup&gt;a&lt;/sup&gt;, B, D&lt;sup&gt;b&lt;/sup&gt;</td>
<td>I&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Acetone&lt;sup&gt;c&lt;/sup&gt;</td>
<td>A&lt;sup&gt;a&lt;/sup&gt;, B&lt;sup&gt;a&lt;/sup&gt;, C, D</td>
<td>E</td>
</tr>
<tr>
<td>Acetonitrile</td>
<td>A, B, C, D</td>
<td>E</td>
</tr>
<tr>
<td>Benzene&lt;sup&gt;c&lt;/sup&gt;</td>
<td>A, D</td>
<td></td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Cyclopentane, methyl-</td>
<td>A, B, D</td>
<td></td>
</tr>
<tr>
<td>Ethanol</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Ethyl Benzene</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>Hexane</td>
<td>B, C, D</td>
<td></td>
</tr>
<tr>
<td>Isopropyl Alcohol</td>
<td>A, B</td>
<td></td>
</tr>
<tr>
<td>Methyl Alcohol&lt;sup&gt;c&lt;/sup&gt;</td>
<td>A, B, C, D, K</td>
<td>E</td>
</tr>
<tr>
<td>Methylene Chloride&lt;sup&gt;c&lt;/sup&gt;</td>
<td>A, B, C, D</td>
<td>E, F, G, H, I</td>
</tr>
<tr>
<td>Methyl Isobutyl Ketone</td>
<td>A, B, D</td>
<td>E, G, H, I</td>
</tr>
<tr>
<td>Pentane&lt;sup&gt;c&lt;/sup&gt;</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Styrene</td>
<td>A, B, D</td>
<td></td>
</tr>
<tr>
<td>Toluene</td>
<td>A, B, D</td>
<td></td>
</tr>
</tbody>
</table>

Reporting limit is <10 or 20 ppbV depending on the chemical.

<sup>a</sup>Indicates that the area summed includes an unresolved compound.

<sup>b</sup>Indicates that there is some question as to identity.

<sup>c</sup>Compound was also detected in the laboratory background sample.
3.3.2 Targeted SVOCs Bulk Crumb Rubber Head Space Analysis: In the crumb rubber bulk samples, five targeted SVOCs were analyzed: benzothiazole, 2-mercaptobenzothiazole, butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), and 4-tert-(octyl)-phenol. Four chemicals, 2-mercaptobenzothiazole, BHA, BHT, and 4-tert-(octyl)-phenol) were added to the list of targeted SVOCs as a result of the findings reported by CAES in 2009. For targeted SVOCs, a Supelco Adsorbent Tube Injector System (ATIS) was utilized to thermally extract the bulk rubber infill samples. The off-gassed SVOCs were loaded onto sampling media and analyzed according to the various analytical methods used in the study. For benzothiazole/4-tert-(octyl)-phenol, the method is based upon National Institute for Occupational Safety and health (NIOSH) Method Number 2550 (Modified). In summary, SVOCs off gassed from bulk infill material collected on XAD filter air sampling devices were desorbed separately with 10 minutes of sonication performed 3 times with 3mL of methanol each. The combined methanol fractions were evaporated to approximately 0.5mL with nitrogen, and brought to a final volume of 1.0mL with methanol. Extracts were analyzed by reversed phase high-performance liquid chromatography employing a 0.1% formic acid:methanol linear gradient program. Detection was achieved by triple quadrupole mass spectrometry using multiple reaction monitoring (MRM).

SVOCs Bulk Crumb Rubber Results: Table 5 provides a list of SVOCs identified in crumb rubber samples from the 11 different turf field fields. Appendix D provides WOHL laboratory analytical reports.

Table 5. Identification of targeted SVOCs in bulk crumb rubber head space samples collected at 11 fields.

<table>
<thead>
<tr>
<th>Semi-Volatile Organic Compounds (SVOCs)</th>
<th>Study Turf Fields A-K</th>
<th>Additional Turf Fields E -J</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzothiazole</td>
<td>A, B, C, D and K</td>
<td>E, G, J</td>
</tr>
<tr>
<td>2-mercaptobenzothiazole</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>4-tert-(octyl)-phenol</td>
<td>A, B, C, D and K</td>
<td>E, F, G, H, I, J</td>
</tr>
<tr>
<td>Butylated hydroxyanisole (BHA)</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Butylated hydroxytoluene (BHT)</td>
<td>A, K</td>
<td>G</td>
</tr>
<tr>
<td>Nitrosamine</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>
3.3.3 Lead

**Bulk Sampling Method:** Composite bulk samples of green artificial turf fibers and composite bulk samples of crumb rubber were collected from 5 locations on each field (Figure 1) at study fields only. The bulk samples were placed in zip lock bags. Because lead was detected in the composite bulk sample from Field D, four additional crumb rubber composite bulk samples (two at 20 paces and two at 40 paces) and one additional composite fiber bulk sample were collected from Field D. The bulk samples were analyzed for environmental lead by the ESIS Environmental Health Laboratory (EHL) in Cromwell, Connecticut. The analytical method used by the laboratory was Modified EPA-SW-846-3050/ICP, Modified OSHA ID 125. The sampling and analytical methods are similar to the methods used by New York City Department of Parks and Recreation during their study of 103 crumb rubber fields [14].

**Results:** Table 6 show that all of the composite samples were below the level EPA considers as presenting a “soil-lead hazard” in play areas (400 ppm). This definition, however, applies to residential buildings and to soil rather than other surfaces [15]. Appendix E provides the EHL analytical laboratory reports.

**Table 6. Concentrations of microgram lead/gram material (µg/g) in fibers and crumb rubber at study field fields.**

<table>
<thead>
<tr>
<th>Field</th>
<th>Fiber Concentration (µg/g)</th>
<th>Crumb Rubber Concentration (µg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&lt; 60.1</td>
<td>&lt; 71.4</td>
</tr>
<tr>
<td>B</td>
<td>&lt; 59.0</td>
<td>&lt; 68.9</td>
</tr>
<tr>
<td>C</td>
<td>&lt; 60.2</td>
<td>&lt; 70.4</td>
</tr>
<tr>
<td>D</td>
<td>&lt; 59.0</td>
<td>271 (20 paces)</td>
</tr>
<tr>
<td></td>
<td>&lt; 76.5</td>
<td>&lt; 70.6 (20 paces)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt; 78.5 (20 paces)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt; 72.6 (40 paces)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt; 78.7 (40 paces)</td>
</tr>
<tr>
<td>K</td>
<td>&lt; 60.8</td>
<td>&lt; 72.1</td>
</tr>
</tbody>
</table>

Limit of Detection: 7.5 µg/sample

Environmental Protection Agency (EPA) lead level for soil in children’s play areas: 400 ppm (µg/g)
3.4 Air Samples
3.4.1 Volatile Organic Compounds (VOCs)

**Personal Sampling:** Personal air samples for VOCs were collected using evacuated 1.4 L silica-lined SUMMA Canisters with FSL QT MicroValve (Entech Instruments, California). Two study team members each wore a canister at waist-height during each sampling session. Each canister was placed inside a cotton “tool belt” and secured to a coated mesh waist belt with plastic ties. Study team members played soccer on the turf field with 2 other members for 120 minutes. One water/food break (5-10 minutes) was taken by the team members during the play period. At the beginning of each sampling event staff checked each canister's gauge and confirmed that the pressure was at the level noted in the laboratory's SOP. At the end of each sampling event, staff confirmed that the pressure gauge had reached “0”. The majority of samples collected air for at least 60 minutes or greater. Two samples collected air for less than 25 minutes (collected at indoor field, Field K). Samples were sent to the WSLH laboratory (Madison, WI) by overnight mail on the day they were collected. All canisters were received by WSLH the next day. Ten samples were collected, two from each turf field field (Fields A, B, C, D, and K). All of the 1.4L cans were pressure checked upon return to the lab and prior to analysis. No data were flagged to indicate problems.

Newly purchased items, such as apron belt, coated mesh belt, and plastic twist ties were used to hold the sampling equipment in place during personal sampling. Because several VOCs, such as acrolein, were present in personal samples and not in any area samples, a request was made to WOHL to analyze these extra items to determine if they released any VOC emissions. Therefore, seven months after sampling, a cloth apron, plastic twist tie, sampling pump, segment of the coated mesh waist belt and the belt buckle were analyzed for VOCs in the head space unit. This sampling was done because these items were in close contact to the sampling inlet of the 1.4L canisters that team members wore.

**Area Sampling:** Area air samples for VOCs were collected using evacuated 6 liter (L) silica-lined SUMMA Canisters with Nupro Valve (Entech Instruments, California). Canisters were placed at 6 inches and at 3 feet above the turf in an area away from active play of study team members (AFAP) during each sampling session. Another canister was placed upwind of the turf field on grass at 3 feet above the ground. At Field L (grass field), the canister was placed at 3 feet. At the beginning of each sampling event staff checked each canister’s gauge and confirmed that the pressure was at the level noted in the laboratory’s SOP. At the end of each sampling event, staff confirmed that the pressure gauge had reached “0”. The majority of samples collected air for at least 60 minutes or greater. One sample collected air for less than 20 minutes (collected at outdoor background, Field K). Samples were sent to the WSLH (Madison, WI) by overnight mail on the day they were collected. All canisters were received by WSLH the next day. In total, sixteen samples were collected from the various fields. Samples were collected from the following fields: A (n=3), B (n=3), C (n=3), D (n=3), K (n=3) and L (n=1). The lab confirmed if the canister valve was closed and tight upon arrival. One 6 L canister valve was open upon arrival, and the sample was not analyzed (collected at Field A, 6 inches above the turf).

**Sample Preparation and Analysis:** All canisters (1.4L and 6L) were calibrated with a mass flow controller to collect air samples for up to 120 minutes by the ESS Organics WSHL. A modified version of Compendium EPA Method TO-15 by GC/MS was used to measure ambient-level concentrations for 60 VOC analytes. Briefly, this method incorporates a multi-stage concentration process using an Entech 7100A Preconcentrator. This removes carbon dioxide, nitrogen, and water with a series of traps. The sample (500ml) is injected on a glass bead trap at a temperature of -150°C. The trap is then heated to 10°C and purged gently with helium to transfer the VOCs and the carbon dioxide to a second trap. The second trap, which contains Tenax(tm), is then cooled to 10°C, allowing the carbon dioxide to pass through the trap while retaining the VOCs. The second trap is heated and back-flushed with helium, sending the sample to the focusing trap, which is cooled to -160°C. The focusing trap is then rapidly heated to 60°C and the sample is injected onto the Rxi-lm s (Restek U.S., 110 Benner Circle, Bellefonte, PA 16823), 60m capillary column and finally the mass spec detector. VOC concentrations were reported in ppbV and microgram per cubic meter (μg/m³).

Each analytical run included one method blank per batch of samples. If an analyte in the method blank was greater than its limit of detection (LOD), the result for that analyte was flagged to indicate blank contamination. One set of samples contained acetone in the blank sample, and concentrations were corrected (samples collected at Field B). Duplicate analysis was performed on one sample per analytical batch. Duplicate analyses were always within 25% for each compound. Daily quality control checks were
performed using a second source standard. Analytes in the quality control/QC check standard were always within 30% of the corresponding calibration standards.

**Results:** The EPA Method TO-15 is designed to scan for 60 VOCs, and the results provide a list of VOCs that are detected at least once on field or background locations. WSHL analytical laboratory reports for all 60 VOCs (in ppbV) in air per field are summarized in Appendix F. Tables 7-10 summarize the VOC concentrations in μg/m³ at Fields A-D, all outdoor turf fields. Table 11 shows the VOC concentrations from Field K (an indoor field), and Table 12 presents data for Field L (the non-turf grass background suburban site). Table 13 provides an additional list of VOCs in the personal, on-turf, and background samples that were tentatively identified through the use of the National Institute of Standards and Technology (NIST) library. VOC concentrations are shown in bold for each VOC analyte if concentrations were two times higher than the background concentration. Total Volatile Organic Compound (TVOC) value is the sum of the all the concentrations that were detectable, and is not an approximate concentration based on toluene response. The airborne VOC concentrations reported at Field C should be reviewed with caution (Table 9). During the first ten minutes of sampling at Field C, a pesticide mixture was applied to the grass field adjacent to the synthetic turf field. Study coordinator asked the applicator to stop the application. Unfortunately, air sampling had already begun in the background location near the grass field when the application occurred. Three different pesticides (Merit 75 WSP Insecticide, Drive 75 DF Herbicide, and Cross Check Insecticide) were applied to the perimeter of the field with a Perma Green Ride-on Spreader.

**Special Sampling Equipment Head Space Results:** WOHL’s VOC head space analyses of the plastic ties, cloth apron bag, mesh waist belt and buckle are summarized in Appendix G. The cloth apron contained detectable levels of acetaldehyde, propanal, hexanal, nonanal, and octanal and trace levels of acrolein. The mesh belt contained acetaldehyde, 2-butenal, pentanal, hexanal, heptanal, and nonanal and trace levels of acrolein. A peak with NIST mass spectral library match for acrolein was detected in the cloth apron and mesh belt sample. These peaks were below the reporting limit of 20ppb and additional mass spectral peaks were present, including possible co-eluting compounds. Detectable levels of nonanal, decanal, and octanal were found in the plastic ties.
<table>
<thead>
<tr>
<th>Compound Name</th>
<th>Personal AFAP 3 ft</th>
<th>Personal 3 ft</th>
<th>On Turf 3 ft</th>
<th>Background 3 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,1,2,2-Tetrachloroethane</td>
<td>&lt;0.68</td>
<td>&lt;0.68</td>
<td>&lt;0.68</td>
<td>1.02</td>
</tr>
<tr>
<td>1,2,4-Trichlorobenzene</td>
<td>&lt;0.74</td>
<td>&lt;0.74</td>
<td>&lt;0.74</td>
<td>0.89</td>
</tr>
<tr>
<td>Acetone</td>
<td>52.17</td>
<td>33.20</td>
<td>12.33</td>
<td>12.33</td>
</tr>
<tr>
<td>Acrolein</td>
<td>1.95</td>
<td>1.40</td>
<td>&lt;1.15</td>
<td>&lt;1.15</td>
</tr>
<tr>
<td>Benzene</td>
<td>&lt;0.32</td>
<td>&lt;0.32</td>
<td>&lt;0.32</td>
<td>0.41</td>
</tr>
<tr>
<td>Bromoform</td>
<td>&lt;1.02</td>
<td>2.35</td>
<td>&lt;1.022</td>
<td>&lt;1.02</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>&lt;0.62</td>
<td>&lt;0.62</td>
<td>&lt;0.62</td>
<td>0.93</td>
</tr>
<tr>
<td>Chloromethane</td>
<td>1.57</td>
<td>1.55</td>
<td>1.45</td>
<td>1.33</td>
</tr>
<tr>
<td>Dichlorodifluoromethane</td>
<td>2.42</td>
<td>2.47</td>
<td>2.28</td>
<td>2.23</td>
</tr>
<tr>
<td>Ethyl Acetate</td>
<td>1.37</td>
<td>1.76</td>
<td>&lt;0.36</td>
<td>0.61</td>
</tr>
<tr>
<td>Halocarbon 11</td>
<td>1.85</td>
<td>1.79</td>
<td>1.74</td>
<td>1.96</td>
</tr>
<tr>
<td>Hexane</td>
<td>24.61</td>
<td>8.79</td>
<td>&lt;0.35</td>
<td>3.30</td>
</tr>
<tr>
<td>Methyl Ethyl Ketone</td>
<td>2.94</td>
<td>2.53</td>
<td>1.35</td>
<td>1.74</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>&lt;0.34</td>
<td>&lt;0.34</td>
<td>&lt;0.34</td>
<td>0.69</td>
</tr>
<tr>
<td>Propene</td>
<td>&lt;0.17</td>
<td>0.38</td>
<td>&lt;0.17</td>
<td>&lt;0.17</td>
</tr>
<tr>
<td>Toluene</td>
<td>1.58</td>
<td>1.92</td>
<td>&lt;0.38</td>
<td>0.75</td>
</tr>
<tr>
<td>Vinyl Acetate</td>
<td>1.23</td>
<td>1.13</td>
<td>&lt;0.35</td>
<td>1.02</td>
</tr>
<tr>
<td>Total VOCs</td>
<td>91.69</td>
<td>59.27</td>
<td>19.15</td>
<td>29.21</td>
</tr>
</tbody>
</table>

A tentative ID match for four compounds was made using the NIST Library in personal samples. No tentative ID matches were found in other areas. See Table 13.

AFAP= away from active play of study team members.

Total VOCs is the sum of all the concentrations that were detectable (does not include values less than reporting limit).
Table 8. Volatile Organic Compound (VOC) Concentrations in μg/m³ at Field B.
(personal and on-turf concentrations 2X higher than background are in bold)

<table>
<thead>
<tr>
<th>Compound Name</th>
<th>Personal AFAP 6 inch</th>
<th>Personal AFAP 3 ft</th>
<th>On Turf AFAP 6 inch</th>
<th>On Turf AFAP 3 ft</th>
<th>Background 3 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,2,4-Trimethyl Benzene</td>
<td>1.32</td>
<td>2.16</td>
<td>&lt;0.49</td>
<td>&lt;0.49</td>
<td>&lt;0.49</td>
</tr>
<tr>
<td>1,2-Dichloropropane</td>
<td>&lt;0.46</td>
<td>1.14</td>
<td>&lt;0.46</td>
<td>&lt;0.46</td>
<td>&lt;0.46</td>
</tr>
<tr>
<td>1,3,5-Trimethyl Benzene</td>
<td>&lt;0.49</td>
<td>1.37</td>
<td>&lt;0.49</td>
<td>&lt;0.49</td>
<td>&lt;0.49</td>
</tr>
<tr>
<td>1-Ethyl-4-Methyl Benzene</td>
<td>&lt;0.49</td>
<td>1.86</td>
<td>&lt;0.49</td>
<td>&lt;0.49</td>
<td>&lt;0.49</td>
</tr>
<tr>
<td>Acetone(^a)</td>
<td>13.75</td>
<td>34.74</td>
<td>3.93</td>
<td>3.65</td>
<td>4.01</td>
</tr>
<tr>
<td>Acrolein</td>
<td>1.58</td>
<td>3.66</td>
<td>&lt;1.15</td>
<td>&lt;1.15</td>
<td>&lt;1.15</td>
</tr>
<tr>
<td>Benzene</td>
<td>&lt; 0.32</td>
<td>1.56</td>
<td>&lt;0.32</td>
<td>&lt;0.32</td>
<td>&lt;0.32</td>
</tr>
<tr>
<td>Carbon Disulfide</td>
<td>&lt;0.31</td>
<td>0.47</td>
<td>&lt;0.31</td>
<td>&lt;0.31</td>
<td>&lt;0.31</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>0.68</td>
<td>&lt;0.68</td>
<td>0.75</td>
<td>0.81</td>
<td>0.75</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>&lt;0.46</td>
<td>0.78</td>
<td>&lt;0.46</td>
<td>&lt;0.46</td>
<td>&lt;0.46</td>
</tr>
<tr>
<td>Chloromethane</td>
<td>1.25</td>
<td>1.70</td>
<td>1.19</td>
<td>1.14</td>
<td>1.04</td>
</tr>
<tr>
<td>Cyclohexane</td>
<td>0.86</td>
<td>17.51</td>
<td>1.51</td>
<td>&lt;0.34</td>
<td>&lt;0.34</td>
</tr>
<tr>
<td>Dichlorodifluoromethane</td>
<td>2.42</td>
<td>2.13</td>
<td>2.52</td>
<td>2.57</td>
<td>2.42</td>
</tr>
<tr>
<td>Ethyl Acetate</td>
<td>1.30</td>
<td>11.87</td>
<td>&lt;0.36</td>
<td>&lt;0.36</td>
<td>&lt;0.36</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>&lt;0.43</td>
<td>4.29</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
</tr>
<tr>
<td>Halocarbon 11</td>
<td>1.46</td>
<td>1.40</td>
<td>1.51</td>
<td>1.51</td>
<td>1.51</td>
</tr>
<tr>
<td>Heptane</td>
<td>&lt;0.41</td>
<td>5.72</td>
<td>&lt;0.41</td>
<td>&lt;0.41</td>
<td>&lt;0.41</td>
</tr>
<tr>
<td>Hexane</td>
<td>&lt;0.35</td>
<td>31.29</td>
<td>&lt;0.35</td>
<td>&lt;0.35</td>
<td>0.88</td>
</tr>
<tr>
<td>M/P-Xylene</td>
<td>&lt;0.87</td>
<td>10.83</td>
<td>&lt;0.87</td>
<td>&lt;0.87</td>
<td>&lt;0.87</td>
</tr>
<tr>
<td>Methyl Ethyl Ketone</td>
<td>&lt;0.29</td>
<td>&lt;0.23</td>
<td>1.41</td>
<td>1.21</td>
<td>1.30</td>
</tr>
<tr>
<td>Methyl Isobutyl Ketone</td>
<td>2.33</td>
<td>3.39</td>
<td>&lt;2.04</td>
<td>&lt;2.04</td>
<td>&lt;2.04</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>&lt;0.34</td>
<td>14.08</td>
<td>&lt;0.34</td>
<td>&lt;0.34</td>
<td>&lt;0.34</td>
</tr>
<tr>
<td>O-Xylene</td>
<td>&lt;0.43</td>
<td>3.90</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
</tr>
<tr>
<td>Propene</td>
<td>0.5</td>
<td>0.89</td>
<td>&lt;0.17</td>
<td>&lt;0.17</td>
<td>&lt;0.17</td>
</tr>
<tr>
<td>Styrene</td>
<td>&lt;0.43</td>
<td>1.96</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
</tr>
<tr>
<td>Tetrachloroethylene</td>
<td>&lt;0.67</td>
<td>3.29</td>
<td>&lt;0.67</td>
<td>&lt;0.67</td>
<td>&lt;0.67</td>
</tr>
<tr>
<td>Tetrahydrofuran</td>
<td>&lt;1.48</td>
<td>2.47</td>
<td>&lt;1.5</td>
<td>&lt;1.5</td>
<td>&lt;1.5</td>
</tr>
<tr>
<td>Toluene</td>
<td>1.54</td>
<td>52.66</td>
<td>0.87</td>
<td>0.79</td>
<td>0.87</td>
</tr>
<tr>
<td>Trichloroethylene</td>
<td>&lt;0.53</td>
<td>23.39</td>
<td>&lt;0.53</td>
<td>&lt;0.53</td>
<td>&lt;0.53</td>
</tr>
<tr>
<td>Total VOCs(^c)</td>
<td>28.99</td>
<td>240.51</td>
<td>13.69</td>
<td>11.68</td>
<td>12.78</td>
</tr>
</tbody>
</table>

A tentative ID match for 16 compounds was made using the NIST Library in personal samples. See Table 12. There was one tentative ID match in a background sample. See Table 13.

AFAP= away from active play of study team members.
\(^a\)Acetone was detected in lab blank (1.5ppb) and all concentrations were corrected.
\(^c\)Total VOCs is the sum of all the concentrations that were detectable (does not include values less than reporting limit).
Table 9. Volatile Organic Compound (VOC) Concentrations in μg/m³ at Field C.
(personal and on-turf concentrations 2X higher than background are in bold)

<table>
<thead>
<tr>
<th>Compound Name</th>
<th>Personal</th>
<th>Personal</th>
<th>On Turf 6 inch AFAP</th>
<th>On Turf 3 ft AFAP</th>
<th>Background 3 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,1,2,2-Tetrachloroethane</td>
<td>&lt;0.68</td>
<td>&lt;0.68</td>
<td>&lt;0.68</td>
<td>&lt;0.68</td>
<td>1.09</td>
</tr>
<tr>
<td>1,1,2-Trichlorotrifluoromethane</td>
<td>&lt;0.78</td>
<td>&lt;0.78</td>
<td>&lt;0.78</td>
<td>0.76</td>
<td>1.99</td>
</tr>
<tr>
<td>1,1-Dichloroethane</td>
<td>&lt;0.40</td>
<td>&lt;0.40</td>
<td>&lt;0.40</td>
<td>&lt;0.40</td>
<td>0.80</td>
</tr>
<tr>
<td>1,1-Dichloroethene</td>
<td>&lt;0.40</td>
<td>&lt;0.40</td>
<td>&lt;0.40</td>
<td>&lt;0.40</td>
<td>0.63</td>
</tr>
<tr>
<td>1,2-Dibromoethane</td>
<td>&lt;0.80</td>
<td>&lt;0.80</td>
<td>&lt;0.80</td>
<td>&lt;0.80</td>
<td>1.84</td>
</tr>
<tr>
<td>1,3-Butadiene</td>
<td>&lt;0.22</td>
<td>&lt;0.22</td>
<td>&lt;0.22</td>
<td>&lt;0.22</td>
<td>0.38</td>
</tr>
<tr>
<td>1,2-Dichlorobenzene</td>
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<td>&lt;0.60</td>
<td>&lt;0.60</td>
<td>&lt;0.60</td>
<td>1.37</td>
</tr>
<tr>
<td>1,3-Dichlorobenzene</td>
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<td>&lt;0.60</td>
<td>&lt;0.60</td>
<td>&lt;0.60</td>
<td>1.37</td>
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<tr>
<td>1,4-Dichlobenzene</td>
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<td>&lt;0.60</td>
<td>&lt;0.60</td>
<td>&lt;0.60</td>
<td>1.37</td>
</tr>
<tr>
<td>Acetone</td>
<td>30.83</td>
<td>26.08</td>
<td>23.71</td>
<td>10.67</td>
<td>11.14</td>
</tr>
<tr>
<td>Benzene</td>
<td>0.61</td>
<td>0.57</td>
<td>0.54</td>
<td>0.54</td>
<td>0.92</td>
</tr>
<tr>
<td>Bromoform</td>
<td>1.94</td>
<td>&lt;1.02</td>
<td>&lt;1.02</td>
<td>&lt;1.02</td>
<td>1.74</td>
</tr>
<tr>
<td>Bromomethane</td>
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<td>&lt;0.38</td>
<td>&lt;0.38</td>
<td>&lt;0.38</td>
<td>0.69</td>
</tr>
<tr>
<td>Carbon Disulfide</td>
<td>&lt;0.31</td>
<td>0.50</td>
<td>&lt;0.31</td>
<td>&lt;0.31</td>
<td>0.62</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>0.68</td>
<td>&lt;0.62</td>
<td>0.87</td>
<td>0.93</td>
<td>1.43</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>&lt;0.49</td>
<td>&lt;0.49</td>
<td>&lt;0.49</td>
<td>&lt;0.49</td>
<td>1.10</td>
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<tr>
<td>Chloroethane</td>
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<td>&lt;0.26</td>
<td>&lt;0.26</td>
<td>&lt;0.26</td>
<td>0.55</td>
</tr>
<tr>
<td>Chloromethane</td>
<td>0.70</td>
<td>0.63</td>
<td>1.00</td>
<td>1.06</td>
<td>1.02</td>
</tr>
<tr>
<td>Cis-1,3-Dichloropropene</td>
<td>&lt;0.45</td>
<td>&lt;0.45</td>
<td>&lt;0.45</td>
<td>&lt;0.45</td>
<td>0.99</td>
</tr>
<tr>
<td>Cyclohexane</td>
<td>0.62</td>
<td>&lt;0.34</td>
<td>&lt;0.34</td>
<td>&lt;0.34</td>
<td>&lt;0.34</td>
</tr>
<tr>
<td>Dibromochloromethane</td>
<td>&lt;0.84</td>
<td>&lt;0.84</td>
<td>&lt;0.84</td>
<td>&lt;0.84</td>
<td>1.85</td>
</tr>
<tr>
<td>Dichlorodifluoromethane</td>
<td>1.43</td>
<td>1.19</td>
<td>2.23</td>
<td>2.42</td>
<td>2.33</td>
</tr>
<tr>
<td>Ethyl Acetate</td>
<td>&lt;0.36</td>
<td>0.61</td>
<td>&lt;0.36</td>
<td>&lt;0.36</td>
<td>&lt;0.36</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>1.21</td>
</tr>
<tr>
<td>Halocarbon 11</td>
<td>1.01</td>
<td>0.84</td>
<td>1.51</td>
<td>1.62</td>
<td>2.46</td>
</tr>
<tr>
<td>Heptane</td>
<td>0.49</td>
<td>&lt;0.41</td>
<td>&lt;0.41</td>
<td>&lt;0.41</td>
<td>&lt;0.41</td>
</tr>
<tr>
<td>Hexane</td>
<td>3.48</td>
<td>0.63</td>
<td>0.87</td>
<td>0.49</td>
<td>1.02</td>
</tr>
<tr>
<td>Methyl Ethyl Ketone</td>
<td>2.06</td>
<td>1.83</td>
<td>1.62</td>
<td>2.03</td>
<td>1.53</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>1.20</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>0.76</td>
</tr>
<tr>
<td>M/P-Xylene</td>
<td>1.56</td>
<td>&lt;0.66</td>
<td>&lt;0.66</td>
<td>&lt;0.66</td>
<td>1.78</td>
</tr>
<tr>
<td>o-Xylene</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>0.91</td>
</tr>
<tr>
<td>Propene</td>
<td>0.34</td>
<td>0.24</td>
<td>&lt;0.17</td>
<td>&lt;0.17</td>
<td>&lt;0.17</td>
</tr>
<tr>
<td>Styrene</td>
<td>&lt;0.42</td>
<td>&lt;0.42</td>
<td>&lt;0.42</td>
<td>&lt;0.42</td>
<td>0.94</td>
</tr>
<tr>
<td>Tetrachloroethylene</td>
<td>&lt;0.67</td>
<td>&lt;0.67</td>
<td>&lt;0.67</td>
<td>&lt;0.67</td>
<td>1.27</td>
</tr>
<tr>
<td>Toluene</td>
<td>4.89</td>
<td>1.77</td>
<td>1.13</td>
<td>1.13</td>
<td>1.54</td>
</tr>
<tr>
<td>Trans-1,2-Dichloroethylene</td>
<td>&lt;0.39</td>
<td>&lt;0.39</td>
<td>&lt;0.39</td>
<td>&lt;0.39</td>
<td>0.82</td>
</tr>
<tr>
<td>Vinyl Chloride</td>
<td>&lt;0.25</td>
<td>&lt;0.25</td>
<td>&lt;0.25</td>
<td>&lt;0.25</td>
<td>0.48</td>
</tr>
<tr>
<td>Total VOCs</td>
<td>51.84</td>
<td>34.89</td>
<td>33.48</td>
<td>21.66</td>
<td>48.43</td>
</tr>
</tbody>
</table>

A tentative ID match for 5 compounds was made using the NIST Library in personal samples. No tentative ID matches for compounds were found in other areas. See Table 13.
AFAP= away from active play of study team members.
*Total VOCs is the sum of all the concentrations that were detectable (does not include values less than reporting limit).
Table 10. Volatile Organic Compound (VOC) Concentrations in $\mu g/m^3$ at Field D.  
(personal and on-turf concentrations 2X higher than background are in bold)

<table>
<thead>
<tr>
<th>Compound Name</th>
<th>Personal Concentration</th>
<th>Personal Concentration</th>
<th>On Turf 6 inch AFAP</th>
<th>On Turf 3 ft AFAP</th>
<th>Background 3 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,2,4-Trimethyl Benzene</td>
<td>1.37</td>
<td>&lt;0.49</td>
<td>&lt;0.49</td>
<td>&lt;0.49</td>
<td>&lt;0.49</td>
</tr>
<tr>
<td>Acetone</td>
<td>28.45</td>
<td>23.71</td>
<td>5.69</td>
<td>6.64</td>
<td>7.35</td>
</tr>
<tr>
<td>Bromoform</td>
<td>1.02</td>
<td>13.29</td>
<td>1.02</td>
<td>1.02</td>
<td>1.02</td>
</tr>
<tr>
<td>Chloromethane</td>
<td>0.98</td>
<td>1.06</td>
<td>1.10</td>
<td>1.08</td>
<td>1.06</td>
</tr>
<tr>
<td>Dichlorodifluoromethane</td>
<td>2.23</td>
<td>2.33</td>
<td>2.42</td>
<td>2.47</td>
<td>2.47</td>
</tr>
<tr>
<td>Ethyl Acetate</td>
<td>1.15</td>
<td>1.22</td>
<td>&lt;0.36</td>
<td>&lt;0.36</td>
<td>&lt;0.36</td>
</tr>
<tr>
<td>Halocarbon 11</td>
<td>1.40</td>
<td>1.40</td>
<td>1.40</td>
<td>1.46</td>
<td>1.46</td>
</tr>
<tr>
<td>Heptane</td>
<td>0.65</td>
<td>0.70</td>
<td>&lt;0.41</td>
<td>&lt;0.41</td>
<td>&lt;0.41</td>
</tr>
<tr>
<td>Hexane</td>
<td>0.77</td>
<td>0.77</td>
<td>&lt;0.35</td>
<td>&lt;0.35</td>
<td>&lt;0.35</td>
</tr>
<tr>
<td>Methyl Ethyl Ketone</td>
<td>1.59</td>
<td>1.44</td>
<td>1.09</td>
<td>1.12</td>
<td>1.06</td>
</tr>
<tr>
<td>Methyl Isobutyl Ketone</td>
<td>2.66</td>
<td>2.29</td>
<td>&lt;2.04</td>
<td>&lt;2.04</td>
<td>&lt;2.04</td>
</tr>
<tr>
<td>Propene</td>
<td>0.48</td>
<td>0.50</td>
<td>&lt;0.17</td>
<td>&lt;0.17</td>
<td>&lt;0.17</td>
</tr>
<tr>
<td>Toluene</td>
<td>1.39</td>
<td>1.47</td>
<td>0.71</td>
<td>&lt;0.38</td>
<td>&lt;0.38</td>
</tr>
<tr>
<td>Total VOCs</td>
<td>44.14</td>
<td>50.18</td>
<td>13.43</td>
<td>13.79</td>
<td>15.47</td>
</tr>
</tbody>
</table>

A tentative ID match for 6 compounds was made using the NIST Library in personal samples. There were tentative ID matches 3 feet above the turf and in the background area. See Table 13.

AFAP= away from active play of study team members.

*Total VOCs is the sum of all the concentrations that were detectable (does not include values less than reporting limit).
Table 11. Volatile Organic Compound (VOC) Concentrations in μg/m³ at Field K. (personal and on-turf concentrations 2X higher than background are in bold)

<table>
<thead>
<tr>
<th>Compound Name</th>
<th>Personal 6 inch AFAP</th>
<th>Personal 3 ft AFAP</th>
<th>On Turf 6 inch AFAP</th>
<th>On Turf 3 ft AFAP</th>
<th>Background 3 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,1,-2-Trichlorotrifluoroethane</td>
<td>0.54</td>
<td>0.54</td>
<td>0.54</td>
<td>0.54</td>
<td>1.53</td>
</tr>
<tr>
<td>1,1,2-Trichloroethane</td>
<td>0.54</td>
<td>0.54</td>
<td>0.54</td>
<td>0.54</td>
<td>0.76</td>
</tr>
<tr>
<td>1,2-Dichloropropane</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>0.69</td>
</tr>
<tr>
<td>1,2,4-Trimethyl Benzene</td>
<td>1.28</td>
<td>2.11</td>
<td>0.49</td>
<td>0.49</td>
<td>&lt;0.49</td>
</tr>
<tr>
<td>1,2-Dichloroethane</td>
<td>1.04</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>0.68</td>
</tr>
<tr>
<td>1,3,5-Trimethyl Benzene</td>
<td>0.49</td>
<td>1.18</td>
<td>0.49</td>
<td>0.49</td>
<td>&lt;0.49</td>
</tr>
<tr>
<td>1-Ethyl-4-Methyl Benzene</td>
<td>0.49</td>
<td>1.37</td>
<td>0.49</td>
<td>0.49</td>
<td>&lt;0.49</td>
</tr>
<tr>
<td>Acetone</td>
<td>92.48</td>
<td>1.19</td>
<td>17.01</td>
<td>12.33</td>
<td>9.25</td>
</tr>
<tr>
<td>Acrolein</td>
<td>3.66</td>
<td>3.89</td>
<td>&lt;1.15</td>
<td>1.15</td>
<td>1.15</td>
</tr>
<tr>
<td>Benzene</td>
<td>1.15</td>
<td>1.18</td>
<td>&lt;0.32</td>
<td>0.32</td>
<td>0.64</td>
</tr>
<tr>
<td>Bromodichloromethane</td>
<td>0.62</td>
<td>&lt;0.62</td>
<td>&lt;0.66</td>
<td>&lt;0.66</td>
<td>0.66</td>
</tr>
<tr>
<td>Bromoform</td>
<td>34.75</td>
<td>&lt;1.02</td>
<td>&lt;1.02</td>
<td>1.02</td>
<td>&lt;1.02</td>
</tr>
<tr>
<td>Carbon Disulfide</td>
<td>0.87</td>
<td>0.84</td>
<td>0.90</td>
<td>0.90</td>
<td>&lt;0.31</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>&lt;0.62</td>
<td>&lt;0.62</td>
<td>&lt;0.62</td>
<td>1.30</td>
<td>0.68</td>
</tr>
<tr>
<td>Chloroform</td>
<td>0.48</td>
<td>&lt;0.48</td>
<td>&lt;0.48</td>
<td>&lt;0.48</td>
<td>0.68</td>
</tr>
<tr>
<td>Chloromethane</td>
<td>1.57</td>
<td>1.45</td>
<td>1.17</td>
<td>1.23</td>
<td>1.21</td>
</tr>
<tr>
<td>Cyclohexane</td>
<td>10.30</td>
<td>7.21</td>
<td>0.82</td>
<td>0.82</td>
<td>&lt;0.34</td>
</tr>
<tr>
<td>Dichlorodifluoromethane</td>
<td>3.02</td>
<td>2.87</td>
<td>2.77</td>
<td>2.87</td>
<td>2.72</td>
</tr>
<tr>
<td>Ethyl Acetate</td>
<td>10.07</td>
<td>11.87</td>
<td>&lt;0.36</td>
<td>&lt;0.36</td>
<td>&lt;0.36</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>4.77</td>
<td>4.77</td>
<td>1.00</td>
<td>1.04</td>
<td>&lt;0.95</td>
</tr>
<tr>
<td>Halocarbon 11</td>
<td>2.07</td>
<td>1.96</td>
<td>1.90</td>
<td>2.02</td>
<td>2.41</td>
</tr>
<tr>
<td>Heptane</td>
<td>10.22</td>
<td>7.36</td>
<td>0.98</td>
<td>0.98</td>
<td>0.53</td>
</tr>
<tr>
<td>Hexane</td>
<td>11.25</td>
<td>10.90</td>
<td>7.38</td>
<td>7.38</td>
<td>9.4</td>
</tr>
<tr>
<td>M/P-Xylene</td>
<td>12.13</td>
<td>11.70</td>
<td>2.17</td>
<td>2.17</td>
<td>&lt;0.87</td>
</tr>
<tr>
<td>Methyl Ethyl Ketone</td>
<td>44.15</td>
<td>44.15</td>
<td>2.09</td>
<td>2.00</td>
<td>1.83</td>
</tr>
<tr>
<td>Methyl Isobutyl Ketone</td>
<td>20.44</td>
<td>22.08</td>
<td>35.98</td>
<td>35.98</td>
<td>&lt;0.29</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>10.30</td>
<td>9.96</td>
<td>1.10</td>
<td>1.17</td>
<td>1.10</td>
</tr>
<tr>
<td>O-Xylene</td>
<td>3.42</td>
<td>4.03</td>
<td>0.87</td>
<td>0.91</td>
<td>&lt;0.43</td>
</tr>
<tr>
<td>Propene</td>
<td>0.76</td>
<td>0.72</td>
<td>&lt;0.17</td>
<td>0.17</td>
<td>&lt;0.17</td>
</tr>
<tr>
<td>Styrene</td>
<td>1.45</td>
<td>3.53</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
</tr>
<tr>
<td>Tetrachloroethylene</td>
<td>1.34</td>
<td>1.14</td>
<td>&lt;0.67</td>
<td>&lt;0.67</td>
<td>0.94</td>
</tr>
<tr>
<td>Tetrahydrofuran</td>
<td>3.83</td>
<td>3.24</td>
<td>&lt;1.42</td>
<td>&lt;1.42</td>
<td>&lt;1.47</td>
</tr>
<tr>
<td>Toluene</td>
<td>135.4</td>
<td>127.88</td>
<td>2.78</td>
<td>2.82</td>
<td>1.09</td>
</tr>
<tr>
<td>Trichloroethylene</td>
<td>2.23</td>
<td>2.13</td>
<td>&lt;0.53</td>
<td>&lt;0.53</td>
<td>&lt;0.53</td>
</tr>
<tr>
<td>Vinyl Acetate</td>
<td>&lt;0.35</td>
<td>2.95</td>
<td>&lt;0.35</td>
<td>&lt;0.35</td>
<td>&lt;0.35</td>
</tr>
<tr>
<td>Total VOCs</td>
<td>424.27</td>
<td>292.47</td>
<td>78.92</td>
<td>71.80</td>
<td>36.76</td>
</tr>
</tbody>
</table>

A tentative ID match for 10 compounds was made using the NIST Library in personal samples. There were tentative ID matches for 5 compounds on turf and no matches were found in the background area. See Table 13.

aConcentration is an estimate. The value is above the upper calibration range.

AFAP= away from active play of study team members.

Total VOCs is the sum of all the concentrations that were detectable (does not include values less than reporting limit).
### Table 12. Volatile Organic Compounds (VOC) Concentrations in μg/m³ at Field L.

<table>
<thead>
<tr>
<th>Compound Name</th>
<th>VOC Concentration (μg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>7.11</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>0.75</td>
</tr>
<tr>
<td>Chloromethane</td>
<td>1.19</td>
</tr>
<tr>
<td>Dichlorodifluoromethane</td>
<td>2.28</td>
</tr>
<tr>
<td>Halocarbon 11</td>
<td>1.46</td>
</tr>
<tr>
<td>Hexane</td>
<td>7.38</td>
</tr>
<tr>
<td>Methyl Ethyl Ketone</td>
<td>1.41</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>0.48</td>
</tr>
<tr>
<td>Propene</td>
<td>0.48</td>
</tr>
<tr>
<td>Toluene</td>
<td>0.90</td>
</tr>
<tr>
<td>Total VOCs</td>
<td>23.44</td>
</tr>
</tbody>
</table>

No tentative ID matches for additional compounds were found using the NIST Library.

*Total VOCs is the sum of all the concentrations that were detectable (does not include values less than reporting limit).

### Table 13. Tentative identification of VOCs in personal, on-turf and background areas matched with the NIST Library at all fields (A-D, K-L).

<table>
<thead>
<tr>
<th>Chemicals</th>
<th>Fields Personal (height of sample)</th>
<th>Fields On-Turf</th>
<th>Fields (Background)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Bromo-propane</td>
<td>B, K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-Chloro-1,1-</td>
<td>K</td>
<td>K (3')</td>
<td></td>
</tr>
<tr>
<td>Difluoroethane</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,1-Difluoroethane</td>
<td>B</td>
<td>B (6” and 3’)</td>
<td>B (3’)</td>
</tr>
<tr>
<td>1,2-diethylbenzene</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-Methyl Butane</td>
<td>B, K</td>
<td>D, K (3’)</td>
<td></td>
</tr>
<tr>
<td>2-Methyl Pentane</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-Methyl Hexane</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-Methyl Pentane</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,3-Pentadiene</td>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1R-Alpha-Pinene</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acetaldehyde</td>
<td>A, B, C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acetonitrile</td>
<td>B, K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beta-Pinene</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Butane</td>
<td></td>
<td>K (6” and 3’)</td>
<td></td>
</tr>
<tr>
<td>D-Limonen</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethanol</td>
<td>K</td>
<td>K (6”)</td>
<td></td>
</tr>
<tr>
<td>Ethyl Alcohol</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluorobenzene</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hexanal</td>
<td>B, K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isobutane</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isobutene</td>
<td>K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isopropyl Alcohol</td>
<td>A, B, C, D, K</td>
<td>K (6” and 3’)</td>
<td></td>
</tr>
<tr>
<td>Methyl-Cyclopentane</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonanal</td>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Octamethyl –</td>
<td>D</td>
<td>D (3’)</td>
<td>D (3’)</td>
</tr>
<tr>
<td>Cyclotetrasiloxane</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Octanal</td>
<td>A, B, C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pentane</td>
<td>B, C, K</td>
<td>K (6” and 3’)</td>
<td></td>
</tr>
</tbody>
</table>
### 3.4.2 Semi-Volatile Organic Compounds (SVOCs)

An SVOC is any organic compound having a vapor pressure of 1 mmHg or less at standard conditions (293 K and 760 mmHg). Three categories of SVOCs were included in this investigation: 1) polyaromatic hydrocarbons (PAHs), 2) miscellaneous SVOCs associated with air pollution such as alkanoic acids (sources include road dust), hopanes/steranes (sources include diesel and gasoline vehicles), and other general compounds such as branched/n-alkanes \(^{[16]}\) and 3) five targeted rubber-related SVOCs: benzothiazole, 2-mercaptobenzothiazole, 4-tert-(octyl-phenol, butylated hydroxanisole (BHA), and butylated hydroxytoluene (BHT).

**PAHs and Miscellaneous SVOCs Area Sampling:** PAHs and miscellaneous SVOCs associated with air pollution were collected with Polyurethane Foam Samplers (PS-1, Anderson Instruments, Inc., GA) according to EPA Method TO-13A. Air samples were collected for two hours at flow rates ranging from 207-237 liters per minute (lpm). At Field D, additional air sampling was conducted for 6 hours at flow rates ranging from 209-226 lpm. Samplers were placed on the turf near the middle of each field and in a location upwind and off the turf field (background). All of the samples were collected at a height of approximately 4 feet. The same sampler was used for each designated location (background or on-turf) at all fields. Several extension cords (100-150ft) were used to supply power to samplers from buildings near the sampling fields. The motor of each sampler was exhausted downwind and away from sampling equipment with a 15 foot flexible duct.

Sampler magnehelic gauges were calibrated for each sampling event using a calibrated critical orifice as a transfer standard. The orifices were connected to a slack tube manometer in the UCHC office in Farmington, CT. Manometer and magnehelic gauge readings were recorded, and flow rates were compared to the WOHL calibrations measurements recorded in the WOHL laboratory. Measurements were within ±10% of one another. Calibration flow verifications were performed after use to ensure that the calculated magnehelic set point was accurate. Prior to each sampling event, sampling heads and samplers were cleaned with hexane.

Sampling heads were loaded with cylindrical glass PUF (polyurethane foam)/XAD-2 cartridge (PUF Plug Part #20038, Supelco, Bellefonte, PA) and filter (Whatman Quartz Microfiber Filters, 102 mm, NJ) in UCHC office. After loading, each head was placed in a ziplock bag, then placed in a travel bag, and transported to the field. In the field, samplers were turned on for five minutes. Leak checks were conducted on site prior to sampling. Sampling heads were placed in the PS-1 samplers and magnehelic gauge measurements were recorded on site at the beginning and end of sampling. Magnehelic gauge measurements were the same at the beginning and end of sampling at all fields. Sampling heads were transported to UCHC on ice. Media was processed out of the sampling heads and placed in glass jars at UCHC. All samples were shipped to WOHL/WSLH on ice on the same day as sampling.

During 2 hour sampling at Field D on July 14, 2009, the PS-1 Sampler was turned on for approximately ten minutes without the valve open (sample 217-background). Site coordinator corrected the problem, checked for air leaks, re-tightened seals, and re-checked for air leaks. During the 6-hour sampling session on July 28 at Field D, power was lost for approximately ten minutes (sample 221-background). The site coordinator reported the power problem, and facilities corrected it.

A total of 12 field samples were collected. The first set of samples collected from Field L (community) broke during shipment to WOHL/WSLH. Shipping procedures were modified to place the glass cartridges in foam and extra wrapping. Unfortunately, glass PUF/XAD cartridges broke during transportation of the media to UCHC and insufficient sampling media was available to collect samples from Fields B and C (upwind background location only). It was not possible to reschedule these sampling events to collect more data. Ten field samples were analyzed.

**Sample Preparation and Analysis:** Samples were prepared and analyzed according to EPA Method TO-13 by WSLH. All samples had all internal standards spiked pre-extraction. A rotovap was used in place of a K-D concentrator. Other parameters include: inlet temp 300 C, flow 1.0 ml/min, and average velocity 37cm/sec. Initial oven temperature 65C hold for 10 min, ramp up at 10 C/min until 300 C, then hold at 300 C for 26.50 minutes. Although laboratory spike recoveries of benzothiazole were acceptable on the PUF/XAD media, low levels of benzothiazole were observed in the high volume field samples in comparison to the personal sampler benzothiazole method. Since collection efficiency is unknown for benzothiazole on high volume sampler media, the high volume sampler results were determined to be non-reportable.
If an analyte in the method blank was greater than its reporting limit, the result for that analyte was flagged to indicate blank contamination. Concentrations were corrected for any blank contamination. Extraction of most chemicals was complete ranging from 75 to 125% as specified by the EPA Method TO-13A. Final concentrations were adjusted by extraction recoveries for analytes below 75% (Appendix H). Concentrations with recoveries exceeding 125% are not adjusted.

**Results:** Tables 1-6 in Appendix I provide the SVOC concentrations for Fields A-D and K. Final SVOC concentrations are reported as nanogram per cubic meter (ng/m$^3$). Analytes not detected are reported as nondetectable (ND). Target analytes positively detected but too far below the reporting limit are reported as DNQ. Values for analyte concentrations confirmed but measured below the reporting limit are reported with the footnote “a”. Values for analyte concentrations corrected by extraction recoveries are reported with the footnote “b”.

**SVOCs Six Hour vs. Two Hour Sampling Method:** Our sampling strategy included a 2 hour sampling time because it represents a typical activity period for athletes using turf fields. At Field D, an extra day of sampling was conducted for 6 hours using EPA Method TO-13A to increase the sensitivity (Tables 3 and 4 in Appendix I). The results suggest that the 2 hour sampling time period allowed for the collection of useful data. During both the 2 and 6 hour sampling periods, similar patterns were observed-nearly half of the SVOCs were either not detected or they were found in greater concentrations on turf than in background locations. Although additional PAHs were detected on turf during the 6 hour sampling (e.g. benz(a)anthracene, benzo(b)fluoranthene, benzo(e)pyrene, benzo(ghi)perylene, benzo(k)fluoranthene), their concentrations on turf were similar to background concentrations. Eight miscellaneous SVOCs were not detected during the 2 hour sampling but were reported with two fold greater concentrations on the turf than in background during the 6 hour sampling period (e.g. decycloclohexane, dodecane, dotriacontane, octacosane, pristine, tetracontane, triacontane, trihiacontane).
Polyaromatic Hydrocarbons
The EPA Method TO-13A includes qualitative and quantitative analyses for certain categories of compounds, such as PAHs. The concentrations of PAHs are provided in Tables 14-16. Because PAHs may be found in crumb rubber made from tires, the following 22 were targeted:

Acenaphthene
Acenaphthylene
Anthracene
Benz(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(e)pyrene
Benzo(GHI)perylene
Benzo(k)fluoranthene
Chrysene
Coronene
Dibenz(a,h)anthracene

Table 14. PAH concentrations in ng/m³ at Fields A-C (ng/m³).
(on-turf concentrations 2X higher than background are in bold for field A only)

<table>
<thead>
<tr>
<th>PAHs</th>
<th>Field A On Turf</th>
<th>SVOC Concentrations ng/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Field A Background</td>
<td>Field B On Turf</td>
</tr>
<tr>
<td>Acenaphthene</td>
<td>2.14</td>
<td>2.95</td>
</tr>
<tr>
<td>Benz(a)anthracene</td>
<td>ND</td>
<td>&lt;0.36</td>
</tr>
<tr>
<td>Benzo(b)fluoranthene</td>
<td>ND</td>
<td>&lt;0.65</td>
</tr>
<tr>
<td>Benzo(e)pyrene</td>
<td>ND</td>
<td>&lt;0.21</td>
</tr>
<tr>
<td>Benzo(GHI)perylene</td>
<td>ND</td>
<td>&lt;0.35</td>
</tr>
<tr>
<td>Benzo(k)fluoranthene</td>
<td>ND</td>
<td>&lt;0.32</td>
</tr>
<tr>
<td>Chrysene</td>
<td>ND</td>
<td>&lt;0.26</td>
</tr>
<tr>
<td>Fluoranthene</td>
<td>1.68</td>
<td>1.474</td>
</tr>
<tr>
<td>Fluorene</td>
<td>2.21&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.87&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>5.99</td>
<td>7.72</td>
</tr>
<tr>
<td>Phenanthrene</td>
<td>5.07</td>
<td>6.35</td>
</tr>
<tr>
<td>Pyrene</td>
<td>1.70</td>
<td>1.01</td>
</tr>
<tr>
<td>1-Methylnaphthalene</td>
<td>3.96&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.34&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>2,6-Dimethylnaphthalene</td>
<td>2.83</td>
<td>4.47</td>
</tr>
</tbody>
</table>

Abbreviations: ND= analytes not detected. DNQ= analytes positively detected but too far below the reporting limit.
<sup>a</sup>Values for analyte concentrations confirmed but measured below the reporting limit.
<sup>b</sup>Values for analyte concentrations corrected by extraction recoveries. See Appendix F.
Table 15. PAH concentrations in ng/m³ at Field D (2 and 6 hour sampling). (on-turf concentrations 2X higher than background are in bold)

<table>
<thead>
<tr>
<th>PAHs</th>
<th>Field D On Turf (2 hour)</th>
<th>Field D Background (2 hour)</th>
<th>Field D On Turf (6 hour)</th>
<th>Field D Background (6 hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acenaphthene</td>
<td>3.38 b</td>
<td>2.95 b</td>
<td>2.79 b</td>
<td>2.47 b</td>
</tr>
<tr>
<td>Acenaphthylene</td>
<td>6.60 g</td>
<td>ND &lt;0.22</td>
<td>ND &lt;0.22</td>
<td>ND &lt;0.07</td>
</tr>
<tr>
<td>Anthracene</td>
<td>ND &lt;0.22</td>
<td>ND &lt;0.22</td>
<td>ND &lt;0.22</td>
<td>ND &lt;0.07</td>
</tr>
<tr>
<td>Benz(a)anthracene</td>
<td>ND &lt;0.42</td>
<td>ND &lt;0.42</td>
<td>0.04 a</td>
<td>0.03</td>
</tr>
<tr>
<td>Benzo(a)pyrene</td>
<td>ND &lt;0.23</td>
<td>ND &lt;0.23</td>
<td>0.07 a</td>
<td>0.05 a</td>
</tr>
<tr>
<td>Benzo(b)fluoranthene</td>
<td>ND &lt;0.75</td>
<td>ND &lt;0.76</td>
<td>0.07 a</td>
<td>0.07 a</td>
</tr>
<tr>
<td>Benzo(e)pyrene</td>
<td>ND &lt;0.24</td>
<td>ND &lt;0.25</td>
<td>0.07 a</td>
<td>0.06 a</td>
</tr>
<tr>
<td>Benzo(GHI)fluoranthene</td>
<td>DNQ</td>
<td>ND &lt;0.41</td>
<td>0.02 a</td>
<td>ND &lt;0.13</td>
</tr>
<tr>
<td>Benzo(GHI)pyrene</td>
<td>ND &lt;0.67</td>
<td>ND &lt;0.69</td>
<td>0.04 a</td>
<td>0.06 a</td>
</tr>
<tr>
<td>Benzo(k)fluoranthene</td>
<td>ND &lt;0.37</td>
<td>ND &lt;0.38</td>
<td>0.05 a</td>
<td>0.04 a</td>
</tr>
<tr>
<td>Chrysene</td>
<td>0.30</td>
<td>0.07 a</td>
<td>0.12</td>
<td>0.08 a</td>
</tr>
<tr>
<td>Fluoranthene</td>
<td>6.76</td>
<td>1.19</td>
<td>2.26</td>
<td>3.96</td>
</tr>
<tr>
<td>Fluorene</td>
<td>3.65 b</td>
<td>3.59 b</td>
<td>2.93 b</td>
<td>2.43 b</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>6.32</td>
<td>4.51</td>
<td>14.34</td>
<td>16.94</td>
</tr>
<tr>
<td>Phenanthrene</td>
<td>14.34</td>
<td>6.11</td>
<td>11.48</td>
<td>13.05</td>
</tr>
<tr>
<td>Pyrene</td>
<td>6.92</td>
<td>0.47</td>
<td>2.42</td>
<td>3.16</td>
</tr>
<tr>
<td>1-Methylnaphthalene</td>
<td>9.31 b</td>
<td>4.08 b</td>
<td>8.31 b</td>
<td>6.91 b</td>
</tr>
<tr>
<td>2,6-Dimethylnaphthalene</td>
<td>4.237 b</td>
<td>2.16 b</td>
<td>3.76 b</td>
<td>3.31 b</td>
</tr>
<tr>
<td>2-Methylnaphthalene</td>
<td>ND &lt;0.95</td>
<td>ND &lt;0.97</td>
<td>7.65</td>
<td>6.13</td>
</tr>
</tbody>
</table>

Abbreviations: ND= analytes not detected. DNQ= analytes positively detected but too far below the reporting limit.

*Values for analyte concentrations confirmed but measured below the reporting limit.

bValues for analyte concentrations corrected by extraction recoveries. See Appendix F.

Table 16. PAH concentrations in ng/m³ at Field K. (on-turf concentrations 2X higher than background are in bold)

<table>
<thead>
<tr>
<th>PAHs</th>
<th>Field K On Turf</th>
<th>Field K Background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acenaphthene</td>
<td>17.37 b</td>
<td>3.99 a</td>
</tr>
<tr>
<td>Acenaphthylene</td>
<td>6.79</td>
<td>ND</td>
</tr>
<tr>
<td>Chrysene</td>
<td>ND &lt;0.26</td>
<td>0.04 a</td>
</tr>
<tr>
<td>Fluoranthene</td>
<td>5.55</td>
<td>0.58</td>
</tr>
<tr>
<td>Fluorene</td>
<td>53.70 b</td>
<td>3.42 b</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>112.99</td>
<td>7.05</td>
</tr>
<tr>
<td>Phenanthrene</td>
<td>32.26</td>
<td>7.56</td>
</tr>
<tr>
<td>Pyrene</td>
<td>11.84</td>
<td>0.37</td>
</tr>
<tr>
<td>1-Methylnaphthalene</td>
<td>114.20 b</td>
<td>6.16 b</td>
</tr>
<tr>
<td>2,6-Dimethylnaphthalene</td>
<td>28.70</td>
<td>10.37</td>
</tr>
<tr>
<td>2-Methylnaphthalene</td>
<td>63.38 b</td>
<td>2.72 b</td>
</tr>
</tbody>
</table>

Abbreviations: ND= analytes not detected.

aValues for analyte concentrations confirmed but measured below the reporting limit.

bValues for analyte concentrations corrected by extraction recoveries. See Appendix F.

*Not in calibration standard mix but is quantitated.
3.4.2.3 Targeted Rubber-Related SVOCs

Air Sampling: Personal and area air samples were collected for the following five rubber-related SVOCs: benzothiazole, 2-mercaptobenzothiazole, 4-tert-(octyl)-phenol, butylated hydroxanisole (BHA), and butylated hydroxytoluene (BHT). Air samples for these compounds were collected using sampling pumps fit with XAD-2 adsorbent media and 37mm, 2 micron PTFE pre-filters. The pumps were pre and post calibrated for approximately 2 liters per minute (LPM). The samples were collected for two hours.

At Fields A-D and K, the personal samples were collected by placing the pumps at waist-height on two study team members involved in active play. Two area samples were collected at 6 inches and 3 feet above the ground at the following locations: on the field near active play (NAP), on the field away from active play (AFAP), and at the upwind background location. At Field L, an area sample was collected at 3 feet. At Field D during the six hour sampling event, two on field air samples were collected (6 inches and 3 feet). The two sampling pumps failed during the six hour sampling event. The data were considered unreliable and are not reported. A field blank was submitted for each field. Field spike samples were also submitted for Fields A, B, D (6 hr), and K. A total of 58 samples were collected including 7 field blanks and 6 field spikes.

Sample Analysis: All samples were analyzed by WOHL using NIOSH Method 2550 (modified). Bulk material or samples collected on XAD-2 (vapor) and/or PTFE pre-filter (particulate) filter air sampling devices were desorbed with 10 minutes of sonication performed with methanol. Desorption volumes were 2mL methanol for the particulate portion and 1mL methanol for vapor portion of each sample. Extracts were analyzed by reversed phase high-performance liquid chromatography employing a 0.1% formic acid:methanol linear gradient program. Detection was achieved by triple quadrupole mass spectrometry using multiple reaction monitoring (MRM). Quality control samples also included laboratory reagent blanks, laboratory method blanks, and laboratory control spikes. Calibration check standards were also analyzed after every 10 samples analyzed.

Results: Concentrations are reported in ng/m³. Benzothiazole and 2-mercaptobenzothiazole recoveries were incomplete (below 75%). The field spike recovery for benzathiozole (vapor phase) was also incomplete (mean recovery = 72%). Therefore, results reported were corrected for incomplete recoveries. 4-tert-(octyl)-phenol, Butylated hydroxanisole (BHA), and Butylated hydroxytoluene (BHT) recoveries were also adjusted when spike recoveries observed were below 75%. In cases where background signal was observed in reagent and/or method blanks, the reporting limit was raised to account for this. The reporting limit chosen for each analyte also represents the lowest calibration standard that resulted in acceptable back calculated recovery (within +/- 25% of theoretical value). Appendix I provides the WOHL analytical laboratory reports.

Tables 17-22 in Appendix I provide the results of the targeted rubber-related SVOCs.
Table 17. Targeted Rubber-Related SVOC concentrations in ng/m³ at Field A. (on turf concentrations higher than two times background are in bold)

<table>
<thead>
<tr>
<th>SVOCs</th>
<th>P1</th>
<th>P2</th>
<th>6” on field NAP</th>
<th>3’ on field NAP</th>
<th>6” on field AFAP</th>
<th>3’ on field AFAP</th>
<th>6” background</th>
<th>3’ background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzothiazole</td>
<td>&lt;81</td>
<td>130</td>
<td>160</td>
<td>240</td>
<td>230</td>
<td>&lt;81</td>
<td>&lt;84</td>
<td>&lt;82</td>
</tr>
<tr>
<td>2-mercapto benzothiazole</td>
<td>&lt;81</td>
<td>&lt;81</td>
<td>&lt;83</td>
<td>&lt;84</td>
<td>&lt;82</td>
<td>&lt;81</td>
<td>&lt;84</td>
<td>&lt;82</td>
</tr>
<tr>
<td>4-tert-octyl</td>
<td>&lt;40</td>
<td>&lt;40</td>
<td>&lt;41</td>
<td>&lt;42</td>
<td>22</td>
<td>&lt;41</td>
<td>&lt;42</td>
<td>26</td>
</tr>
<tr>
<td>BHA</td>
<td>&lt;40</td>
<td>&lt;40</td>
<td>&lt;41</td>
<td>&lt;42</td>
<td>&lt;41</td>
<td>&lt;41</td>
<td>&lt;42</td>
<td>&lt;41</td>
</tr>
<tr>
<td>BHT</td>
<td>&lt;81</td>
<td>&lt;81</td>
<td>&lt;83</td>
<td>&lt;84</td>
<td>86</td>
<td>&lt;81</td>
<td>150</td>
<td>&lt;82</td>
</tr>
</tbody>
</table>

Abbreviations: NAP=near active play; AFAP=away from active play

Table 18. Targeted Rubber-Related SVOC concentrations in ng/m³ at Field B. (on turf concentrations higher than two times background are in bold)

<table>
<thead>
<tr>
<th>SVOCs</th>
<th>P1</th>
<th>P2</th>
<th>6” on field NAP</th>
<th>3’ on field NAP</th>
<th>6” on field AFAP</th>
<th>3’ on field AFAP</th>
<th>6” background</th>
<th>3’ background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzothiazole</td>
<td>&lt;80</td>
<td>&lt;83</td>
<td>210</td>
<td>210</td>
<td>180</td>
<td>&lt;85</td>
<td>&lt;85</td>
<td>&lt;84</td>
</tr>
<tr>
<td>2-mercapto benzothiazole</td>
<td>&lt;80</td>
<td>&lt;83</td>
<td>&lt;80</td>
<td>&lt;85</td>
<td>&lt;85</td>
<td>&lt;85</td>
<td>&lt;85</td>
<td>&lt;84</td>
</tr>
<tr>
<td>4-tert-octyl</td>
<td>&lt;40</td>
<td>&lt;41</td>
<td>&lt;40</td>
<td>&lt;43</td>
<td>&lt;42</td>
<td>&lt;42</td>
<td>&lt;43</td>
<td>&lt;42</td>
</tr>
<tr>
<td>BHA</td>
<td>&lt;40</td>
<td>&lt;40</td>
<td>&lt;40</td>
<td>&lt;43</td>
<td>&lt;42</td>
<td>&lt;42</td>
<td>&lt;43</td>
<td>&lt;42</td>
</tr>
<tr>
<td>BHT</td>
<td>&lt;80</td>
<td>&lt;83</td>
<td>&lt;80</td>
<td>&lt;85</td>
<td>&lt;85</td>
<td>&lt;85</td>
<td>&lt;85</td>
<td>&lt;84</td>
</tr>
</tbody>
</table>

Abbreviations: NAP=near active play; AFAP=away from active play

Table 19. Targeted Rubber-Related SVOC concentrations in ng/m³ at Field C. (on turf concentrations higher than two times background are in bold)

<table>
<thead>
<tr>
<th>SVOCs</th>
<th>P1</th>
<th>P2</th>
<th>6” on field NAP</th>
<th>3’ on field NAP</th>
<th>6” on field AFAP</th>
<th>3’ on field AFAP</th>
<th>6” background</th>
<th>3’ background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzothiazole</td>
<td>&lt;82</td>
<td>&lt;81</td>
<td>220</td>
<td>&lt;74</td>
<td>220</td>
<td>&lt;82</td>
<td>&lt;81</td>
<td>&lt;80</td>
</tr>
<tr>
<td>2-mercapto benzothiazole</td>
<td>&lt;82</td>
<td>&lt;81</td>
<td>&lt;73</td>
<td>&lt;74</td>
<td>&lt;82</td>
<td>&lt;82</td>
<td>&lt;81</td>
<td>&lt;80</td>
</tr>
<tr>
<td>4-tert-octyl</td>
<td>&lt;41</td>
<td>&lt;41</td>
<td>&lt;36</td>
<td>&lt;37</td>
<td>&lt;41</td>
<td>&lt;41</td>
<td>&lt;40</td>
<td>&lt;40</td>
</tr>
<tr>
<td>BHA</td>
<td>&lt;41</td>
<td>&lt;41</td>
<td>&lt;36</td>
<td>&lt;37</td>
<td>&lt;41</td>
<td>&lt;41</td>
<td>&lt;40</td>
<td>&lt;40</td>
</tr>
<tr>
<td>BHT</td>
<td>&lt;82</td>
<td>&lt;81</td>
<td>&lt;73</td>
<td>&lt;74</td>
<td>&lt;82</td>
<td>&lt;82</td>
<td>&lt;81</td>
<td>&lt;80</td>
</tr>
</tbody>
</table>

Abbreviations: NAP=near active play; AFAP=away from active play
Table 20. Targeted Rubber-Related SVOC concentrations in ng/m³ at Field D.  
(on turf concentrations higher than two times background are in bold)

<table>
<thead>
<tr>
<th>SVOCs</th>
<th>P1</th>
<th>P2</th>
<th>6” on field</th>
<th>3’ on field</th>
<th>6” on field</th>
<th>3’ on field</th>
<th>6” background</th>
<th>3’ background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzothiazole</td>
<td>240</td>
<td>&lt;82</td>
<td>610</td>
<td>210</td>
<td>1200</td>
<td>280</td>
<td>700</td>
<td>&lt;77</td>
</tr>
<tr>
<td>2-mercapto benzothiazole</td>
<td>&lt;81</td>
<td>&lt;82</td>
<td>&lt;78</td>
<td>&lt;80</td>
<td>&lt;82</td>
<td>&lt;84</td>
<td>&lt;79</td>
<td>&lt;77</td>
</tr>
<tr>
<td>4-tert-octyl</td>
<td>&lt;40</td>
<td>&lt;41</td>
<td>&lt;39</td>
<td>&lt;40</td>
<td>&lt;41</td>
<td>&lt;42</td>
<td>&lt;40</td>
<td>&lt;38</td>
</tr>
<tr>
<td>BHA</td>
<td>&lt;40</td>
<td>&lt;41</td>
<td>&lt;39</td>
<td>&lt;40</td>
<td>&lt;41</td>
<td>&lt;42</td>
<td>&lt;40</td>
<td>&lt;38</td>
</tr>
<tr>
<td>BHT</td>
<td>&lt;81</td>
<td>97</td>
<td>160</td>
<td>130</td>
<td>&lt;82</td>
<td>&lt;84</td>
<td>&lt;79</td>
<td>&lt;77</td>
</tr>
</tbody>
</table>

Abbreviations: NAP=near active play; AFAP=away from active play

Table 21. Targeted Rubber-Related SVOC concentrations in ng/m³ at Field K.  
(on turf concentrations higher than two times background are in bold)

<table>
<thead>
<tr>
<th>SVOCs</th>
<th>P1</th>
<th>P2</th>
<th>6” on field</th>
<th>3’ on field</th>
<th>6” on field</th>
<th>3’ on field</th>
<th>6” back ground</th>
<th>3’ back ground</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzothiazole</td>
<td>11000</td>
<td>13000</td>
<td>14000</td>
<td>12000</td>
<td>11000</td>
<td>12000</td>
<td>&lt;82</td>
<td>&lt;82</td>
</tr>
<tr>
<td>2-mercapto benzothiazole</td>
<td>&lt;82</td>
<td>&lt;86</td>
<td>&lt;81</td>
<td>&lt;83</td>
<td>&lt;82</td>
<td>&lt;82</td>
<td>&lt;82</td>
<td>&lt;82</td>
</tr>
<tr>
<td>4-tert-octyl</td>
<td>&lt;41</td>
<td>&lt;43</td>
<td>&lt;41</td>
<td>&lt;42</td>
<td>&lt;41</td>
<td>&lt;41</td>
<td>&lt;41</td>
<td>&lt;41</td>
</tr>
<tr>
<td>BHA</td>
<td>&lt;41</td>
<td>&lt;43</td>
<td>&lt;41</td>
<td>&lt;42</td>
<td>&lt;41</td>
<td>&lt;41</td>
<td>&lt;41</td>
<td>&lt;41</td>
</tr>
<tr>
<td>BHT</td>
<td>1300</td>
<td>1800</td>
<td>2100</td>
<td>3900</td>
<td>2100</td>
<td>1900</td>
<td>88</td>
<td>&lt;82</td>
</tr>
</tbody>
</table>

Abbreviations: NAP=near active play; AFAP=away from active play

Table 22. SVOC concentrations in ng/m³ at Field L.

<table>
<thead>
<tr>
<th>SVOCs</th>
<th>3’ on grass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzothiazole</td>
<td>&lt;83</td>
</tr>
<tr>
<td>2-mercapto benzothiazole</td>
<td>&lt;83</td>
</tr>
<tr>
<td>4-tert-octyl</td>
<td>&lt;42</td>
</tr>
<tr>
<td>BHA</td>
<td>&lt;42</td>
</tr>
<tr>
<td>BHT</td>
<td>280</td>
</tr>
</tbody>
</table>
3.4.3 Nitrosamines

*Air Sampling:* Personal and air samples for Nitrosamine were collected using sampling pumps fit with Thermosorb/N™ tubes. The pumps were pre and post calibrated at approximately 2 liters per minute. The samples were collected for two hours.

At fields A-D and K, the personal samples were collected by placing the pumps at waist-height on two study team members involved in active play. Two area samples were collected on the fields away from active (AFAP) at 6 inches and 3 feet above the ground, and two area samples were collected at the upwind background location at 6 inches and 3 feet above the ground. At Field L, one area sample was collected at 3 feet. At Field D during the six hour sampling event, two on field area samples (6 inches and 3 feet) were collected. A field blank was collected at each field. A total of 40 samples were collected including 7 field blanks. Upon arrival to WOHL, one field sample had a cracked inlet.

*Analysis:* All samples were analyzed by WOHL using NIOSH 2522 for the following nitrosamines: N-nitrosodimethylamine (NDMA), N-nitrosomorpholine (NMOR), N-nitrosopyrrolidine (NPYR), N-nitrosodiethylamine (NDEA), N-nitrosopiperidine (NPIP), N-nitrosodipropylamine (NDPA), and N-nitrosodibutylamine (NDBA). Nitrosamines were not found in the field blanks.

*Results:* Table 23 provides the results of the nitrosamine sampling. Concentrations are reported in µg/m³. All concentrations were below the reporting limits. Appendix J provides the WOHL analytical laboratory reports for nitrosamine sampling.
Table 23. Nitrosamine concentrations in µg/m³ at each field (A-D, K-L)

<table>
<thead>
<tr>
<th>Field</th>
<th>Location</th>
<th>Nitrosamine µg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6” on field AFAP</td>
<td>&lt;0.41</td>
</tr>
<tr>
<td>A</td>
<td>3’ on field AFAP</td>
<td>&lt;0.32</td>
</tr>
<tr>
<td>A</td>
<td>6” background</td>
<td>&lt;0.42</td>
</tr>
<tr>
<td>A</td>
<td>3’ background</td>
<td>&lt;0.41</td>
</tr>
<tr>
<td>A</td>
<td>Personal</td>
<td>&lt;0.42</td>
</tr>
<tr>
<td>B</td>
<td>6” on field AFAP</td>
<td>&lt;0.34</td>
</tr>
<tr>
<td>B</td>
<td>3’ on field AFAP</td>
<td>&lt;0.41</td>
</tr>
<tr>
<td>B</td>
<td>6” background</td>
<td>&lt;0.35</td>
</tr>
<tr>
<td>B</td>
<td>3’ background</td>
<td>&lt;0.43</td>
</tr>
<tr>
<td>B</td>
<td>Personal</td>
<td>&lt;0.39</td>
</tr>
<tr>
<td>B</td>
<td>Personal</td>
<td>&lt;0.41</td>
</tr>
<tr>
<td>C</td>
<td>6” on field AFAP</td>
<td>&lt;0.41</td>
</tr>
<tr>
<td>C</td>
<td>3’ on field AFAP</td>
<td>&lt;0.34</td>
</tr>
<tr>
<td>C</td>
<td>6” background</td>
<td>&lt;0.39</td>
</tr>
<tr>
<td>C</td>
<td>3’ background</td>
<td>&lt;0.32</td>
</tr>
<tr>
<td>C</td>
<td>Personal</td>
<td>&lt;0.38</td>
</tr>
<tr>
<td>C</td>
<td>Personal</td>
<td>&lt;0.38</td>
</tr>
<tr>
<td>D</td>
<td>6” on field AFAP</td>
<td>&lt;0.42</td>
</tr>
<tr>
<td>D</td>
<td>3’ on field AFAP</td>
<td>&lt;0.42</td>
</tr>
<tr>
<td>D</td>
<td>6” background</td>
<td>&lt;0.38</td>
</tr>
<tr>
<td>D</td>
<td>3’ background</td>
<td>&lt;0.35</td>
</tr>
<tr>
<td>D</td>
<td>Personal</td>
<td>&lt;0.39</td>
</tr>
<tr>
<td>D</td>
<td>Personal</td>
<td>&lt;0.40</td>
</tr>
<tr>
<td>D-6hr</td>
<td>6” on field AFAP</td>
<td>&lt;0.14</td>
</tr>
<tr>
<td>D-6hr</td>
<td>3’ on field AFAP</td>
<td>&lt;0.14</td>
</tr>
<tr>
<td>K</td>
<td>6” on field AFAP</td>
<td>&lt;0.40</td>
</tr>
<tr>
<td>K</td>
<td>3’ on field AFAP</td>
<td>&lt;0.39</td>
</tr>
<tr>
<td>K</td>
<td>6” background</td>
<td>&lt;0.31</td>
</tr>
<tr>
<td>K</td>
<td>3’ background</td>
<td>&lt;0.34</td>
</tr>
<tr>
<td>K</td>
<td>Personal</td>
<td>&lt;0.39</td>
</tr>
<tr>
<td>K</td>
<td>Personal</td>
<td>&lt;0.41</td>
</tr>
<tr>
<td>L</td>
<td>3’</td>
<td>&lt;0.25</td>
</tr>
</tbody>
</table>

Abbreviations: AFAP=away from active play.

* The sampler had a cracked inlet upon arrival to WOHL.
3.4.3 Air Particulate Matter (PM$_{10}$)

**Air Sampling:** Area Air samples for particulate matter (PM$_{10}$) were collected using the Harvard Impactor (MS&T Area Sampler, Air Diagnostics and Engineering, Harrison, ME, USA). Samples were collected onto 37 mm Teflon filters (2.0 um) at a flow rate of 20 Liters/minute (Pump Model SP-280, Air Diagnostics and Engineering Inc., Harrison, ME; S/N 30637 and 30565). Two samples were collected at 3 feet above the ground per field: on turf near the middle of the field and upwind off-turf (background). Field blanks were collected and analyzed at every sampled field. Extension cords were connected to electrical outlets in external buildings to provide power to the sampling pumps. The airflow rate was measured with a rotameter (AALBORG, Orangeburg, NY, S/N 227-202-4) before and after sampling with a representative sample medium according to HSPH Type Impactor SOP Protocol (6-26-00-Air Diagnostics and Engineering, Harrison, ME, USA). Flow rates after sampling were within ± 5% of the initial flow rate at each sampling field.

Twelve field samples and six field blanks were collected (two field samples and one blank per field). Filters were shipped to the WOHL laboratory on the same day as sampling on ice and frozen upon receipt until weight analysis.

**Analysis:** Samples were weighed according to CFR Title 40 Part 50 (Appendix L) before and after sampling to determine PM$_{10}$ concentration. Tare (before sampling) and post sampling weights were measured three times on a Mettler Toledo Model MX5 Balance (weighs to 0.001mg). These measurements were averaged, and the difference between the average tare and post sampling concentrations were used to calculate PM$_{10}$ concentration as micrograms per cubic meter of air (μg/m$^3$). Final PM$_{10}$ concentrations for field samples were corrected by field blanks (samples at fields C and K were corrected).

**Results:** Table 24 provides the PM$_{10}$ concentrations for all fields. PM$_{10}$ concentrations were greater in background locations than on the turf at all fields with the exception of Field B. However, the concentration on turf at Field B, 5.89 μg/m$^3$, was within the range of background concentrations (4.96-17.79 μg/m$^3$). The protocol for sampling at Field A was not followed properly and, therefore, data is not available.

<table>
<thead>
<tr>
<th>Field ID</th>
<th>Location Type</th>
<th>Pm$_{10}$ Concentration (μg/m$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>On Turf</td>
<td>Background</td>
</tr>
<tr>
<td>A</td>
<td>Outdoor</td>
<td>---$^a$</td>
</tr>
<tr>
<td>B</td>
<td>Outdoor</td>
<td>5.89</td>
</tr>
<tr>
<td>C</td>
<td>Outdoor</td>
<td>16.54$^b$</td>
</tr>
<tr>
<td>D</td>
<td>Outdoor</td>
<td>4.52</td>
</tr>
<tr>
<td>L</td>
<td>Outdoor</td>
<td>NA$^c$</td>
</tr>
<tr>
<td></td>
<td>(non-turf site)</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>Indoor</td>
<td>7.22</td>
</tr>
</tbody>
</table>

$^a$ --- Sampling protocol was not followed during sampling.
$^b$Pesticide application occurred adjacent to field during sampling day (~10 minutes)
$^c$NA is non applicable because sampling occurred in an suburban grass field (non-turf).

**Air Particulate Matter (PM$_{10}$) Characterization**

Following gravimetric analysis, samples were stored at room temperature until particulate characterization analyses. Six samples were selected for Microscopic Particle Identification and characterization by Polarized Light Microscopy (WP001.20 Analysis), Scanning Electron Microscopy, and Energy Dispersive X-Ray (EDXA) analyses. These samples were collected from Fields B, D, K (on turf) and L (suburban grass). Appendix K provides the WOHL analytical laboratory reports for PM$_{10}$. Other samples were not analyzed as planned because rubber fragments were not easily detected and identification of particles were inconclusive.
4.0 Summary Findings
This report identifies and measures chemicals across several synthetic crumb rubber turf fields and background locations. The measurements collected from background locations are necessary to better understand the data because many of these chemicals are present in ambient air as a result of air pollution.

The following algorithm was used to identify a possible turf-related VOC, targeted SVOC or nitrosamine: Chemicals found in: A) either 6” or 3’ samples; or B) in both personal and either 6” or 3’ samples, greater than two times the background concentration measured near the field, were considered to have originated from the turf. The attribution of a chemical to the turf was considered stronger if the chemical was also found in at least one field’s crumb rubber head space.

For PAHs and general SVOC’s the following algorithm was used to identify a possible turf related chemical: Chemicals found in turf air samples but: A) not in background air samples or B) at twice the field’s background concentration, were considered to have originated from the turf. Attribution of a chemical to an origin in the turf was considered stronger if this finding held on at least two fields.

4.1 Crumb Rubber Infill Bulk VOCs
The most commonly found VOCs (range of concentrations in parts per billion-ppbV) detected in crumb rubber infill include: acetonitrile (60-300ppbV), methylene chloride (dichloromethane) (20-430ppbV), methyl alcohol (33-270ppbV), and methyl isobutyl ketone (21-150ppbV). Bulk crumb rubber from the newer fields (A, B and D) contained more than ten VOCs. Crumb rubber from other fields contained less than 5 VOCs. Bulk crumb rubber can act as a sink for organic compounds in the environment. Some VOCs, such as methylene chloride, methyl alcohol and acetone, were also found in a laboratory blank where the crumb rubber field samples were processed for the head space analysis. Presence of a VOC in the head space of the bulk crumb rubber infill as well as in air samples at two times greater than background levels is considered more suggestive that crumb rubber infill is the source of the VOC.

4.2 Air VOCs-Possibly Turf-Related
Of the 60 VOCs tested, 4 VOCs appear to be associated with turf. The concentration of methyl isobutyl ketone (35.98 μg/m³) was the highest VOC detected in area samples collected on the turf (Field K). Acetone was the second highest VOC found in area samples on the turf, and it was also found in the air of the background location at lower concentration. Inter-player variability of total VOC air concentrations was notable on fields B (28.99 vs. 240.51 μg/m³) and K (292.47 vs. 424.27 μg/m³). The highest air concentrations on the turf for most VOCs were found at Field K.

Table 25 summarizes one possible algorithm for determining which VOCs may be related to crumb rubber emissions. Chemicals meeting these criteria are bolded, and most frequently found in Field K, the indoor facility, and not in the outdoor fields. Chemicals found in personal samples (at two times greater concentrations than background) but not in 6” or 3’ or any bulk crumb rubber head space sample are unlikely to be turf related.

The belts and aprons that held the personal samplers in place during simulated soccer play emit a number of chemicals. Trace levels of acrolein were detected seven months later in mesh belt and cloth apron. Other sources of VOCs, such as sweat or the players’ use of personal care products (e.g. sunscreen, deodorant, etc.) may be contributing to the VOC levels found in the personal results; however, it is difficult to determine this. In the future, personal samples should also be collected on grass (non-turf) field in order to better interpret the data.
Table 25. VOC exposure assessment- screening algorithm for chemicals’ relationship to crumb rubber emissions.

<table>
<thead>
<tr>
<th>Screen for each field</th>
<th>Chemical</th>
<th>Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Either 6” or 3’ two times &gt; background for this field</td>
<td>Toluene</td>
<td>D</td>
</tr>
<tr>
<td>Chemical in this field’s crumb rubber head space</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Either 6” or 3’ two times &gt; background for this field</td>
<td>Acetone&lt;sup&gt;c&lt;/sup&gt;</td>
<td>C</td>
</tr>
<tr>
<td>Chemical not in field’s crumb rubber head space but in at least one other field’s</td>
<td>Ethyl Benzene</td>
<td>K</td>
</tr>
<tr>
<td>Chemical in this field’s crumb rubber head space</td>
<td>Methyl Isobutyl Ketone</td>
<td>K</td>
</tr>
<tr>
<td></td>
<td>Toluene</td>
<td>K</td>
</tr>
<tr>
<td>Either 6” or 3’ two times &gt; background for this field</td>
<td>Carbon Disulfide</td>
<td>K</td>
</tr>
<tr>
<td>Chemical is not in any field’s crumb rubber head space</td>
<td>Cyclohexane</td>
<td>B, K</td>
</tr>
<tr>
<td></td>
<td>M/P-Xylene</td>
<td>K</td>
</tr>
<tr>
<td></td>
<td>O-Xylene</td>
<td>K</td>
</tr>
<tr>
<td>Personal two times &gt; background for this field</td>
<td>Toluene</td>
<td>D</td>
</tr>
<tr>
<td>Chemical is two times background in 6” or 3’ sample</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical is in this field’s crumb rubber head space</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal two times &gt; background for this field</td>
<td>Acetone&lt;sup&gt;c&lt;/sup&gt;</td>
<td>C</td>
</tr>
<tr>
<td>Chemical is two times background in 6” or 3’ sample</td>
<td>Ethyl Benzene</td>
<td>K</td>
</tr>
<tr>
<td>Chemical not in field’s crumb rubber head space but in at least one other field’s</td>
<td>Methyl Isobutyl Ketone</td>
<td>K</td>
</tr>
<tr>
<td>Chemical in this field’s crumb rubber head space</td>
<td>Toluene</td>
<td>K</td>
</tr>
<tr>
<td></td>
<td>Carbon Disulfide</td>
<td>K</td>
</tr>
<tr>
<td></td>
<td>Cyclohexane</td>
<td>B, K</td>
</tr>
<tr>
<td></td>
<td>M/P-Xylene</td>
<td>K</td>
</tr>
<tr>
<td></td>
<td>O-Xylene</td>
<td>K</td>
</tr>
<tr>
<td>Personal two times &gt; background for this field</td>
<td>Acetone&lt;sup&gt;c&lt;/sup&gt;</td>
<td>A, B</td>
</tr>
<tr>
<td>Chemical is not two times &gt; background in 6” or 3’ sample</td>
<td>Hexane</td>
<td>B, C</td>
</tr>
<tr>
<td>Chemical is in this field’s crumb rubber head space</td>
<td>Methylene Chloride</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>Methyl Isobutyl Ketone</td>
<td>B, D</td>
</tr>
<tr>
<td></td>
<td>Toluene</td>
<td>A, B</td>
</tr>
<tr>
<td></td>
<td>(Acetonitrile)&lt;sup&gt;^&lt;/sup&gt;</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>(Isopropyl Alcohol)&lt;sup&gt;^&lt;/sup&gt;</td>
<td>A, B</td>
</tr>
<tr>
<td>Personal two times &gt; background for this field</td>
<td>Acetone&lt;sup&gt;c&lt;/sup&gt;</td>
<td>D</td>
</tr>
<tr>
<td>Chemical is not two times &gt; background in 6” or 3’ sample</td>
<td>Benzene&lt;sup&gt;c&lt;/sup&gt;</td>
<td>B</td>
</tr>
<tr>
<td>Chemical not in field’s crumb rubber head space but in at least one other field’s</td>
<td>Ethyl Benzene</td>
<td>B</td>
</tr>
<tr>
<td>Chemical in this field’s crumb rubber head space</td>
<td>Hexane</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Toluene</td>
<td>B, C</td>
</tr>
<tr>
<td></td>
<td>(Acetonitrile)&lt;sup&gt;^&lt;/sup&gt;</td>
<td>K</td>
</tr>
<tr>
<td></td>
<td>(Isopropyl Alcohol)&lt;sup&gt;^&lt;/sup&gt;</td>
<td>C, D, K</td>
</tr>
<tr>
<td>Personal two times &gt; background for this field</td>
<td>Acrolein</td>
<td>A, B, K</td>
</tr>
<tr>
<td>Chemical not two times &gt; background in 6” or 3’ sample</td>
<td>Bromodichloromethane</td>
<td>K</td>
</tr>
<tr>
<td>Chemical is not in any field’s crumb rubber head space</td>
<td>Bromoform</td>
<td>A, K</td>
</tr>
<tr>
<td></td>
<td>Carbon Disulfide</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>Ethyl Acetate</td>
<td>A, B, C, D, K</td>
</tr>
<tr>
<td></td>
<td>Heptane</td>
<td>B, C, D</td>
</tr>
<tr>
<td></td>
<td>M/P-Xylene</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>O-Xylene</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>Propene</td>
<td>B, C, D, K</td>
</tr>
<tr>
<td></td>
<td>Styrene</td>
<td>B, K</td>
</tr>
<tr>
<td></td>
<td>Tetrachloroethylene</td>
<td>B, K</td>
</tr>
<tr>
<td></td>
<td>Tetrahydrofuran</td>
<td>B, K</td>
</tr>
<tr>
<td></td>
<td>Trichloroethylene</td>
<td>B, K</td>
</tr>
<tr>
<td></td>
<td>Vinyl Acetate</td>
<td>K</td>
</tr>
<tr>
<td></td>
<td>1,2-Dichloropropane</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>1-Ethyl-4-Methyl Benzene</td>
<td>B, K</td>
</tr>
<tr>
<td></td>
<td>1,2,4-Trimethyl Benzene</td>
<td>B, K</td>
</tr>
<tr>
<td></td>
<td>1,3,5-Trimethyl Benzene</td>
<td>B, K</td>
</tr>
</tbody>
</table>

<sup>^</sup> tentative identification with NIST Library

<sup>c</sup> Compound was detected in the background sample of the laboratory used to analyze the bulk crumb rubber head space.
Air VOCs-Background
Twenty VOCs of 60 were found in upwind background locations (Table 26). Five of these VOCs (chloromethane, dichlorodifluormethane, halocarbon 11, hexane and methyl ethyl ketone) were found in the upwind background locations at all five fields. Air concentrations of acetone, carbon tetrachloride and toluene were found at four background sites, whereas benzene and methylene chloride were detected at three sites.

Table 26. VOC Concentrations in upwind background locations at all fields.

<table>
<thead>
<tr>
<th>VOCs</th>
<th>Fields</th>
<th>Range of VOC Concentrations μg/m³ (parts per billion ppbV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,1,-2-Trichlorotrifluoroethane</td>
<td>K</td>
<td>1.53 (0.20)</td>
</tr>
<tr>
<td>1,1,2-Trichloroethane</td>
<td>K</td>
<td>0.76 (0.14)</td>
</tr>
<tr>
<td>1,2-Dichloropropane</td>
<td>K</td>
<td>0.69 (0.15)</td>
</tr>
<tr>
<td>1,2-Dichloroethane</td>
<td>K</td>
<td>0.68 (0.17)</td>
</tr>
<tr>
<td>1,1,2,2-Tetrachloroethane</td>
<td>A</td>
<td>1.02 (0.15)</td>
</tr>
<tr>
<td>Acetone</td>
<td>A, B, D, L</td>
<td>7.11-12.33 (3.0-5.2)</td>
</tr>
<tr>
<td>Benzene</td>
<td>A, D, L</td>
<td>0.41-0.64 (0.13-0.20)</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>A, B, K, L</td>
<td>0.75-1.30 (0.14-0.21)</td>
</tr>
<tr>
<td>Chloroform</td>
<td>K</td>
<td>0.68 (0.14)</td>
</tr>
<tr>
<td>Chloromethane</td>
<td>A, B, D, K, L</td>
<td>1.06-1.33 (0.52-0.65)</td>
</tr>
<tr>
<td>Dichlorodifluromethane</td>
<td>A, B, D, K, L</td>
<td>2.23-2.47 (0.45-0.5)</td>
</tr>
<tr>
<td>Ethyl Acetate</td>
<td>A</td>
<td>0.61 (0.17)</td>
</tr>
<tr>
<td>Halocarbon 11</td>
<td>A, B, D, K, L</td>
<td>0.53-1.96 (0.13-0.35)</td>
</tr>
<tr>
<td>Heptane</td>
<td>K</td>
<td>0.53 (0.13)</td>
</tr>
<tr>
<td>Hexane</td>
<td>A, B, D, K, L</td>
<td>0.88-9.40 (0.25-2.6)</td>
</tr>
<tr>
<td>Methyl Ethyl Ketone</td>
<td>A, B, D, K, L</td>
<td>1.06-1.74 (0.36-0.62)</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>A, K, L</td>
<td>0.48-1.83 (0.14-0.32)</td>
</tr>
<tr>
<td>Propene</td>
<td>L</td>
<td>0.48 (0.28)</td>
</tr>
<tr>
<td>Toluene</td>
<td>A, B, K, L</td>
<td>0.75-0.1.09 (0.2-0.29)</td>
</tr>
<tr>
<td>Vinyl Acetate</td>
<td>A</td>
<td>1.02 (0.29)</td>
</tr>
</tbody>
</table>
4.3 Air PAHs and SVOCs—Possibly Turf Related

The EPA Method TO-13A was followed to collect and analyze ten air samples for 115 SVOCs. Table 27 provides the range of concentrations of PAHs across all the fields on outdoor turf, indoor turf and upwind background locations.

Table 28 summarizes one possible algorithm for determining which miscellaneous SVOCs may be related to crumb rubber emissions. The criteria used to determine if a chemical is potentially turf-related includes: Chemicals found in turf air samples but: A) not in background air samples or B) at twice the field’s background concentration, were considered to have originated from the turf. Attribution of a chemical to an origin in the turf was considered stronger if this finding held on at least two fields.

At Field K, several compounds were ten fold higher on turf than background including five PAHS (1-methylnaphthalene, 2-methylnaphthalene, fluorene, naphthalene, and pyrene) and 7 general SVOCs (dotriacontane, heptacosane, hexacosane, octanoic acid, pentacosane, tetracosane, and tetradecane).

### Table 27. Range Concentrations of PAHs in ng/m³ On Outdoor Turf and Upwind Background Locations.

<table>
<thead>
<tr>
<th>PAH</th>
<th>Outdoor On Turf Range ng/m³ (n=5*)</th>
<th>Indoor On Turf Concentration ng/m³ (n=1)</th>
<th>Background Range ng/m³ (n=4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Methylnaphthalene</td>
<td>3.72-9.31</td>
<td>ND</td>
<td>4.08-6.91</td>
</tr>
<tr>
<td>2,6 Dimethylnaphthalene</td>
<td>ND-7.65</td>
<td>28.70</td>
<td>ND-10.37</td>
</tr>
<tr>
<td>2-Methylnaphthalene</td>
<td>1.88-4.24</td>
<td>63.38</td>
<td>ND-3.31</td>
</tr>
<tr>
<td>Acenaphthene</td>
<td>2.14-3.45</td>
<td>17.37</td>
<td>ND-0.3.99</td>
</tr>
<tr>
<td>Acenaphthylene</td>
<td>ND-6.59</td>
<td>6.78</td>
<td>ND-0.77</td>
</tr>
<tr>
<td>Anthracene</td>
<td>ND-ND</td>
<td>ND</td>
<td>ND-0.02</td>
</tr>
<tr>
<td>Benz(a)anthracene</td>
<td>ND-ND</td>
<td>ND</td>
<td>ND-0.03</td>
</tr>
<tr>
<td>Benzo(a)pyrene</td>
<td>ND-0.19</td>
<td>ND</td>
<td>ND-0.05</td>
</tr>
<tr>
<td>Benzo(b)fluoranthene</td>
<td>ND-0.21</td>
<td>ND</td>
<td>ND-0.07</td>
</tr>
<tr>
<td>Benzo(e)pyrene</td>
<td>ND-0.26</td>
<td>ND</td>
<td>ND-0.06</td>
</tr>
<tr>
<td>Benzo(GHI)fluoranthene</td>
<td>ND-0.08</td>
<td>ND</td>
<td>ND-ND</td>
</tr>
<tr>
<td>Benzo(GHI)pyrene</td>
<td>ND-0.14</td>
<td>ND</td>
<td>ND-0.06</td>
</tr>
<tr>
<td>Benzo(k)fluoranthene</td>
<td>ND-0.08</td>
<td>ND</td>
<td>ND-0.04</td>
</tr>
<tr>
<td>Chrysene</td>
<td>ND-0.34</td>
<td>ND</td>
<td>ND-0.04</td>
</tr>
<tr>
<td>Fluoranthene</td>
<td>1.68-6.76</td>
<td>5.55</td>
<td>0.58-3.96</td>
</tr>
<tr>
<td>Fluorene</td>
<td>2.21-4.09</td>
<td>53.70</td>
<td>2.43-3.59</td>
</tr>
<tr>
<td>Indeno(1,2,3-cd)pyrene</td>
<td>ND-0.05</td>
<td>8.90</td>
<td>ND-0.05</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>5.99-14.57</td>
<td>113.00</td>
<td>4.50-16.94</td>
</tr>
<tr>
<td>Phenanthrene</td>
<td>5.07-14.34</td>
<td>32.26</td>
<td>6.11-13.05</td>
</tr>
<tr>
<td>Pyrene</td>
<td>0.97-6.92</td>
<td>11.84</td>
<td>0.37-3.16</td>
</tr>
</tbody>
</table>

ND=nondetectable; see appendix for reporting limits.

*Four fields were sampled, and one field (D) was sampled twice.*
Table 28. SVOC exposure assessment- screening algorithm for chemicals’ relationship to crumb rubber emissions.

<table>
<thead>
<tr>
<th>Screen for each field</th>
<th>Chemical</th>
<th>Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAHs detected on the turf field and not detected in background, and found on at least 2 fields</td>
<td>Acenaphthylene</td>
<td>D and K</td>
</tr>
<tr>
<td>PAHs detected on the turf field at more than two times the concentration of background levels, and found on at least 2 fields</td>
<td>1-Methylnaphthalene 2- Methylnaphthalene Fluoranthene Phenanthrene Pyrene</td>
<td>D and K D and K D and K D and K D and K</td>
</tr>
<tr>
<td>Miscellaneous SVOCs detected on the turf field at more than two times the concentration of background levels, and found on at least 2 fields</td>
<td>Eicosane Eicosanic acid Heneicosane Hexadecanoic acid Octadecanoic acid Phytane Tetradecanoic acid Tetratriacontane Tricosane</td>
<td>D and K D and K D and K A and D D and K D and K A and K D and K</td>
</tr>
</tbody>
</table>
4.4 Targeted SVOCs—Possibly Turf-Related

Of the five targeted SVOCs in air, Benzothiazole and BHT were the only chemicals detected above background (Table 29). Concentrations of benzothiazole were higher on the turf at six inches away from active play than in background locations at all fields. Most concentrations of benzothiazole and BHT were an order of magnitude lower among the outdoor turf fields than the indoor field, ranging from <80-1200 ng/m³ and <80-130 ng/m³, respectively. Indoor concentrations of benzothiazole and BHT on the turf range from 11000-14,000 and 1240-3900 ng/m³, respectively. The indoor field contained the highest concentration of benzothiazole in the crumb rubber. 4-tert-(octyl)-phenol was detected in the crumb rubber head space in all fields (A-K), however, it was only found in two air samples (on turf level was less than background). BHT was detected in air at 3 feet at the grass background Site L (280 ng/m³).

Table 29. Field locations where air concentrations are greater than relative background concentration for each field.

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Personal</th>
<th>6&quot; NAP</th>
<th>3' NAP</th>
<th>6&quot; AFAP</th>
<th>3' AFAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzothiazole</td>
<td>A, D*, K</td>
<td>A, B, K</td>
<td>B, D, K</td>
<td>A, B, C, D, K</td>
<td>D, K</td>
</tr>
<tr>
<td>2-mercaptobenzothiazole</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>4-tert-octyl</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>BHA</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>BHT</td>
<td>D*, K</td>
<td>K</td>
<td>D, K</td>
<td>K</td>
<td>K</td>
</tr>
</tbody>
</table>

Abbreviations: NAP=near active play; AFAP=away from active play
* one of two personal samples exceeded background
# one of two personal samples exceeded 6" background but not 3" background

Table 30 summarizes one possible algorithm for determining which targeted SVOC may be related to crumb rubber emissions. Chemicals found in: A) either 6" or 3' samples; or B) in both personal and either 6" or 3' samples, greater than the background concentration measured near the field, were considered to have originated from the turf. The attribution of a chemical to the turf was considered stronger if the chemical was also found in at least one field’s crumb rubber head space. Chemicals meeting these criteria are bolded. Benzothiazole and BHT met this criteria.

Table 30. Targeted SVOCs exposure assessment—screening algorithm for chemicals’ relationship related to crumb rubber emissions.

<table>
<thead>
<tr>
<th>Screen for each field</th>
<th>Chemical</th>
<th>Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Either 6&quot; or 3’ two times &gt; background for this field</td>
<td>Benzothiazole</td>
<td>A, B, C, D, K</td>
</tr>
<tr>
<td>Chemical in this field’s crumb rubber head space</td>
<td>BHT</td>
<td>K</td>
</tr>
<tr>
<td>Either 6&quot; or 3’ two times &gt; background for this field</td>
<td>BHT</td>
<td>D</td>
</tr>
<tr>
<td>Chemical not in field’s crumb rubber head space but in at least another field’s crumb rubber head space</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal two times &gt; 3’ background for this field</td>
<td>Benzothiazole</td>
<td>A, D, K</td>
</tr>
<tr>
<td>Chemical is in 6&quot; or 3’ sample two times background</td>
<td>BHT</td>
<td>K</td>
</tr>
<tr>
<td>Personal two times &gt; 3’ background for this field</td>
<td>BHT</td>
<td>D</td>
</tr>
<tr>
<td>Chemical is in 6&quot; or 3’ sample two times background</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical not in field’s crumb rubber head space but in at least another field’s crumb rubber head space</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Nitrosamine
All samples were below the reporting limit including the crumb rubber infill.

Particulate Matter (PM₁₀)
PM₁₀ concentrations measured on the turf are typical levels found in background locations. Rubber fragments were not easily detected and analyses of particles were inconclusive.

Lead
All of the composite samples of artificial turf fibers and crumb rubber were below the level EPA considers as presenting a "soil-lead hazard" in play areas (400ppm). This definition, however, applies to residential buildings and to soil rather than other surfaces.
5.0 Limitations

The primary objective of this project was to characterize human exposure via inhalation to a targeted group of chemicals that are associated with crumb rubber synthetic turf. Other routes of exposures, such as ingestion and contact, were not within the scope of this study. Some chemicals of potential concern, such as natural rubber latex, were not included as part of the targeted chemicals in our study but should be included in future studies. There are several limitations to this project. This project has a potential for selection bias because participation was voluntary and self-selected. The sample size was small (4 outdoor fields and 1 indoor field), however, goals of the project were met in recruiting outdoor turf fields, an indoor facility and a suburban grass field.

During the summer of 2009, temperature conditions for the sampling events were on average lower than normal. The 30-year monthly average maximum temperature for the month of July is 84.9 °F, and during July 2009, the average was 79.9 °F. Most notably, wind conditions were low, and little cloud overcast occurred on most sampling days.

Personal sampling occurred at waist height, and not in the normal breathing zone of the study team players. The placement of 1.4 L SUMMAs and personal sampling pumps at this height is not a conventional industrial hygiene personal sampling method. This method was chosen to better represent a child’s height. Some VOCs (e.g. acrolein) were found in personal samples and not on the turf or in the background areas. Players wore the SUMMAs close to their bodies, and they were up against the sampling belts and plastic ties that players wore to hold all the sampling equipment. The belts were purchased new, and may have had some coatings on them. SUMMAs are a very sensitive air sampling method, and may have collected VOCs associated with personal care products and sampling belts worn by the team players. Players were asked not to wear products to limit any contamination. Because of the intense heat and sun exposure, some players wore sun protection and all players sweated. WOHL conducted a follow-up experiment to determine if the new belts and plastic ties were capable of releasing compounds. WOHL detected trace levels of several compounds in the 7 month old belt, apron and tie. Any future personal sampling must address these kinds of issues, and “control” team members playing on the grass (non turf setting) should be included in the sampling strategy. There are many factors to consider for “control” team members, including the type of player clothing, personal product use, personal characteristics (sweat and exhaled breath), laundering practices, and behavior.

Field coordination for this project was challenging at times. For example, it is unfortunate that background samples were not collected at two fields with the PS-1 Samplers as a result of media breakage issues during transportation. In addition, one of the fields (C) was contaminated by a pesticide application which may explain the larger number of VOCs found in comparison to the other outdoor fields. The indoor field had multiple uncharacterized potential point sources.

Sampling for two hours was a limitation. Although the 6-hour sampling at Field D allowed for greater sensitivity, similar patterns were observed with both strategies. Benzothiazole is not a targeted SVOC for the TO-13A Method, and more validation studies are needed to better understand how to collect air samples with the PS-1 Samplers and analyze them for benzothiazole. NIOSH Method 2550 (modified) was adequate to capture concentrations of benzothiazole at the three levels, and other targeted SVOCs.

The lab was not able to identify rubber particles on the Teflon filters from several fields, and therefore, SEM analysis was not completed for all field samples. U.S. EPA’s study used polycarbonate filters with the same air sampling method and reported similar difficulties. More research is needed to better characterize particulate matter containing crumb-rubber.

The airborne concentrations of VOCs, Targeted SVOCs (e.g. benzothiazole) and SVOCs were highest in the indoor field. These data were collected from only one indoor facility. The crumb rubber of the indoor facility was manufactured by the same company as Field B, and installed one year earlier. The air in the indoor field was not influenced by outdoor factors that may degrade and off gas chemicals, such as sunlight, high temperatures, rain, and other weather conditions. Furthermore, potential point sources were identified in the facility, (electric carts, portable chargers, and maintenance supplies), and the indoor facility did not have its exhaust system operating on the day samples were collected. The use of the exhaust...
system in this facility varies according to need. More research is needed to better understand chemical exposures in indoor facilities.

6.0 Connecticut Academy of Science and Engineering Review (CASE): CASE performed a peer review of this final report in June 2010. The scope of the technical review for this report included an examination of the appropriateness of the methods used to sample targeted compounds and the laboratory analytical methods. Based on CASE comments, this report was revised to: 1) clarify laboratory quality control and assurance laboratory procedures for VOCs by WSLH and WOHL, 2) strengthen the criteria of the algorithm used to identify a turf-related compound to take into account variability among concentrations (e.g. turf-related compound was reported as twice a field’s background concentration), 3) move tables presenting concentrations of miscellaneous SVOCs commonly found in the environment to appendices and 4) include a description of the similarities and source locations of the bulk crumb rubber samples collected from UCHC and CAES. CASE also highlighted that the SVOC air contaminants found above the field are consistent between fields, and are also consistent with air contaminants reported in other similar studies. Issues raised by the CASE review are addressed below and incorporated into the report.

Design of Experiment: Analysis of crumb rubber for latex antigen was beyond the scope of the current investigation. This should be included in future studies.

Explain why PM10 was measured and not PM2.5: During our planning for this study, several states and US EPA were finishing reports related to synthetic turf. We discussed their findings, and used data that best represents inhalation exposure while playing on a turf field. In US EPA’s scoping study, two kinds of PM10 integrated air samples were collected (one for particle mass and metals analysis and another for scanning electron microscopy analysis). NYC did not reveal meaningful differences in concentrations between the results for the samples collected upwind and those on the field. In addition, they did not find rubber dust in the respirable range. Because of these findings, we decided to use the PM10 range.

Concern with VOC Results: Precautions used by the laboratories to prevent VOC contamination were added in the UCHC final report as recommended by CASE. The OEM UCHC sub-contracted laboratory analyses to three AIHA accredited laboratories: Wisconsin Occupational Health Laboratory (WOHL), the Wisconsin State Laboratory of Hygiene (WSLH) and the ESIS Environmental Health Laboratory (EHL) in Cromwell, Connecticut. WOHL is a full service industrial hygiene chemistry laboratory that is part of the Wisconsin State Laboratory of Hygiene (WSLH) at the University of Wisconsin-Madison. WSLH analyzed air samples for VOCs, SVOCs and PM10. WOHL analyzed bulk crumb rubber head space for VOCs and targeted SVOCs (e.g. benzothiazole), and air samples for nitrosamines and targeted SVOCs. Additional bulk samples were analyzed for lead by the ESIS Environmental Health Laboratory (EHL). The following precautions were taken for the personal and area VOC analysis by WSLH: WSLH followed the quality control and assurance protocols defined in the EPA TO-15 Method. Each analytical run included one method blank per batch of samples. If an analyte in the method blank was greater than its limit of detection (LOD), the result for that analyte was flagged to indicate blank contamination. As indicated in the report, one set up samples contained acetone in the blank sample (1.5 ppb), and concentrations were corrected. Duplicate analysis was performed on one sample per analytical batch. Duplicate analyses were always within 25% for each compound. Daily quality control checks were performed using a second source standard. Analytes in the quality control/QC check standard were always within 30% of the corresponding calibration standards.

The following precautions were taken for the bulk crumb rubber VOC analysis by WOHL and added to the final report: 1) bulk crumb rubber samples were stored in teflon lined screw capped jars and were opened only when removing sample for analysis; 2) the 340mL LVSH were baked at 70°C overnight; and 3) one of the LVSH units was analyzed empty with each analytical run as a method blank, and any VOCs detected above reporting limit noted in the analytical report. In addition, a laboratory background VOC air sample was collected in the storage cooler of the bulk crumb rubber samples. As indicated in the report, six VOCs were found and reported in this sample. These six VOCs were flagged as a footnote in tables presenting results.

Criteria used to determine concentrations greater than background: CASE recommended that qualifiers be included for the VOC and SVOC data for concentrations greater than background. UCHC agrees with CASE and modified the report. The criteria for identifying a possibly turf-related chemical of concern was changed: all concentrations greater than two times background were indicated in tables and bolded.
Semivolatile Organic Compound (SVOC) Results: CASE recommended leaving out the miscellaneous SVOCs since it appears that few, if any, of these pertain to crumb rubber or artificial turf. UCHC agrees with CASE, and moved the data into an appendix.

Off-Gas Findings: DPH risk assessment discusses the consistency of the SVOC concentrations across fields. The UCHC final report provides the data for the risk assessment.

Reference Lead Levels: CASE identified other reference levels for lead (e.g. Consumer Product Safety Commission standard for children’s products). UCHC is referencing the EPA lead in soil standard (400ug/g) in the final report because it is the most comparable standard for athletic playing fields.

Analytical Results- CAES versus WOHL: CASE recommended including more information to describe the similarities and differences between CAES and WOHL samples. In the final report, UCHC included a description of the similarities and source locations of the bulk crumb rubber samples collected from UCHC and CAES. CAES collected and analyzed samples of crumb rubber material supplied by several manufacturers [5]. Their crumb rubber samples included material from only two of UCHC outdoor fields (A and D). These two crumb rubber fields were manufactured by two different companies. The results are difficult to compare between the two laboratories (WOHL and CAES) because they used different analytical methods.
REFERENCES


7.0 Appendices (available upon request)

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Appendix B Meteorological Report
Appendix C Crumb Rubber Head Space VOC WOHL Reports
Appendix D Crumb Rubber Head Space Target SVOCs WOHL Reports
Appendix E Crumb Rubber Bulk Samples Lead EHL Reports
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APPENDICES

Appendix A: Stormwater Sampling and Analysis Documentation

Appendix B: Stormwater Treatment Measures, UNH Fact Sheets
1. PROJECT OVERVIEW

In December 2008, four Connecticut State agencies, the University of Connecticut Health Center, The Connecticut Agricultural Experiment Station, the Connecticut Department of Environmental Protection and the Connecticut Department of Public Health, agreed to jointly develop and implement a study to evaluate the health and environmental impacts associated with artificial turf fields. The overall objectives of the study were to:

1. Identify comprehensively substances, including organic compounds and elements, which derive from the crumb rubber infill used on synthetic turf fields, as well as currently available alternative infill products, through off-gassing and leaching pathways;
2. Establish the level of chemical variability for infill at individual synthetic turf fields and between different synthetic fields in Connecticut;
3. Measure levels of off-gassed compounds and airborne particulate matter in the normal breathing zone of children during a "simulated worse-case scenario" at athletic field(s) in Connecticut (inhalation risk);
4. Measure levels of leached compounds in storm water runoff collected in actual field conditions (environmental risk); and
5. Utilize collected data to make environmental and public health risk assessments regarding outdoor artificial turf fields.

The Department of Environmental Protection (“DEP”) was specifically tasked with: (1) collecting stormwater runoff samples from the four artificial turf fields selected for the study; (2) analyzing the stormwater samples for levels of compounds leached from the artificial turf materials; (3) scientifically evaluating the laboratory analysis results; and (4) developing an environmental risk assessment for the artificial turf fields.

This report is not intended to be a comprehensive investigation of the environmental risks associated with artificial turf fields, but a basic assessment of water quality data collected from a limited number of fields during a three-month period. It should be understood, that the ultimate conclusions in the report are based on eight stormwater sampling events, essentially a "snapshot", of an ongoing chemical and physical process.

2. SITE SELECTION

The four artificial turf fields selected for DEP’s stormwater sampling plan were the same fields sampled in the summer of 2009 by the University of Connecticut Health Center for airborne contaminants. Specific field selection criteria included: crumb rubber infill, owner permission, installation date, different manufacturers and site location. The owners of the selected four fields provided engineered drainage plans to DEP. DEP staff reviewed the drainage plans and established sampling points that only collected stormwater draining from the artificial turf field.

3. ARTIFICIAL TURF FIELD SYSTEMS

The artificial turf fields selected were installed by different engineering, synthetic turf and construction companies, but are similar in general design. The fields are composed of a top layer
of polyethylene or polypropylene grass fibers, with a crumb rubber (sometimes intermixed with sand) infill layer, and underlain by crushed stone/gravel with a piped drainage system (see Figures 1 and 2 below).

Figure 1.

Figure 2. (source: www.suncountrysystems.com/.../syntheticgrass.jpg)

The critical field component for this study is the infill layer, which includes crumb rubber materials produced from recycled tires. The infill layer can be composed of entirely styrene-butadiene rubber (SBR) granules, produced by ambient and/or cryogenic grinding process, or intermixed with quartz crystals (sand). The assumption for this study, and the sampling plan, is that precipitation lands on the surface of the artificial turf field, flows downward through the infill and rock/gravel layers, collects in the subsurface drain pipes and then ultimately discharges from the field. The artificial turf drainage pipes often discharge to existing subsurface drainage
systems at catch basin and/or manhole connections. The subsurface drainage pipes utilized under the fields can be solid or perforated.

4. SAMPLING PROTOCOLS

DEP staff reviewed EPA protocols and previous artificial turf leaching studies and established the following stormwater sampling plan:

1. Sampling Plan
   a. One sampling station was established at each of the four artificial turf fields;
   b. The sampling stations were located at a point where runoff was only from the artificial turf field;
   c. The size of the drainage area (in square feet) to each sampling station was calculated;
   d. Grab samples were collected and delivered to the laboratory by qualified individuals during the fall of 2009; and
   e. Samples were analyzed by an EPA certified laboratory.

2. Storm Event Criteria
   a. Samples were collected from discharges resulting from a storm event that was greater than 0.1 inch in magnitude and that occurred approximately 72 hours after any previous storm event of 0.1 inch or greater;
   b. Grab samples were collected during the first 30 minutes of a storm event discharge, or as close thereto as possible, and were completed as soon as possible;
   c. The following information was collected for the storm events monitored:
      i. The date, temperature, time of the start of the discharge, time of sampling, and magnitude (in inches) of the storm event sampled; and
      ii. The duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event.

3. Sampling Procedures
   a. Grab sample collection, chain of custody and laboratory delivery were performed in accordance with the EPA NPDES Stormwater Sampling Guidance Document (EPA 833-B-92-001, 7/92); [http://www.epa.gov/npdes/pubs/owm0093.pdf](http://www.epa.gov/npdes/pubs/owm0093.pdf)
   b. Laboratory analysis of grab samples included the following:
      i. Acute Toxicity 48 hour LC50 *Daphnia pulex* & 48 hour and 96 hour LC50 *Pimephales promelas* (EPA 821-R-02-012).
      ii. EPA Method 130.1, Hardness, Total (mg/L as CaCO₃)
      iii. EPA Method 150.2, pH
      iv. EPA Method 200.7, (Antimony, Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium, Thallium, Vanadium and Zinc)
      v. EPA Method 624, Volatile Organic Compounds
      vi. EPA Method 625, Semivolatile Organic Compounds (TIC’s for Benzothiazole, Butylated hydroxyanisole (BHA), n-hexadecane and 4-(t-octyl) phenol.
5. FIELD SAMPLING METHODS

In September of 2009, the stormwater sampling plan was implemented at the four artificial turf fields: Field A, Field B and Field D all constructed in 2007; and Field C constructed in 2005. Stormwater samples were successfully collected from Fields A, C and D. Field B was visited during five precipitation events and no discharge from the established sampling station was observed. A total of eight stormwater samples were collected from Fields A, C and D between 9/11/09 and 12/3/09. Based on DEP staff observations, Fields B and C did not appear to regularly discharge runoff during or after precipitation events, while Fields A and D discharged during and after every precipitation event monitored. For the one sample collected from Field C, DEP staff was fortunate to experience an extremely hard (downpour) rain event that exceeded the infiltration rate of the perforated underdrain system. DEP staff reviewed the engineered drainage plans and determined that Fields B and C utilized perforated drainage pipes causing the stormwater to normally infiltrate into the soil beneath the fields. Fields A and D utilized solid drainage pipes, which discharge the stormwater to local drainage systems at the sites, similar to an impervious surface.

For each precipitation event, stormwater collected at the fields was sampled for total metals, hardness, pH, volatile organic compounds, semi-volatile organic compounds (including rubber Tentatively Identified Compounds found by The Connecticut Agricultural Experiment Station in a 2007 study), pesticides/ polychlorinated biphenyls (PCBs) and acute aquatic toxicity (48 hours for *Daphnia pulex* (Dp)and 96 hours for *Pimephales promelas* (Pp)). Stormwater samples were analyzed at the Connecticut Department of Public Health Laboratory, Environmental Chemistry Division, Inorganic Chemistry Section, 10 Clinton Street Hartford, CT 06106 for pH, Hardness and Total Metals; at Phoenix Environmental Laboratories, Inc. 587 East Middle Turnpike, Manchester, CT 06040 for volatile organic compounds, semi-volatile organic compounds, pesticides, PCBs; and at GZA GeoEnvironmental, Inc., 120 Mountain Avenue, Bloomfield, CT 06002 for acute toxicity. A summary of the tests performed on the samples collected are shown in Table A below.

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6. DEP STORMWATER SAMPLING RESULTS

a) Method 624/Method 625 and Tentatively Identified Compounds (TICs):

No standard volatile or semi-volatile organic compounds were detected in any sample using the EPA 624 and 625 analytical methods. All samples were analyzed for non-standard semi-volatile organic compounds, including the following rubber compounds benzothiazole, butylated hydroxyanisole (BHA), n-hexadecane and 4-(t-octyl) phenol. The semi-volatile analysis detected the analytical peaks of twenty-two compounds, of which nine were tentatively identified (see Table B below). The concentrations of these compounds ranged from 1 ug/l to 150 ug/l. The grey columns in Table B correspond to the three stormwater samples determined to be acutely toxic. Table C details the aquatic toxicity information found for the other tentatively identified compounds listed in Table B.

b) Pesticides and PCBs (Method 608)

Pesticides

Pesticides were detected in the samples of stormwater collected on September 11, 2009 from Field C and on October 28, 2009 from Field D. DEET and heptachlor were detected at estimated concentrations of 6.9 ug/l and 0.18 ug/l, respectively. It is assumed that these substances were not derived from the artificial turf, but were a result of pesticide applications at the site.

PCBs

No PCBs were detected during the stormwater sampling events.

c) pH, Hardness and Metals:

The results from the pH, hardness and metals analysis conducted on the stormwater runoff from the fields are presented in the table below.

pH

The pH of the stormwater samples ranged from 6.6 to 8.0. The pH of stormwater in Connecticut is generally considered to be between 5.6 and 6.0. Based on this fact, the pH of the stormwater samples are more alkaline than expected. It is possible that the crushed stone used as a sub-base in the fields affected the pH of the stormwater as it drained through the field.

The pH alone does not exhibit toxic effects unless it falls below 5 or is higher than 10. However, metals are often more soluble and toxic at lower pH’s. The observed neutral pH in the stormwater may have reduced the concentrations and toxicity of the metals leaching from the fields.
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<td>2 ethyletra hydro thiopene</td>
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<td>2(3H)- Benzo thiazolone</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
Hardness

The hardness of the stormwater samples ranged from 8 to 59 mg/L. Hardness in the range of 0 to 60 mg/L is generally termed “soft”. Hardness can also influence the toxicity of metals; the greater the hardness, the less toxic the metals. It is not expected that the observed hardness had much effect on metal concentrations in the stormwater.

Metals

The metal parameters which had results reported above the detection limit are listed in Table C below. Silver, molybdenum, thallium and beryllium were analyzed but were below the detection limit for every sample. In Table C, the values bolded and underlined exceed Connecticut’s acute aquatic life criteria. Metal concentrations in excess of the acute aquatic life criteria for more than one hour could cause mortality to the more sensitive organisms in the receiving surface waters. The values bolded meet or exceed Connecticut’s chronic aquatic life criteria. Average metal concentrations which exceed the chronic life criteria for more than 4 continuous days are expected to impact the ability of organisms to survive, reproduce or grow. EPA recommends that neither of these criteria be exceeded more than once in three years (EPA TSD EPA/505/2-90-001). The samples highlighted in grey also exhibited acute toxicity. Since stormwater is an intermittent discharge, the acute criteria for aquatic toxicity are more applicable. A review of the data indicates that only zinc consistently violates the acute criteria.

TABLE D

<table>
<thead>
<tr>
<th>Location</th>
<th>Sample #</th>
<th>Sample date</th>
<th>pH</th>
<th>Hardness</th>
<th>Conductivity</th>
<th>Cu ug/l</th>
<th>Zn ug/l</th>
<th>Ba ug/l</th>
<th>Fe ug/l</th>
<th>Al ug/l</th>
<th>V ug/l</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field C 2005</td>
<td>A</td>
<td>9/11/09</td>
<td>6.6</td>
<td>NA</td>
<td>18</td>
<td>4</td>
<td>150</td>
<td>4</td>
<td>320</td>
<td>210</td>
<td>40</td>
</tr>
<tr>
<td>Field A 2007</td>
<td>B</td>
<td>9/27/09</td>
<td>6.6</td>
<td>8</td>
<td>20</td>
<td>1.5</td>
<td>130</td>
<td>1.5</td>
<td>20</td>
<td>25</td>
<td>1.5</td>
</tr>
<tr>
<td>Field A 2007</td>
<td>C</td>
<td>10/7/09</td>
<td>7.5</td>
<td>29</td>
<td>65</td>
<td>1.5</td>
<td>10</td>
<td>6</td>
<td>50</td>
<td>160</td>
<td>5</td>
</tr>
<tr>
<td>Field A 2007</td>
<td>E</td>
<td>10/18/09</td>
<td>7.5</td>
<td>39</td>
<td>86</td>
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<td>7</td>
<td>20</td>
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<tr>
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<td>D</td>
<td>10/18/09</td>
<td>7.6</td>
<td>53</td>
<td>130</td>
<td>5</td>
<td>260</td>
<td>220</td>
<td>170</td>
<td>120</td>
<td>6</td>
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<tr>
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<td>10/28/09</td>
<td>7.9</td>
<td>59</td>
<td>157</td>
<td>4</td>
<td>50</td>
<td>8</td>
<td>80</td>
<td>80</td>
<td>8</td>
</tr>
<tr>
<td>Field D 2007</td>
<td>G</td>
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<td>9</td>
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<tr>
<td>Field D 2007</td>
<td>H</td>
<td>12/3/09</td>
<td>8</td>
<td>58</td>
<td>147</td>
<td>4</td>
<td>20</td>
<td>5</td>
<td>170</td>
<td>100</td>
<td>8</td>
</tr>
</tbody>
</table>

acute standard <5.0 | >10 14.3 | 65 | 2000 | 780 | 150 |
chronic standard <5.0 | >10 4.8 | 65 | 220 | 1000 | 87 | 44 |
d) Aquatic Toxicity

The toxicity tests conducted on the stormwater measured both an LC50 value (the concentration of stormwater that is lethal to 50% of the test organisms) and an NOAEL (No Observable Acute Effect Level, the concentration of stormwater where no acute toxicity is observed). Toxicity tests conducted on the samples of stormwater collected indicate that 3 out of 8 sampling events were acutely toxic. Acute toxicity is observed when there is less than 90% survival of the test organisms in the undiluted effluent. The frequency of occurrence for acute toxicity was at least one sample per field. Where both *Pimephales promelas*(Pp) and *Daphnia pulex*(Dp) toxicity tests were conducted, the fathead minnow (*Pimephales promelas*) seemed to be slightly more sensitive to the contaminants in the stormwater discharge. Due to laboratory issues, the test duration for the fish, *Pimephales promelas*, for the October 18, 2009 Field A and Field D samples was limited to only 48 hours. If the test duration was extended to 96 hours, both samples could have had an LC50 value less than the 100% reported. The results for the aquatic toxicity testing conducted are shown in Table E below.

<table>
<thead>
<tr>
<th>Location:</th>
<th>Sample #</th>
<th>Sample date</th>
<th>Dp % Surv 100%</th>
<th>Dp LC50</th>
<th>Dp NOAEL</th>
<th>Pp % Surv in 100%</th>
<th>Pp LC50</th>
<th>Pp NOAEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field C 2005</td>
<td>A</td>
<td>9/11/2009</td>
<td>65.0</td>
<td>&gt;100</td>
<td>12.5</td>
<td>NT</td>
<td>NT</td>
<td>NT</td>
</tr>
<tr>
<td>Field A 2007</td>
<td>B</td>
<td>9/27/2009</td>
<td>70.0</td>
<td>&gt;100</td>
<td>50</td>
<td>45</td>
<td>93.89</td>
<td>50</td>
</tr>
<tr>
<td>Field A 2007</td>
<td>C</td>
<td>10/7/2009</td>
<td>100.0</td>
<td>&gt;100</td>
<td>100</td>
<td>100</td>
<td>&gt;100</td>
<td>100</td>
</tr>
<tr>
<td>Field A 2007</td>
<td>E</td>
<td>10/18/2009</td>
<td>100.0</td>
<td>&gt;100</td>
<td>100</td>
<td>96</td>
<td>&gt;100</td>
<td>100</td>
</tr>
<tr>
<td>Field D 2007</td>
<td>D</td>
<td>10/18/2009</td>
<td>70.0</td>
<td>&gt;100</td>
<td>6.25</td>
<td>50</td>
<td>100</td>
<td>25</td>
</tr>
<tr>
<td>Field D 2007</td>
<td>F</td>
<td>10/28/2009</td>
<td>100.0</td>
<td>&gt;100</td>
<td>100</td>
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<td>&gt;100</td>
<td>100</td>
</tr>
<tr>
<td>Field D 2007</td>
<td>G</td>
<td>11/20/2009</td>
<td>100.0</td>
<td>&gt;100</td>
<td>100</td>
<td>100.0</td>
<td>&gt;100</td>
<td>100</td>
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<tr>
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<td>100.0</td>
<td>&gt;100</td>
<td>100</td>
<td>95</td>
<td>&gt;100</td>
<td>100</td>
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</tbody>
</table>

Acutely toxic

7. CAES LABORATORY HEADSPACE AND LEACHING RESULTS

The CAES performed both headspace (off-gassing) and SPLP (Standard Precipitation Leaching Procedure) evaluations on seventeen samples of crumb rubber materials used as infill for artificial turf fields. These studies indicated the primary contaminants likely to be found in the stormwater coming from these sites. Organic compounds were identified by head space analysis, with results shown in Table F below. The other organic compounds detected from the crumb rubber infill, but not quantified in the analysis, included hexadecane, fluoranthene, phenanthrene and pyrene.
CAES also performed simulated weathering experiments on the crumb rubber samples to determine trends in organic compound emissions over time. The weathering test results show that, except for 4-(t-octyl)-phenol, all other detected volatile compounds significantly decreased in concentration after only 20 days of outdoor exposure. By the end of the eight week study, benzothiazole, butylated hydroxyanisole and 4-(t-octyl)-phenol were detected at the highest concentrations. The results are shown in Table G. below.

### TABLE G: (Table 9 from CAES, 2009) Concentrations (ng /ml) of Volatile Compounds in Headspace Over Crumb Rubber Samples Aged at CAES (average of two analyses per sample)

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>benzothiazole</th>
<th>1-methyl naphthalene</th>
<th>2-methyl naphthalene</th>
<th>4-(t-octyl)-phenol</th>
<th>naphthalene</th>
<th>4-(t-octyl)-phenol</th>
<th>butylated hydroxyanisole</th>
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</thead>
<tbody>
<tr>
<td>A1001</td>
<td>0.13</td>
<td>0.19</td>
<td>0.28</td>
<td>3.98</td>
<td>n.d.</td>
<td>0.42</td>
<td>0.50</td>
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<tr>
<td>A1002</td>
<td>0.11</td>
<td>0.15</td>
<td>0.31</td>
<td>5.59</td>
<td>n.d.</td>
<td>0.31</td>
<td>0.61</td>
</tr>
<tr>
<td>A1003</td>
<td>0.03</td>
<td>0.07</td>
<td>0.19</td>
<td>8.67</td>
<td>n.d.</td>
<td>0.10</td>
<td>0.68</td>
</tr>
<tr>
<td>A1004</td>
<td>0.04</td>
<td>0.07</td>
<td>0.31</td>
<td>6.52</td>
<td>0.15</td>
<td>0.16</td>
<td>0.69</td>
</tr>
<tr>
<td>A1005</td>
<td>0.08</td>
<td>0.09</td>
<td>0.23</td>
<td>2.35</td>
<td>0.09</td>
<td>0.23</td>
<td>0.46</td>
</tr>
<tr>
<td>A1006</td>
<td>0.08</td>
<td>0.14</td>
<td>0.31</td>
<td>4.89</td>
<td>0.12</td>
<td>0.23</td>
<td>0.75</td>
</tr>
<tr>
<td>A1007</td>
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<td>0.20</td>
<td>0.52</td>
<td>3.50</td>
<td>n.d.</td>
<td>0.23</td>
<td>0.69</td>
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<tr>
<td>A1008</td>
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<td>0.10</td>
<td>0.18</td>
<td>1.93</td>
<td>n.d.</td>
<td>0.22</td>
<td>0.43</td>
</tr>
<tr>
<td>A1009</td>
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<td>0.06</td>
<td>0.13</td>
<td>2.89</td>
<td>0.13</td>
<td>0.08</td>
<td>0.50</td>
</tr>
<tr>
<td>A1010</td>
<td>0.07</td>
<td>0.11</td>
<td>0.22</td>
<td>4.91</td>
<td>0.13</td>
<td>0.20</td>
<td>0.64</td>
</tr>
<tr>
<td>A1011</td>
<td>0.04</td>
<td>0.06</td>
<td>0.30</td>
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<td>0.11</td>
<td>0.62</td>
</tr>
<tr>
<td>A1012</td>
<td>0.08</td>
<td>0.14</td>
<td>0.46</td>
<td>2.70</td>
<td>0.13</td>
<td>0.28</td>
<td>0.64</td>
</tr>
<tr>
<td>A1013</td>
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<td>n.d.</td>
<td>0.30</td>
<td>0.65</td>
</tr>
<tr>
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<td>n.d.</td>
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<td>0.65</td>
</tr>
<tr>
<td>B1002</td>
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<td>n.d.</td>
<td>0.43</td>
<td>1.21</td>
<td>0.67</td>
<td>0.09</td>
<td>0.36</td>
</tr>
<tr>
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<td>n.d.</td>
<td>n.d.</td>
<td>0.07</td>
<td>1.29</td>
<td>0.48</td>
<td>0.06</td>
<td>0.35</td>
</tr>
<tr>
<td>B1010</td>
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<td>n.d.</td>
<td>0.06</td>
<td>1.03</td>
<td>0.40</td>
<td>0.05</td>
<td>0.34</td>
</tr>
</tbody>
</table>

CAES also performed an SPLP test on the same seventeen samples of the crumb rubber infill material. The resulting leachate was then analyzed for metals and organic compounds. Based on communications with CAES, the leachate contained the same organic compounds that were identified in the head space analyses, however, only benzothiazole concentrations were estimated for the test. A summary of compounds detected and their concentrations are listed in Table H below. Based on these results, the predominant contaminant leaching from artificial turf fields is
zinc, followed by barium, manganese and lead. It should be noted some metals associated with tires and rubber products were not analyzed in this experiment, such as iron and vanadium.

In Table H, the values which exceed Connecticut’s acute aquatic life criteria are highlighted in yellow. The summary shows that zinc is present in the leachate at concentrations about 500 times greater than the toxicity criteria. The leachate study indicates that there is a high potential for the artificial turf to leach acutely toxic levels of metals especially copper and zinc. Certain samples of crumb rubber also leached acutely toxic levels of cadmium, barium, manganese and lead.

**TABLE H**

<table>
<thead>
<tr>
<th>ug/l</th>
<th>Benzothiazole</th>
<th>Cr</th>
<th>Mn</th>
<th>Ni</th>
<th>Cu</th>
<th>Zn</th>
<th>As</th>
<th>Cd</th>
<th>Ba</th>
<th>Pb</th>
</tr>
</thead>
<tbody>
<tr>
<td>average</td>
<td>0.153</td>
<td>6.24</td>
<td>263.16</td>
<td>19.88</td>
<td>22.31</td>
<td>34170.5</td>
<td>3.35</td>
<td>1.60</td>
<td>313.88</td>
<td>11.57</td>
</tr>
<tr>
<td>80th</td>
<td>0.209</td>
<td>11.28</td>
<td>348.45</td>
<td>27.48</td>
<td>20.41</td>
<td>50269.8</td>
<td>1.50</td>
<td>0.50</td>
<td>463.62</td>
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</tr>
<tr>
<td>Max</td>
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<td>31.47</td>
<td>1443.19</td>
<td>57.15</td>
<td>143.32</td>
<td>71535.5</td>
<td>27.94</td>
<td>17.01</td>
<td>502.91</td>
<td>69.90</td>
</tr>
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<td>Acute</td>
<td>21333.000</td>
<td>323</td>
<td>616</td>
<td>260.5</td>
<td>14.3</td>
<td>65</td>
<td>340</td>
<td>2.02</td>
<td>2000</td>
<td>30</td>
</tr>
<tr>
<td>Chronic</td>
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<td>42</td>
<td>28.9</td>
<td>4.8</td>
<td>65</td>
<td>150</td>
<td>1.35</td>
<td>220</td>
<td>1.2</td>
<td></td>
</tr>
</tbody>
</table>

8. DISCUSSION

a) Potential Contaminants

The analyses performed on the stormwater samples were focused on compounds previously documented to leach from crumb rubber material derived from recycled tires, primarily volatile organic compounds, semi-volatile organic compounds and metals. The stormwater samples were also assessed for whole effluent toxicity. Other potential parameters of concern in the stormwater were identified from the results of the CAES off-gassing and leaching laboratory studies performed on the crumb rubber material.

b) Organic compounds

The stormwater generated at the artificial turf sites did not include many readily identifiable, volatile or semi-volatile organic compounds, as evidenced by no detections using EPA Methods 625 and 624. Additional semi-volatile compound investigations were performed on the stormwater samples, resulting in nine tentatively identified compounds and thirteen unidentified chromatograph peaks. Benzothiazole, which CAES also detected in their leaching analysis, was identified in the September 27 and October 7, 2009 samples from Field A at concentrations of 1 and 4.9 ug/l, respectively. Of the compounds that were tentatively identified such as benzothiazole, pentanoic acid, and thiopenes, none of these compounds are considered particularly toxic to aquatic organisms at the estimated concentrations.
Although it is not possible to determine the potential impact of the unidentified semi-volatile compounds, it is important to note, that the six highest concentrations of the unidentified semi-volatile compounds detected (150 ug/l, 28 ug/l, 14 ug/l, 12 ug/l, 10 ug/l and 9.5 ug/l) did not correspond to the three acutely toxic samples of stormwater determined in the study.

The results from the CAES laboratory headspace, leaching and simulated weathering tests suggest that benzothiazole, 4-(t-octyl)-phenol, 1-methyl naphthalene, 2-methyl naphthalene, naphthalene, butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) are the likely semi-volatile compounds to be found in the stormwater discharge from artificial turf fields. The test results also suggest that Benzothiazole, 4-(t-octyl)-phenol and butylated hydroxytoluene (BHT) would be the most persistent SVOCs in the crumb rubber as the artificial turf fields aged.

Comparing the VOCs and SVOCs results to EPA’s Maximum Contaminant Levels for drinking water (MCLs) and DEP’s Remediation Standards Regulations, Section 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies (June 1996), no exceedences of groundwater standards have been identified.

Based on our results, no VOCs or SVOCs have been identified as risks to surface and groundwater resources.

c) Metals

The laboratory leaching analyses performed by CAES as part of the State of Connecticut Artificial Turf Study detected the following metals: arsenic (As), barium (Ba), cadmium (Cd), chromium (Cr), lead (Pb), manganese (Mn), nickel (Ni), and zinc (Zn). Zinc was present in concentrations orders of magnitude greater than the other metals. CAES’s leaching analyses indicated that both copper (Cu) and zinc (Zn) concentrations exceeded acute aquatic toxicity criteria for 80% of the tests, with limited (<20%) exceedences of acute criteria for cadmium (Cd), manganese (Mn) and lead (Pb).

The stormwater analysis results show that the artificial turf fields in our study leached significantly less contaminants, specifically zinc and copper, than predicted by the CAES leaching test results. The lower metal concentrations observed in the stormwater could be a result of alkaline pHs, the weathering (2-4 years since installation) of the crumb rubber infill, or the conservative approach inherent in the SPLP methodology.

The stormwater analysis results showed that zinc was the only metal to exceed the acute aquatic toxicity criteria (65 ug/l), with one exceedence at each of the three study fields. The overall mean concentration of zinc in the stormwater samples analyzed was 84 ug/l, with a maximum of 260 ug/l and a minimum of 10 ug/l. The stormwater analysis results showed that aluminum, barium, copper and zinc all exceeded chronic aquatic toxicity criteria at least once during the sampling. Since chronic toxicity criteria apply to four days of continuous discharge, these exceedences are not of significant concern for these intermittent discharges.

No metal concentrations exceeded EPA’s and DEP’s drinking water standards. However, the concentration of zinc in three stormwater samples did exceed the surface water protection
criteria of 123 ug/l established in the Appendix D to Sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies Surface-water Protection Criteria for Substances in Ground Water (June 1996). Since the mean concentration of zinc in the stormwater samples (84 ug/l) is below the surface water protection criteria, the discharge from the artificial turf fields to groundwater is intermittent, and zinc is immobilized in soils by adsorption, absorption and precipitation, the potential for impacts to surface waters being recharged by this groundwater is minimal.

Based on our results, zinc has been identified as a potential risk to surface waters. No other metals have been identified as a risk to groundwater or surface waters.

9. ENVIRONMENTAL RISK ASSESSMENT

a) Potential Risk to Surface Waters

The only potential risk to surface waters identified in the stormwater collected from the artificial turf fields is zinc, since it was the only chemical parameter that was detected above the acute aquatic life criteria of 65 ug/l. Acute toxicity is assumed to occur when the zinc concentration in-stream exceeds 65ug/l for one hour in any three year period. In three of the eight stormwater samples analyzed, zinc concentrations were detected at 130, 150 and 260 ug/l, well above the acute aquatic life criteria. It is important to note, that the three stormwater samples with acutely toxic levels of zinc were also determined to exhibit aquatic toxicity (<90% survivorship) for both species *Pimephales promelas* and *Daphnia pulex* in the whole effluent toxicity testing.

Other than the acute aquatic toxicity criteria, there are no specific zinc standards or permit limits that are applicable to artificial turf fields. For industrial sites that discharge to surface waters, DEP has set a stormwater general permit guideline (Section 5 (c) (1) (F) (i) of the General Permit) for total zinc of 200 ug/l. This industrial stormwater total zinc guideline assumes a default 5:1 dilution factor for the receiving surface water at the 7Q10 flow. The 7Q10 is the lowest flow expected to occur for seven continuous days at a frequency of every 10 years. The 7Q10 flow is the critical low flow used when evaluating toxicity and toxic impacts (CT WQS 2002). Based on the results of our study, the stormwater discharges from artificial turf fields would not be expected to regularly exceed this zinc limit.

However, the estimated 7Q10 flows for the receiving watercourse from Fields A, C and D did not meet the 5:1 dilution factor for stormwater discharges from artificial turf football fields (57,600 square feet), assuming a one inch rain storm over one hour with direct discharge to the watercourse over an hour. It is important to note, that this a conservative approach, which assumes the watercourse receives no other stormwater runoff from its representative watershed. For the three receiving streams in the study, the highest dilution factor at the DEP estimated 7Q10 flow was equivalent to a 0.14:1 ratio. Given this dilution ratio of the receiving streams in the study, there is a potential for acute toxicity due to zinc loading.

Since zinc concentrations in stormwater from artificial turf fields may pose a risk to surface waters, especially to smaller watercourses, it is important to note that these fields are not the only sources of stormwater runoff in any given watershed. During the sampling at Fields A, C and D,
DEP staff observed stormwater runoff, generated by acres of parking lots, roadways and buildings, entering the same drainage systems that collected runoff from the artificial turf fields. Based on these observations, it appears that stormwater runoff from the artificial turf fields is combined with the runoff from the adjacent impervious surfaces prior to ultimate discharge at the site.

This is an interesting phenomenon, since the levels of zinc in urban runoff are comparable to the concentrations detected in the discharge from artificial turf fields. It has been well established that urban runoff contains many contaminants such as nutrients, suspended solids, hydrocarbons and heavy metals, including zinc. The average concentration of zinc in urban stormwater runoff has been estimated at 129 ug/l in recent studies (Smullen 1998). EPA’s Nationwide Urban Runoff Program (NURP) has collected runoff data and determined that for urban sites the median concentrations of total zinc ranged from 179 -226 ug/l. The National Stormwater Quality Database (NSQD, version 1.1), dated February 16, 2004, compiled zinc concentration data in runoff from various land uses across the United States, which is shown in Table L below.

<table>
<thead>
<tr>
<th>Land Uses</th>
<th>Zinc Total (ug/l) Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall (All Uses)</td>
<td>117</td>
</tr>
<tr>
<td>Residential</td>
<td>73</td>
</tr>
<tr>
<td>Mixed Residential</td>
<td>99.5</td>
</tr>
<tr>
<td>Commercial</td>
<td>150</td>
</tr>
<tr>
<td>Mixed Commercial</td>
<td>135</td>
</tr>
<tr>
<td>Industrial</td>
<td>210</td>
</tr>
<tr>
<td>Mixed Industrial</td>
<td>160</td>
</tr>
<tr>
<td>Institutional</td>
<td>305</td>
</tr>
<tr>
<td>Freeways</td>
<td>200</td>
</tr>
<tr>
<td>Mixed Freeways</td>
<td>90</td>
</tr>
<tr>
<td>Open Space</td>
<td>40</td>
</tr>
<tr>
<td>Mixed Open Space</td>
<td>88</td>
</tr>
<tr>
<td>CT Artificial Turf Stormwater</td>
<td>84 (mean)</td>
</tr>
</tbody>
</table>

Since zinc concentrations in the runoff from artificial turf fields are consistent with those associated with urban runoff, it would be a logical step to apply the same best management practices (BMPs) to mitigate the toxicity effects to surface waters. The 2005 Stormwater Management Manual for Western Washington specifically recommends the following BMPs to remove dissolved zinc (and other metals) from stormwater runoff: stormwater treatment wetlands, wet ponds, infiltration structures, compost filters, sand filters and biofiltration structures. The 2004 Connecticut Stormwater Quality Manual suggest the same measures since these treatment practices incorporate biological removal mechanisms that are more effective in removing pollutants than systems that strictly rely on gravity or physical separation of particles in the stormwater. The 2004 Connecticut Stormwater Quality Manual further recommends a treatment train approach, which provides a series of BMPs each designed to provide targeted pollution control benefits.
The University of New Hampshire Stormwater Center has field tested many of these stormwater BMPs that demonstrate significant removal of dissolved zinc. For example, the Retention Pond, Subsurface Gravel Wetland and Bioretention System (Bio II) stormwater treatment measures, over a two year period, removed between 90% and 100% of the soluble zinc, based on a median annual influent Event Mean Concentrations (EMC) of 60ug/l (see Appendix B for fact sheets). The three highest zinc concentrations detected in the stormwater from artificial turf fields in our study were 130, 150 and 260 ug/l, respectively. Assuming 80% removal of zinc from the stormwater prior to discharge to surface waters, all three of the highest zinc concentrations would meet the acute aquatic toxicity criteria (26, 30 and 52 ug/l, respectively). To mitigate the risk to aquatic life and surface waters, the DEP strongly recommends that the aforementioned stormwater best management practices be incorporated into the design of the drainage system for artificial turf fields.

10. ENVIRONMENTAL RISK ASSESSMENT IN RECENT STUDIES

Several other studies were conducted to determine the risk to surface waters and groundwater from the stormwater discharges from artificial turf fields. Since artificial turf fields can either discharge to groundwater or surface water, the ecological risks must be evaluated for both potential pathways. This was confirmed by Nilsson et al (2008), that drainage from artificial turf fields can enter the environment by either seeping through the underlying soil and potentially contaminating the groundwater, or alternatively, by stormwater runoff entering the adjacent watercourses.

a) Overall Surface Water Contamination Risk

1) Organic Compounds

The studies conducted by Plessler (2004) indicated that concentrations of the common polycyclic aromatic hydrocarbons (PAHs) anthracene, fluoranthene and pyrene, as well as nonylphenols, would exceed the limits for freshwater specified in the Canadian Environmental Quality Guidelines. Torsten (2005) from the Norwegian Institute for Water Research (2005) also predicted that concentrations of alkyl phenols and octylphenol in particular would exceed the limits for environmental effects in the scenario which was allowed a 10:1 dilution of run-off. Torsten (2005) further determined that the leaching of chemicals from the materials in the artificial turf system would decrease slowly, so that environmental effects could occur over many years. However, Torsten (2005) anticipated only localized impacts due to the relatively small concentration of the leaching pollutants. The SVOCs analysis of the stormwater in our study, utilizing EPA Method 625, and a specific search for 4-(t-octyl)-phenol, detected no anthracene, fluoranthene, pyrene or standard phenol compounds.

Kolitzus (2006) detected no appreciable PAHs concentrations in the runoff analyzed from artificial surface systems. The PAHs that were found above detection limit were ubiquitous substances in the environment. The PAH concentrations in the unbound supporting layer were determined to be in the range of analytic determination limit (0.02 μg/l). The sum of all 16 PAHs was 0.1 to 0.3 μg/l. Similarly, in a recent New York study (Lim et al 2009), no standard organics were detected utilizing EPA Method 624 and 625 in the stormwater sample collected. The
SVOC analysis of the stormwater in our study, utilizing EPA Method 625, detected no standard PAHs.

In surface systems with EPDM and recycled rubber infill, Kolitzus (2006) found several aromatic amino complexes and benzothiazole detected in the range of 10 – 300 μg/l. These concentrations were similar to the results of simulated normal tire wear tests. Lim et al (2009) reported a semi-volatile rubber compound, benzothiazole, at 1,000 ug/l as a Tentatively Identified Compound (TIC) in one stormwater sample. The SVOC analysis of the stormwater in our study, utilizing EPA Method 625, detected no standard aromatic amines, but further TIC analysis did detect identified and unidentified organic compounds. Benzothiazole was detected in two stormwater samples at estimated concentrations of 1.0 and 4.9 ug/l, respectively, which is significantly lower than concentrations found by Lim et al (2009). The Connecticut acute and chronic toxicity benchmark for benzothiazole are 21,333 ug/l and 3,200 ug/l, respectively, based on available toxicity information. The estimated concentrations of benzothiazole are insignificant compared to both the acute and chronic toxicity criteria. Also, a number of unidentified organic compounds were detected during the SVOC TIC analysis at concentrations ranging from 1 ug/l to 150 ug/l, with a median concentration of 6.6 ug/l. The 10/7/09 Field C stormwater sample, which the maximum unidentified compound concentration of 150 ug/l was detected in, was not found to be acutely toxic.

The results from our study appear to be consistent with the results from Kolitzus (2006) and Lim et al (2009), including the detection of benzothiazole in the stormwater samples. Overall, our study did not identify any organic compounds at sufficient concentrations to be considered a potential contamination risk to surface waters.

2) Metals

Based on our analysis of the stormwater collected from the artificial turf fields, zinc is the only metal detected in concentrations which could pose a risk to surface water resources. This finding is consistent with many recent studies which analyzed leachate and stormwater from crumb rubber infill, which indicate that zinc is the primary contaminant of concern coming from artificial turf sites. In sites with limited dilution both the Norwegian Pollution Control Authority (2005) and Verschoor (2007) conclude that the concentration of zinc in the leachate would exceed applicable water quality standards. The Norwegian Pollution Control Authority classifies artificial turf runoff as Environmental Quality Class V (very strongly polluted water) due to the high concentration of zinc in the leachate. The risk assessment conducted by Norwegian Institute for Water Research (2005) shows that the concentration of zinc poses a significant local risk of environmental effects in surface water which receives run-off from artificial turf fields.

Verschoor (2007) also conducted a risk assessment concluding that the estimated concentrations of zinc in the drainage water from artificial football fields to be between 1100-1600 ug/L. This concentration exceeded the Dutch legal criterion for surface water Maximum Permissible Chronic Concentration (MPC) of 40 ug/l by a factor of 27-40. Verschoor explained that drainage water concentrations would be diluted in the receiving surface waters, but indicated that zinc in “small ditches” could exceed MPA (Maximum Permissible Acute). Verschoor espoused a general discharge impact rule that only 10% of the permissible concentration of a contaminant (=
4 ug/l) may be consumed by a particular source. This would imply that the concentration of zinc in smaller receiving water would exceed the water quality criteria by a factor of 45-80.

Verschoor identified zinc as a potential eco-toxicological risk to surface water, but did indicate that if the crumb rubber were to be replaced by infill materials with a lower zinc emission, the pollutant concentrations in runoff and adjacent surface water should drop quickly.

Lim et al (2009) conducted a mathematical assessment of the risks to aquatic life from crumb rubber leachate based on the SPLP test results for zinc, aniline and phenol. Based on these concentrations, NYSDEC’s Division of Fish, Wildlife and Marine Resources concluded that there may be a potential aquatic life impact due to zinc being release from crumb rubber solely derived from truck tires. However, New York State also concluded that an impact is unlikely if the crumb rubber material is from mixed tires and concentrations of zinc from a column test were used rather than the SPLP. It should be noted, that for the column test to better simulate field conditions, the material in the column must reflect local soil conditions and pH.

Several recent studies analyzed stormwater samples collected from artificial turf fields for metals. Lim et al (2009) and Kolitzus (2006) detected concentrations of zinc at 59.5 ug/l and 20 ug/l, respectively. Milone and MacBroome (2008), conducted field studies and detected zinc in the stormwater from four of the six sampling dates, with a maximum concentration of 31 ug/l which is below acute aquatic toxicity criteria of 65 ug/l.

The zinc concentrations in our stormwater samples were significantly higher than those of Lim, Kolitzus and Milone and MacBroom, with three of the eight the samples tested exceeding acute surface water quality criteria. If not mitigated with appropriate stormwater treatment measures, the zinc concentrations found in our study could contribute to the environmental risk of aquatic organisms in surface waters.

3) Aquatic Toxicity

Wik (2006) studied the toxicity of various tire brands and determined that different formulas for rubber contributed to varying degrees of toxicity in the leachates to *Daphnia magna*. By conducting a toxicity identification evaluation on various tire leachates (EPA 600/6-91/003), Wik determined that although zinc was prevalent, the semi-volatile non polar organics also heavily influenced the toxicity of the resulting leachate. Passing the simulated tire leachates through carbon filters was the only manipulation that consistently reduced toxicity. Compared to the results from Milone and MacBroom (2008), this study reported significantly higher levels of both aquatic toxicity and zinc. This study found that three of the eight stormwater samples tested were acutely toxic to both the invertebrate (*Daphnia pulex*) and the fathead minnow (*Pimephales promelas*). These acutely toxic samples directly coincided with the exceedences of the acute aquatic life criteria for zinc. Consequently, zinc seems to be the primary pollutant of concern. This study indicates that there is risk associated with whole effluent toxicity and zinc.

b) Overall Groundwater Contamination Risk

Stormwater from the fields can impact groundwater directly by percolating through the artificial turf via an “open” underground drainage system (perforated pipes, coarse bedding materials, stone trenches). The stormwater discharges to the underlying soil layers, and ultimately, enters
the ground water. Based on the nature of the underlying soil and the depth to groundwater, the field stormwater is likely to physically and chemically interact with a mineral soil layer (vadose zone) prior to encountering groundwater. This stormwater/soil interaction would be affected by pH, volume of stormwater and soil characteristics, such as moisture, chemistry, mineralogy, soil texture, hydraulic conductivity and drainage class. These interactions would likely influence the concentrations of contaminants found in the groundwater.

There are two primary concerns with the contamination of groundwater in the environment - the threat to drinking water and the threat to surface water resources via groundwater recharge. Several other studies were conducted on the crumb rubber fill from 2004 to 2009; (Plesser(2004), Nilsson et al (2008), the Norwegian Institute for Water Research (2005), Verschoor, A.J., RIVM Report 601774011/2007(2007) Study, (Milone & MacBroom Study 2007), NYSDEC May 2009 an Kolitzus, Hans J. (2006). These studies compared the relative concentration of contaminants found in laboratory leachates and/or artificial turf generated stormwater with various drinking water and aquatic life criteria.

1) Organic Compounds

It should be noted that substances, to a varying degree, will be absorbed by the sand/clay layers which the drainage water passes. Although Nilsson et al (2008) found that concentrations of nonylphenols in the contact water from leaching tests were in the order of 20-800 times above the threshold values for drinking water, it was uncertain as to whether this concentration would be significant in the actual groundwater. The EPA aquatic life acute criteria for nonylphenol for freshwater and saltwater resources are 28 ug/l and 7.0 ug/l, respectively. It is important to note that nonnyphenol has been associated with the disruption of fish endocrine systems at concentrations below EPA’s criteria. No data was available for phthalates and nonylphenols under such realistic conditions from lysimeter data. Nilsson determined that the assessment of the impact on water systems also requires more realistic lysimeter tests or measurements on drainage water from artificial turf fields over time.

Plesser (2004) compared leachate results with Canadian Environmental Quality Guidelines for ground water. Groundwater guidelines are developed for both protection of drinking water and protection of surface water via groundwater recharge. Plesser identified anthracene, fluoranthene, pyrene and nonylphenols as compounds in the leachate that could exceed the more protective criteria for groundwater. Plesser also concluded that analyzing possible paths and changes in leaching properties over time is necessary to determine the degree to which the concentrations of these compounds are actually harmful to people and the environment.

Lim et al (2009) conducted a leachate (SPLP) test on rubber crumble material, and analyzed for zinc, phenol and aniline. The results from recent leaching studies indicated a potential for release of aniline, benzothiazole, phenol, and zinc to the groundwater. However, concentrations of the organic contaminants analyzed were below levels that would impose a risk to drinking water. Lim also collected 32 groundwater samples from wells installed downgradient of four artificial turf fields and analyzed them for SVOCs, including aniline and benzothiazole, using SW-846 Method 8270C. The wells were installed in sandy textured soils with depth to the groundwater ranging from 8.3 to 70 feet. All test results were below the limit of detection for all
groundwater samples analyzed. Based on test results of 32 samples, no organics were detected in the groundwater at the turf fields.

Our results are consistent with the leachate and groundwater sampling results in Lim et al (2009). The concentrations of organic compounds in our study did not exceed groundwater protection criteria.

2) Metals

In general, metals are immobilized in soils by adsorption, absorption and precipitation. All of these mechanisms impede movement of the metals to ground water. Metal-soil interaction is such that when metals are introduced at the soil surface, downward transportation does not occur to any great extent unless the metal retention capacity of the soil is overloaded, or metal interaction with the associated waste matrix enhances mobility.

Zinc is the most prevalent contaminant in the leachate and stormwater studies. In several of these studies, zinc concentrations measured in leachate exceeded drinking water standards. Most of the zinc in soil is absorbed to the soil as zinc hydroxide or oxide and does not dissolve in water. Zinc does show moderate mobility under relatively acid soil conditions (pH 5–7) because of increased solubility and formation of soluble complexes with organic ligands (Elliott et al. 1986; Stevenson and Fitch, 1986; Klamberg et al. 1989). Zinc is retained in an exchangeable form at low pH in iron and manganese oxide dominated soils but becomes non-exchangeable as the pH was increased above 5.5 (Stahl and James, 1991). Therefore, depending on the acidity of the soil and water, some zinc may reach groundwater.

Nillson et al (2008) determined that although leachate concentrations of zinc were in excess of the drinking water quality standards, similar concentrations were not observed in (field) lysimeter tests. Nillson concluded that the concentration of zinc in the lysimeter tests were a more accurate reflection of zinc in the groundwater and, therefore, zinc concentrations would not exceed drinking water standards.

Lim et al (2009) was the only study that did not report concentrations of zinc in the SPLP leachate that exceeded drinking water standards.

Verschoor (2007) concluded that, for the majority of situations, the risks of zinc to public health are minimal since it is not very toxic to humans and the World Health Organization (WHO) drinking water criteria was not exceeded in tests. However, Verschoor (2007) did note that in sandy areas discharges to groundwater may exceed Dutch Intervention Values by a factor of 1.5 to 2.2. In sandy soils, infiltration of water with dissolved zinc will result in weak binding of zinc to the soil matrix and could cause protection criteria to be exceeded by a factor of 12. Verschoor concluded that zinc was a potential eco-toxicological risk to groundwater and soil.

Plessner (2004) and CAES (2009) indicated that zinc was the most likely contaminant to exceed drinking water standards in the leachate. All studies indicate that, although compounds were present in the leachate or stormwater, it was uncertain as to what affect the underlying soils and groundwater would have on the actual concentration of contaminants in the groundwater. Actual groundwater testing may be necessary to determine the impact.
The leachate results reported by CAES showed zinc concentrations up to ten times the drinking water standards and up to 500 times the surface water protection criteria. Our study detected concentrations of zinc in the stormwater significantly lower than CAES results, with no exceedences of drinking water standards and no significant concerns for groundwater quality. It is important to note that no groundwater samples were collected for our study.

11. CONCLUSIONS

The DEP concludes that there is a potential risk to surface waters and aquatic organisms associated with whole effluent and zinc toxicity of stormwater runoff from artificial turf fields. Zinc concentrations in the stormwater may cause exceedences of the acute aquatic toxicity criteria for receiving surface waters, especially smaller watercourses. The DEP suggests that use of stormwater treatment measures, such as stormwater treatment wetlands, wet ponds, infiltration structures, compost filters, sand filters and biofiltration structures, may reduce the concentrations of zinc in the stormwater runoff from artificial turf fields to levels below the acute aquatic toxicity criteria. Individual artificial turf field owners may want to evaluate the stormwater drainage systems at the fields and the hydrologic and water quality characteristics of any receiving waters to determine the appropriateness of a stormwater treatment measure.

This study did not identify any significant risks to groundwater protection criteria in the stormwater runoff from artificial turf fields. It is important to note, that the DEP study did not directly collect and analyze groundwater at these artificial turf fields. Consequently, this conclusion regarding consistency with groundwater protection criteria is an extrapolation of the stormwater results collected and the evaluation of data presented in recent studies, such as Nillson et al (2008) and Lim et al (2009). To make a final conclusion regarding the overall risk from exposure to groundwater affected by stormwater runoff from artificial turf fields, further sampling and analysis of groundwater at the artificial turf fields would be required.

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Natural Landscaping and Artificial Turf: Achieving Water Use and Pesticide Reduction

By Alex Wilson and Jessica Boehland

What’s Wrong with the Conventional Lawn

Throughout North America today, the dominant landscaping aesthetic is a broad, open lawn punctuated by trees and shrubs. While this landscaping system has been engrained into us through our culture and media, it creates an ecologically depleted landscape that requires significant amounts of resources and chemicals to maintain, especially in dry climates.

Conventional lawns require inputs of water and energy while causing air, water, and noise pollution. Annually in the U.S. we spend tens of billions of dollars caring for them. In some areas we use over half of our municipal freshwater to irrigate lawns, and we fortify them with millions of tons of fertilizer and thousands of tons of pesticides. What’s wrong with this picture?

From an environmental, health, and even economic standpoint, a lot is wrong with conventional turf. Maintenance of turf necessitates regular mowing during the growing season, which is responsible for approximately 5% of the nation's air pollution, according to the U.S. Environmental Protection Agency (EPA)—and a good deal more in many metropolitan areas. A typical 3.5 horsepower gas mower emits about the same quantity of volatile organic compounds (VOCs) in one hour as a late-model car driven 340 miles (550 km), according to the California Air Resources Board. On top of that, EPA estimates that users of such equipment spill 17 million gallons of fuel each year—which is more than the Exxon Valdez oil spill!

Watering lawns consumes 30% of municipal freshwater in the eastern U.S. and 60% in the West. A U.S. News & World Report article reported that a 1,000 square-foot (93 m²) lawn requires, on average, 10,000 gallons (37,850 liters) per summer. With droughts continuing in the West and expected to increase in severity as a result of global climate change, this is a growing concern.

To maintain lush lawns, we use a lot of fertilizer—some 70 million tons (64 million tonnes) per year in the U.S. We use more fertilizer on our lawns in the U.S. than India uses on its food crops. Nitrogen fertilizers are produced by converting molecular nitrogen (N₂) in the air into ammonia through the Haber-Bosch process, which is extremely energy-intensive, requiring approximately 18,000 Btus per pound (41 GJ/tonne) of primary energy input, which comes primarily from natural gas. Worldwide, ammonia production accounts for approximately 1% of global primary energy use.

Insecticides, herbicides, fungicides, and other pesticides are a growing concern with lawns. U.S. homeowners use 67 million pounds (30 million kg) of pesticides on lawns each year, according to EPA. Our suburban lawns and gardens receive heavier pesticide applications than our agricultural land: between 3.2 and 9.8 pounds per acre (3.6—11 kg/ha) vs. an average of 2.7 pounds per acre (3.0 kg/ha) for agricultural lands.

Along with the resource and environmental burdens of producing fertilizers and pesticides, a significant portion of these chemicals applied to lawns ends up in stormwater runoff and in groundwater. According to EPA, 40–60% of the nitrogen applied to lawns ends up in surface water or groundwater. Stormwater runoff from turf is one of North America’s biggest sources of water pollution.

Noise pollution is another concern. Lawnmowers, weed whackers, hedge trimmers, and leaf blowers cause significant noise pollution, a very real but often overlooked health hazard.

Due to the need for all this maintenance, lawns are a huge expense. Homeowners spend roughly $27 billion per year on lawn care, according to the National Wildlife Federation (NWF)—ten times more than we spend on school textbooks.

At the business level, the lawn care industry did approximately $61 billion in business in 1997 and has been experiencing roughly 20% annual growth in recent years. On a per-acre basis, maintenance costs for mowing, irrigation, and application of fertilizer and pesticides average $1,120 per year, according to the organization Wild Ones Natural Landscapers.

Bene its o Natural Landscaping

http://www.fmlink.com/article.cgi?type=Sustainability&pub=BuildingGreen&id=40602&m... 6/3/2011
Just as there are significant environmental burdens and costs associated with conventional turf landscaping, there are benefits associated with natural landscaping. The primary benefits are described below.

**Reduced air pollution.** Native landscaping generally does not require regular mowing, which eliminates or greatly reduces the air pollution resulting from turf landscapes. There can be pollution emissions from natural landscaping, however—see discussion below on pollution from fire management.

**Reduced nutrient runoff.** Native landscaping does not require fertilizer, so the runoff and infiltration of nutrients is eliminated. Buffers of natural landscaping can be used to capture runoff from hard surfaces or less permeable turf to keep the pollutants in that stormwater from entering surface waters. Keeping nutrients out of the groundwater also protects surface waters, because groundwater surfaces in springs and flows into streams and rivers.

**Reduced pesticide use.** Because natural landscaping involves the establishment of balanced ecosystems, the use of herbicides, insecticides, and other pesticides is generally not required (though herbicides are often used to remove invasive plants during the establishment of natural landscapes). Reduced operation of lawnmowers and other lawn-care-related power equipment reduces air pollution both locally and regionally, thus improving health. And keeping pollutants out of water supplies also protects our health.

**Increased biodiversity.** Natural landscapes inherently support greater biodiversity than conventional turf landscapes. Native plants provide diverse food and habitat for birds, small mammals, insects, reptiles, and amphibians. In heavily developed urban areas, even small patches of natural landscape can be critical in maintaining populations of native fauna and flora.

**Cost avoidance.** Significant savings in landscape management costs can be realized by converting lawns to natural landscapes. While the initial costs of creating natural landscapes can be relatively high, annual operating costs of established natural landscapes are generally far lower than annual operating costs of lawn area. Operating cost savings were a primary motivation for the Metropolitan Water Reclamation District of Chicago to convert turf area to tall-grass prairie—to date, approximately 20 acres (8 ha) of turf has been restored to natural landscape, with guidance from Conservation Design Forum of Elmhurst, Illinois.

**Downsides of Natural Landscaping**

While the arguments for natural landscaping are compelling, there are some challenges:

- The aesthetic palette is more limited. Strict adherence to an all-native landscaping program restricts plant choices, which many property owners (as well as landscape architects and landscapers) object to.
- Establishing and maintaining natural landscapes requires new knowledge and skills. There are both direct and indirect costs associated with building these skills, and there is often inherent resistance to change in any profession.
- Fire management, a key component of many—if not most—natural landscapes, poses obvious risk and liability. These risks gained national attention when, on May 4, 2000, a prescribed burn at Bandelier National Monument in Los Alamos, New Mexico, got out of hand and burned nearly 48,000 acres (19,400 ha), destroying 400 homes and causing more than a billion dollars in damage.
- Fire management also generates air pollution. Depending on the type of landscape and the weather conditions during a prescribed burn, however, these emissions are usually fairly low.

**Establishing Natural Landscapes**

The key to establishing natural landscapes is careful planning to ensure that adequate management and stewardship is carried out until the landscape is established, at which point maintenance requirements become fairly minimal. Natural habitat landscaping is not about individual plant species but about ecosystems. With natural landscaping, the goal is to create balanced, self-sustaining ecosystems, not just assemblages of individual native plants. Because almost any ecosystem existing today has been degraded to some extent, creating a healthy, largely self-sustaining landscape often
Dealing with invasive plants

Invasive exotic plants are the bane of natural landscaping. Hundreds of plant species are wreaking havoc in ecosystems throughout North America. Each region of the country has particular invasive plant species that are problematic: from kudzu in the Southeast to honeysuckle and Japanese knotweed in the Northeast to cheatgrass and garlic mustard in the Midwest and West.

Strategies for removal of invasive plants all have advantages and disadvantages: hand-pulling is labor-intensive but safe for the environment; herbicides (such as Roundup©) are fast and easy but may have unintended consequences for other organisms in the ecosystem; turning over the soil (to kill turf grass, for example) avoids chemicals but may damage the soil structure and soil microorganisms; prescribed burns are often the best method to control invasives and allow the ecosystem to return to a pre-European settlement balance, but they cause safety concerns and air pollution.

The success of invasive plants is often related to changes in overall habitat conditions. When conditions that favor native species are restored through such restoration management tools as selective clearing to provide appropriate light levels and annual burn management, the invasive species are often gradually eliminated.

Converting turf to natural landscapes

A number of approaches can be taken to convert turf or other invasive vegetation to natural (restored) ecosystems. Short-lived herbicides are effective, and have the advantage of keeping root systems in place to help prevent erosion while new species are being established. Mechanical strategies, including repeated discing and harrowing, are also effective, and do not present any toxicity concerns. Sometimes simply easing off on mowing allows native species to gradually return—if native species are growing nearby—but this approach yields less certain results than complete replacement of the existing vegetation, and often nearby intact habitats do not exist.

In designing landscapes that will be managed with controlled burns, firebreaks often make sense. Roads can serve as firebreaks. Bands of turf grass along road corridors and around building can make sense to keep fire under control.

Increasing people's comfort with natural ecosystems

Given the American infatuation with lawns, social and psychological factors often emerge as barriers to natural landscape designs. Joan Nassauer, Ph.D., FASLA, of the University of Michigan, has researched human responses to various landscape designs.

Her research suggests that most Americans (indeed, people in most Western cultures) are uncomfortable with landscapes that they perceive to be wild or unmaintained, but are attracted to natural plantings within an obviously managed context. Signs of human care and attention to a space, whether it is a recently mown lawn or a freshly painted picket fence, represent what Nassauer calls “cues to care.” Thus, boundaries of well-maintained turf around naturally landscaped areas not only provide firebreaks but also increase most people's comfort level with the native plantings.

Which Grass is Greener? Comparing Natural and Artificial Turf

Another alternative to the resource-intensive conventional lawn is artificial turf. Early adopters of plastic grass were professional sports teams, who had the cash to spend on the newest technologies. Artificial turf continues to replace natural playing fields not just for the pros but for college-level athletes and Little Leaguers alike.

And it doesn't stop there. Artificial turf is replacing grass in a variety of applications, ranging from community parks to parking-lot medians, and even outside American homes. Plastic grass sidesteps many of natural turf's downsides, but could it possibly be greener than grass itself?

Early Artificial Turf

The first artificial turf, which would become known as AstroTurf, was made by the Chemstrand Company, a subsidiary of the Monsanto Company, and installed in 1964 at the Moses Brown School in Providence, Rhode Island. In 1965, Monsanto's artificial turf was laid in Houston's Astrodome, the largest indoor sports facility in the world at the time.

Popular for its convenience, early artificial turf was largely loathed by the athletic community. First-generation artificial turf was typically stiff, low-pile polypropylene or nylon fiber adhered to a concrete or asphalt base. The fibers caused "turf burn," the hard base was less forgiving than soil, and athletes are united in their claims that first-generation turf caused more injuries than grass. Although this primitive turf is still available, it has been largely superseded by softer, safer, more naturalistic surfaces.

In the early 1990s, artificial turf began expanding from playing fields to other uses. Increasing incidences of drought, concern over the dangers posed by pesticides, and the grasslike look and feel of modern artificial turf have led to increasingly use of plastic grass in parks, day care centers, dog runs, and the yards of homes and businesses.

Secon Generation Artificial Turf
Artificial turf needs no mowing, watering, fertilizing, aerating, or reseeding, and it will not outgrow its painted field lines; the rubber bits in the crumb layer of artificial turf are often made from recycled tires. Memorial Stadium field at the University of Nebraska—Lincoln used 14,000 recycled Nebraska tires. Some artificial turf also incorporates recycled tennis shoes. If it is replaced before it is worn out, artificial turf can be reused. When Aloha Stadium, in Honolulu, Hawaii, upgraded its fields in 1999, and again in 2003, state officials donated the used AstroTurf to local high schools. RS Global, Inc., based in Carrollton, Texas, has removed artificial turf from more than one hundred used fields over the past three years. RS Global breaks the turf into pieces for use in smaller applications, such as batting cages.

Reduced water use.
From an environmental perspective, the potential for water savings is probably the most significant benefit of artificial turf. Plastic grass, of course, needs no irrigation to stay green. The only water used on artificial turf is to cool it down in extremely hot conditions or clean it, if necessary. The City of San Marcos, Texas awarded Southwest Texas State University with a Water Efficiency Achievement Award in 2003 for converting the natural field at Bobcat Stadium to SRI's AstroPlay ©, a move which the school estimates is saving more than 2 million gallons (7.5 million liters) of water each year.

Reduced pesticide and fertilizer use.
Since artificial turf needs no regular chemical treatment, it eliminates a major source of non-point-source groundwater pollution and human exposure to chemicals. For residential applications, artificial turf also offers the benefit of reducing the amount of chemicals (and dirt) tracked into homes. Artificial turf's chemical-free care may make it especially appropriate for daycare centers and dog yards, because children and pets spend more time than adults in close contact with grass, and they are affected more severely by contact with pesticides.

Reduced maintenance.
Artificial turf needs no mowing, watering, fertilizing, aerating, or reseeding, and it will not outgrow its painted field lines; synthetic grass, though, demands its own maintenance regimen. Caring for residential artificial turf generally involves just the occasional use of a leaf blower or a carpet rake. When necessary, artificial turf can be washed with a garden hose. Biological material, including leaves and feces, will not decompose as quickly on plastic as on natural grass, so just the occasional use of a leaf blower or carpet rake may be enough. Artificial turf also contributes to the urban heat-island effect. Although they look green from an angle, artificial fields are often closer to black when viewed from above, owing to the rubber layer surrounding the blades. Darren Gill, marketing manager for artificial turf company FieldTurf, says that in direct sun, artificial turf averages between 6 and 10°F (3—5°C) warmer than grass, though he's seen differences as high as 15°F (8°C). He also mentioned that in especially warm climates, maintenance staff sometimes spray sports fields with water once or twice a day to keep them cool. This trendiness to heat up in hot weather makes artificial fields less appropriate in southern climates. Gill stresses that artificial turf cools quickly when it's not in direct sun.

Benefits of Artificial Turf

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Turf, Air quality and the Atmosphere

Through the process of photosynthesis, grass converts carbon dioxide to oxygen and other gases. Turfgrass Producers International (TPI) claims that a 2,500 ft² (230 m²) lawn releases "enough oxygen for a family of four to breathe." Simultaneously, the absorption of carbon dioxide mitigates to some extent the process of global climate change. Another argument for natural grass is its ability to cool the surrounding area through evapotranspiration. According to TPI, lawns are 14°F (8°C) cooler than bare soil on hot days, or 30°F (17°C) cooler than asphalt. Natural grass also helps to clean the air: grass areas trap 12 million tons (10.8 million tonnes) of dust and dirt from the air each year, TPI reports, and some studies have shown that grass absorbs carbon monoxide.

Artificial turf, in contrast, frequently offgasses volatile organic compounds (VOCs). This could be a concern for children, who are often more sensitive to emissions, and especially for the rapidly growing number of Americans with asthma. Artificial turf also contributes to the urban heat-island effect. Although they look green from an angle, artificial fields are often closer to black when viewed from above, owing to the rubber layer surrounding the blades. Darren Gill, marketing manager for artificial turf company FieldTurf, says that in direct sun, artificial turf averages between 6 and 10°F (3—5°C) warmer than grass, though he's seen differences as high as 15°F (8°C). He also mentioned that in especially warm climates, maintenance staff sometimes spray sports fields with water once or twice a day to keep them cool. This trendiness to heat up in hot weather makes artificial fields less appropriate in southern climates. Gill stresses that artificial turf cools quickly when it's not in direct sun.
Ecology

Of the 50 species cultivated for use as turf, only a handful dominate the market. In colder climates, four or five species are typically mixed for each application, according to Joyce, while in warmer climates turf is generally close to a true monoculture. The species of grass we commonly use on our lawns did not evolve here and are not adapted to America's climates and ecologies. Left to their own devices, most of these grasses would happily go dormant and turn brown during dry spells. Even where these species are native, they do not naturally grow in a monoculture, bereft of other plant species, as we expect them to do on our lawns and golf courses. Intruding plants and animals are called weeds and pests, and we obliterate them with chemicals. DDT, once a popular turf grass pesticide, was actually marketed as “the atomic bomb of the insect world.”

A new movement in turf management shows some promise of improvement for biodiversity. In order to avoid the need for pesticides, fertilizers, and irrigation, some homeowners are planting grass species that are drought-tolerant or native to their climates. Buffalo grass, for example, native to America's central and southern Great Plains, is gaining popularity in hot climates. The Prairie Nursery Corporation, based in Wisconsin, has been marketing a mix of native fescue grasses for lawns since 1993. Their No Mow mix, including cool-season fescue grasses native to Oregon and Canada, was designed for the colder, less sunny climate of the northern U.S.

Kim Sorvig, research associate professor at the University of New Mexico, and co-author of Sustainable Landscape Construction: A Guide to Green Building Outdoors, is concerned about the soil conditions under artificial turf. “It blocks both water and sunlight either completely or in very large degree,” he said, “and without that, you can't have a living system in the soil.” Sorvig thinks it is ironic that artificial turf is heralded as a solution to water shortages, since it diminishes the health of the underlying soil, thereby decreasing its ability to hold water. “When you remove the vegetation from an area so completely,” he said, “you're actually, in the long term, contributing to drought.”

The only application for which Sorvig believes artificial turf is appropriate is indoor stadiums, since they are “already separated from the soil system.” Ecology may be one area where neither artificial nor conventionally maintained natural turf can claim victory.

Biophilia

The biggest strength of artificial turf is also its biggest weakness. Artificial turf remains a “monofilament ribbon file product”, by definition, it can never be alive. So why bother to make it look or feel like the real thing? Nostalgia begins to explain our intangible trouble with artificial turf—gone are the stubborn grass stains and the smell of freshly mown grass. The best explanation, though, is that we feel an innate connection to good-old-fashioned grass.

Harvard biologist Edward O. Wilson sought to explain this phenomenon in his 1984 book Biophilia: The Human Bond with Other Species. Human beings, he argued, subconsciously seek a connection with other species and with life. Plastic grass will always feel foreign to us because it is not living and robs us of our cues to natural processes. It refuses to die—or even fade—as the seasons change.

So-called natural turf, it has been argued, is itself far from natural. Most turf grass yards and fields would be biological impossibilities without significant inputs of water, chemicals, and energy. Yet, grassy lawns feel natural. Perhaps our biophilic impulse is fooled by this seemingly natural landscape. Or perhaps it doesn't care—a living landscape is a living landscape, no matter how it came to be.

Final Thoughts

Conventionally managed natural turf carries a plethora of environmental burdens, but it does support soil organisms to some degree. The grass and these organisms play a crucial ecological role by purifying water as it leaches into the earth. It is questionable, though, whether this function is positive enough to offset the repercussions of watering, pest treatments, fertilization, and mowing.

Playing fields subject to heavy use, especially where pristine appearance is a priority, may represent a setting in which artificial turf can be justified. But the fact that it doesn't support soil organisms, and therefore is a biologically dead zone, suggests that its use should be limited.

In many situations, the optimal choice, at least from an environmental perspective, is a natural landscape of native or adapted plants. Approaching the condition of a natural ecosystem, such a landscape minimizes maintenance while offering biological diversity.

In places where a uniform, cropped surface is needed, natural turf managed in an ecologically sound manner is a good choice. Natural lawns and fields can be maintained responsibly by beginning with native and adapted species that require little or no water, allowing them to go dormant (and turn brown) at times, and feeding them appropriate, organic fertilizers. Even mowing, when necessary, can be done using low-emitting and quiet machinery. The result may not live up to the standards of the Garden Club of America, but other species will approve.
low maintenance landscaping

Agricultural Experiment Station
and Cooperative Extension Service
Although the term Xeriscape* is relatively new in Kansas, the concept is not. It simply imitates nature’s design: putting hardy, adapted plant materials in the places where they grow best. Once established, this kind of landscape requires little maintenance because it is designed to work in harmony with nature, not against it.

Estimates indicate that nearly 50 percent of water the average household uses is for outside landscape and turfgrass areas. You can reduce your water use by imitating nature with a low-maintenance landscape design. It is applicable to both homes and businesses, on new building sites or previously landscaped sites. To be successful, it requires careful consideration and planning.

Ultimately, you will realize a savings not only in water but also in time, labor, equipment, and materials such as fertilizers and herbicides, and that’s dollars in your pocket. Furthermore, because of increasing demands on a limited water supply, a landscape with a record of low water bills may boost the resale value of your home.

A water-conserving landscape design involves using hardy, adapted plant materials which are suited to your particular location in Kansas, its soil and its climate. More specifically, it requires selecting plants according to soil type, slope and available rainfall. It means arranging these plant materials in such a way that they actually can contribute further to water conservation by reducing the evaporative effects of wind and sun in your yard or business site.

Typically the design would include native plant species, those that grow naturally in Kansas, but certainly is not restricted to them and is not boring. In fact, choosing this type of design can result in a greater diversity of plant materials from one yard to the next.

The seven Xeriscape principles are Planning and Design, Limited Turf Areas, Efficient Irrigation, Soil Improvement, Mulching, Lower Water-Demand Plants, and Appropriate Maintenance.

*Xeriscape is a trademark term of the National Xeriscape Council.
Designs can be simple or elaborate, but every plan should take into consideration factors that affect water use. Steep slopes or grades encourage water runoff and soil erosion. Drought-tolerant groundcovers, shrubs and trees can be used to slow down and absorb water, and to reduce evaporation by shading the soil. Terracing with plants is another possibility.

South- or west-facing exposures get maximum sunlight and can benefit from use of mulches or drought-tolerant plants. Wind increases the amount of plant moisture lost through evapotranspiration. Fences and screens can greatly reduce the amount of supplemental water needed by slowing or blocking the wind. Using trees and shrubs as windbreaks can be effective, if the species don’t require watering.

As trees provide shade which reduces the soil temperature and lowers water lost through evaporation, they also reduce air temperatures, which reduces water loss. Trees such as maples should be avoided in the low water use landscape. Their invasive surface-feeding roots compete with nearby plants for water and nutrients.

Plant trees and shrubs in attractive compositions and arrange plant materials along water-need zones to prevent overwatering some plants while underwatering others.

Turfgrass areas usually require the most water and maintenance in a landscape. Limit irrigated turfgrass areas to places with high use. Use low-maintenance and native grasses for other areas. The lawn must fit the landscape, but avoid making it long and narrow, which is more difficult to irrigate effectively. Select hardy, adapted lawn grasses suited to the site. Manage your lawn for stress, deep watering when needed.

Warm-season grasses—bermudagrass, zoysiagrass and buffalograss—are drought resistant. Cool-season grasses—bluegrass, fescue and ryegrass—require watering for maintenance (See table). Keep in mind that warm-season grasses do not grow well in shade. When nature is left to take its course, warm-season grasses will dominate sunny areas and cool-season grasses will dominate shady
Turfgrass Drought Resistance

<table>
<thead>
<tr>
<th>Turfgrass</th>
<th>Drought Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bermudagrass</td>
<td>excellent</td>
</tr>
<tr>
<td>Buffalograss</td>
<td>excellent</td>
</tr>
<tr>
<td>Zoysiagrass</td>
<td>excellent</td>
</tr>
<tr>
<td>Tall fescue</td>
<td>good</td>
</tr>
<tr>
<td>Bluegrass</td>
<td>fair</td>
</tr>
<tr>
<td>Ryegrass</td>
<td>poor</td>
</tr>
</tbody>
</table>

areas. You may see this as a patchwork look because the two types of grasses are different in texture and color. But the total water required will be reduced, and both types of grasses will grow best in the areas suited to them.

Cool-season grasses green up earlier in the spring and stay green later in the fall, which means a longer growing season. They also require more water than warm-season grasses during hot weather—most of the summer in Kansas.

An increased interest in using native grasses for lawns has developed in recent years due to their low water and maintenance requirements and naturalistic appearance. Most native grasses are warm-season grasses and must be planted in areas that receive full sunlight. Buffalograss is the most common native grass used in lawns. It grows best in areas with less than 25 inches of annual rainfall.

Native grasses should be watered and fertilized sparingly or not at all. Watering and fertilizing these grasses causes them to become weedy and you lose the low maintenance aspect of a native grass lawn. Under suitable conditions, native grasses can save water and maintenance, but the cost of seed is high and some watering to get them established is recommended. Weeds are the major problem in establishing a native grass lawn.

Lawn watering and maintenance reduction must be accompanied by a reduction in the amount of fertilizer applied and adjustment of other cultural practices. Taller mowing helps control weeds and reduces watering and mowing frequency. The amount of fertilizer you put on a lawn determines your maintenance program.

The amount of mowing, watering, problems and pests is largely related to the amount and timing of fertilizer
Total Nitrogen per Year

<table>
<thead>
<tr>
<th>Cool-season grasses</th>
<th>lbs.</th>
<th>Warm-season grasses</th>
<th>lbs.</th>
<th>(low to high range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High maintenance</td>
<td>4*</td>
<td>Bermudagrass</td>
<td>2-4*</td>
<td></td>
</tr>
<tr>
<td>Good maintenance</td>
<td>3</td>
<td>Buffalograss</td>
<td>0-2</td>
<td></td>
</tr>
<tr>
<td>Low maintenance</td>
<td>2</td>
<td>Zoysia</td>
<td>1-3</td>
<td></td>
</tr>
<tr>
<td>Minimal maintenance</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*lbs. AN/1000 sq. ft. (AN = actual nitrogen)

applications. The table above provides guidelines for the total seasonal nitrogen. Phosphorus and potassium should be applied as indicated by a soil test.

Efficient watering is part of the low-maintenance design. Your landscape design should incorporate zones for water need areas—high, medium, low or none at all.

Prevent runoff; harvest water! Collect or redirect water from the downspouts to areas of the landscape that need it. Select and combine different irrigation systems—drip, trickle, sprinkler. Water slowly, deeply and infrequently.

Each type of plant has a maximum depth to which its roots will grow. Roots will penetrate only to that depth where water, air and nutrients are present. Deep watering encourages deep rooting, increasing the reservoir of water so plants can go longer between watering. Deeply placed water is also less subject to loss by evaporation from the soil surface.

The roots of most small trees and shrubs may reach up to 6 feet deep, while smaller shrubs or flowers may root 2–4 feet deep. Consider grouping plants together that may be shallow rooted and require more frequent watering such as flower beds or a mixed border of small shrubs.

It is important to water only long enough to wet the soil to the depth of the root system and not beyond because this is a waste of water. A soil probe or thin rod pressed into the soil will go in easily until it reaches the dry zone.

The most critical factor in determining water use is weather—temperature, humidity, wind, sunlight, and precipitation. There is a constant flow of water through plants, bringing nutrients to the upper plant parts. This
transpiration flow of water increases as conditions cause greater movement of water through a plant.

Most of the absorption of water and nutrients occurs in the upper half of the root system, thus water should be applied directly to the soil surface or the root zone. Water applied to plant leaves and tops is wasted, especially in hot weather, because much of it will evaporate before it reaches the ground.

Most small trees and shrubs should be watered to wet the soil to a depth of 4 feet once a month or every 6 weeks. Plants with shallow roots require more frequent soaking, perhaps to a depth of 2–3 feet every 2–4 weeks. Remember, the water requirements for a mature landscape allow flexibility in this watering pattern; those of a newly planted landscape do not.

Know your soils. Improving the soil helps conserve water. Adding organic matter is by far the most important soil improvement affecting water use. A soil test, which is available through your county Extension office, will determine the organic matter level of your soil.

In sandy soils, organic matter slows down the rapid movement of water through the soil, making it more available to plant roots. In heavy clay soils, the addition of organic matter increases infiltration of moisture, which prevents runoff and wasted water.

Adding organic material is easiest and most effective before planting. Incorporate at least 2–3 inches of organic matter into the top 8 inches of the planting area unless your soil test indicates otherwise. Because organic matter continually decomposes, it needs to be replenished on a yearly basis. Applying an organic-type mulch is the most effective way to do this in an established landscape.

### Types of Organic Matter

<table>
<thead>
<tr>
<th>Straw</th>
<th>Compost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well rotted manure</td>
<td>Well rotted sawdust</td>
</tr>
<tr>
<td>Leaf mulch</td>
<td>Wood chips</td>
</tr>
<tr>
<td>Peat moss</td>
<td>Shredded bark</td>
</tr>
<tr>
<td>Lawn clippings</td>
<td>Green manures</td>
</tr>
</tbody>
</table>
In areas with hardpan—an underlying layer of clay—subsoiling is recommended before planting. Plants growing on top of unbroken hardpan are more vulnerable to water fluctuations because of the shallow growing area. Planting a deep-rooted legume can be effective in breaking up hardpan, although it may take some time to accomplish.

Mulches can do much more than cut down on water use. They also can improve soil texture, suppress weeds, lower soil temperature, and add ornamental value to the landscape. How well a mulch conserves moisture is determined by its composition and how deeply it is applied.

Common mulches range from wood chips, stone and gravel to landscape fabric, plastic and polyethylene film. Deciding which mulch to use will depend on its cost, availability, ease of use, durability and appearance in your particular landscape. Each mulch has advantages and disadvantages.

Plastic or polyethylene film prevents moisture evaporation effectively; is thin, lightweight, and inexpensive. Perforated plastic is more expensive. Some disadvantages are you must punch holes to let in water and air; it is unsightly; must be covered with another material; doesn’t improve soil; and can cause roots to concentrate at the soil surface, increasing drought susceptibility.

Landscape fabric—Geotextiles, Weed Barrier, Weed X, Weed Block—are water and air permeable; suppress most water-competing weeds; and are durable. They are, however, expensive; allow some weeds to grow; and must be covered by a top mulch layer.

Wood chips, tree trimmings, and shredded or chunk bark are relatively inexpensive; let in water and retain it in soil; break down to improve soil texture; and suppress weeds if the smaller size is used. The most effective depth for these mulches is 3–4 inches. These materials do break down in 1–3 years, depending on particle size and type of tree used. Smaller sized particles may require addition of nitrogen for plants.
Stone and gravel allow moisture in and retain it in the soil; are long lasting; come in a variety of sizes; suppress weeds; and can have an ornamental appearance. Prices vary with size and type. They do not improve soil; are unattractive if used in a large area; increase soil temperature and glare; and tend to get scattered by lawn mowers and small children.

Selecting lower water use plant materials is essential. A partial list of plants appears at the end of this publication. Check with a nursery for your particular site needs.

Once the planning and planting are complete, maintenance becomes the key to a successful low water use landscape. Mowing, pruning, weeding, mulching and fertilizing will maintain your landscape in a healthy, productive and beautiful condition for years to come.

**Selecting Plant Materials**

Consider the importance of turfgrass qualities such as drought, cold, heat and shade tolerances, wearability, and fertilizer requirements in your landscape plan; then choose the species that meet your needs. (The following turfgrass information adapted from “Conserving Water in the Landscape,” Nebguide published by Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska—Lincoln.)

- **Drought tolerance of popular turfgrasses,** ranging from most to least tolerant: buffalograss, bermudagrass, zoysiagrass, tall fescue, Kentucky bluegrass, perennial ryegrass.
- **Cold tolerance of popular turfgrasses,** ranging from most to least tolerant: Kentucky bluegrass, buffalograss, tall fescue, perennial ryegrass, zoysiagrass, bermudagrass.
- **Heat tolerance of popular turfgrasses,** ranging from most to least tolerant: buffalograss, bermudagrass, zoysiagrass, tall fescue, Kentucky bluegrass, perennial ryegrass.
- **Shade tolerance of popular turfgrasses** ranging from most to least tolerant: tall fescue, perennial ryegrass, Kentucky bluegrass, zoysiagrass, bermudagrass, buffalograss.
The shade tolerance of a grass depends on many conditions. Check with your county Extension agent for more information on suitability of turfgrass species for your specific site.

- Wearability of popular turfgrasses, ranging from those that can withstand most wear to least wear: bermudagrass, zoysiagrass, tall fescue, perennial ryegrass, Kentucky bluegrass, buffalograss.
- Fertilizer requirements for popular turfgrasses, ranging from most to least: Kentucky bluegrass, perennial ryegrass, tall fescue, bermudagrass, zoysiagrass, buffalograss.

While a lawn may exist on low amounts of fertilizer, a high-quality lawn will require moderate amounts. The cultivar, soil type and climate greatly influence fertilizer needs.

The following plants are adapted to all parts of Kansas though some may need protection in certain areas of the state. All require regular watering until well-rooted and established. This may take 1–2 years or more, depending on the type and size of plants. Only after the plants are established can water be reduced or, in some cases, eliminated. Remember, check with your nursery for your particular site needs!

- **Tall Deciduous Trees (over 45')**— Black Walnut, Chinkapin Oak, Common Hackberry (‘Prairie Pride’ and other cultivars), Green Ash, Honeylocust (‘Skyline’ and other cultivars), Kentucky Coffeetree, Sawtooth Oak, Bur Oak.
- **Medium Deciduous Trees (30–45')**— Aristocrat Pear, Goldenrain Tree, Lacebark Elm (True Chinese Elm), Osage Orange (thornless and fruitless), White Mulberry (fruitless).
- **Large Deciduous Shrubs (over 8')**— Autumn Olive, Beauty Bush, Border Privet, Chokecherry, Common Buckthorn, Elderberry, Lilac, Mountain Ninebark, Ninebark,


- Large Evergreen Shrubs—Junipers, Mugho Pine.

- Medium Evergreen Shrub—Junipers, Mahonia, Manhattan Euonymus.

- Small Evergreen Shrubs—Compact Mahonia, Compact Mugho Pine, Juniper, Soapweed, Yucca.

- Groundcovers for shade (beneath trees, shrubs, or along north walls)—Bergenia, Bishop’s Weed, Hall’s Honeysuckle, Mahonia, Creeping Grape Holly, Periwinkle, Potentilla (Cinquefoil), Sweet Woodruff.

- Groundcovers for full sun—Baby’s Breath (Creeping), Bachelor Buttons, Bird’s Foot Trefoil, Crownvetch, Border Jewel (Himalayan), Buttercup (Creeping), Catmint, Creeping Junipers, Daylily (most species), Evergreen Candytuft, Gro-Low Fragrant Sumac, Hall’s Honeysuckle, Hen and Chicks, Lilyturf, Mock Strawberry, Phlox (Creeping), Pussytoes, Ribbon Grass, Rock Soapwort, Sedum (Stonecrop), Silvermound, Snow in Summer, Spurge (Cushion), Spurge (Donkey-tail), Thyme (Creeping), Veronica (Rock Speedwell), Wintercreeper, Woolly Yarrow.
Ornamental Grasses—Big Bluestem, Blue Fescue, Blue Oat Grass, Feather Reed Grass, Fountain Grass (annual), Fountain Grass (perennial), Indiangrass, Little Bluestem, Oat Grass, Quaking Grass (annual), Ravenna Grass, Ribbon Grass, Sideoats Grama, Weeping Lovegrass.


For assistance with identifying low-maintenance, drought-tolerant plants for your home or business landscape design, contact your county Extension office.

Brand names appearing in this publication are used for product identification. No endorsement is intended, nor is criticism of similar products not mentioned.
REQUEST FOR SPECIAL EXCEPTION FOR ARTIFICIAL TURF CHECK LIST

☐ Signed & Notarized Special Exception Application
☐ Signed Authorization for Agent Affidavit (if applicable)
☐ $750.00 Application Fee
☐ A copy of the deed or other evidence of ownership.
☐ Date applicant met with the representatives of Urban Design staff prior to the submission of a Special Exception Application ___________________

☐ Two copies (2) of a detailed signed and sealed site survey of the property that is less than one year old that indicates the location of existing trees and shrubs and all other improvements on the property.

☐ Two copies (2) of the landscape plot plan indicating the proposed location of the artificial turf and other landscape materials. Setbacks to the seawall will be required to be shown for any trees, large shrubs, curbing, areas of rock beds or boulder type landscape material that is planned. All landscape plans must meet minimum standards as denoted in this Article.

☐ If the property is zoned commercial or multi-family, a copy of an approved Southwest Florida Water Management District permit shall be included in the permit application.

☐ Evidence that the artificial turf proposed will have a minimum tufted weight of 56 ounces per square foot, be a natural green in color, and have a minimum 8 year warranty. A sample of the turf proposed that meets these standards shall be submitted with the Special Exception application including a copy of the manufacturers specifications and warranty information.

☐ Evidence that all artificial turf installations will have a minimum permeability of 30 inches per hour per square yard and provide anchoring information as to the size and location of anchors to ensure the turf will withstand the effects of wind.

☐ Consideration of the percentage of living plant materials versus percentage of artificial turf proposed for any property shall be part of the review process. Evidence that living plant material will be drought tolerant and consist of 50 percent Florida native species including shrubs, vines, trees, and ground covers.

☐ Certificate of Appropriateness application and application fee if property is located within the National Register Historic Overlay District, listed on the National Register, or property listed on the Florida Master Site File by the State of Florida Department of State, Bureau of Historic Preservation of the Division of Historical Resources.

Florida Master Site File No. __________________________ Contributing Structure ☐ Yes ☐ No
REQUEST FOR SPECIAL EXCEPTION FOR ARTIFICIAL TURF

Date Received ________________  File Number SE-__________________________

Application Fee: $750.00
Continuance: $500.00

This application, with all required supplemental data and information, must be completed in accordance with the specific instructions in the application, and returned to the Urban Design before same will be advertised for a hearing.

IMPORTANT: The applicant or his representative MUST be present at the hearing. There will be a fee of $500.00 for a Voluntary Continuance (a request by the applicant to continue a petition before the appropriate board or council, or by the failure of the applicant to attend or be represented at the appropriate meeting).

1. Name of Applicant(s): ____________________________  Phone: ________________
   Address: ______________________________________
2. Owner(s) of Record: ____________________________  Phone: ________________
   Address: ______________________________________
4. Attorney or Agent: ____________________________  Phone: ________________
   Address: ______________________________________
5. Property Address or Street Name: ____________________________
6. Property Legal Description:

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<tr>
<th>Parcel ID / Account #</th>
<th>Lot #</th>
<th>Block #</th>
<th>Section</th>
<th>Total Sq Feet/ Acres</th>
<th>Existing Zoning</th>
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7. Artificial Turf Use Location:
8. Written statement describing the proposed use:

9. What is the minimum tufted weigh per square foot:

10. What is the permeability per hour per square yard:

11. What is the anchor size and location:

12. How long is the manufactures warranty:

13. Approval Criteria. The Planning Commission and City Council shall use the following criteria, in addition to other reasonable considerations, in making their decision please explain your position on the following:

   (1) The proposed use will not adversely affect the use of neighboring properties.

   (2) The use shall comply with applicable district regulations and applicable provisions of the adopted Comprehensive Plan and downtown plans.

   (3) The location, size and height of buildings structures, walls and fences, and the nature and extent of screening, buffering and landscaping shall be such that the use will not hinder or discourage the appropriate development and use of adjacent or nearby land and/or buildings.

   (4) The proposed use will be such that pedestrian and vehicular traffic generated will not be hazardous or conflict with the existing and anticipated traffic in the neighborhood and on the streets serving the site.
Any Special Exception granted to allow artificial turf shall include the following conditions:

1. Precautions for installation around existing trees shall be monitored and may be restricted to ensure tree roots are not damaged with the installation of the base material.
2. Rubber, sand and any other weighting or infill material is prohibited.
3. If artificial turf is planned to be installed next to the seawall, the artificial turf shall be pinned or staked behind the seawall. Nothing shall be attached directly to or placed on the seawall or seawall cap.
4. A copy of the Special Exception and conditions thereof shall be recorded in the Public Records of Charlotte County so that any subsequent purchaser will be on notice regarding the special rules relating to the artificial turf.
5. A landscape inspection shall be conducted after the installation of the artificial turf to ensure all living plant materials conform to the provided landscape plot plan and meet the drought tolerant and native species requirements.
6. If artificial turf is to be installed in the City right-of-way, a separate right-of-way permit must be obtained prior to commencing work.
7. Artificial turf shall be maintained in a green fadeless condition and shall be maintained free of dirt, mud, stains, weeds, debris, tears, holes, and impressions, as determined by Code Compliance. All edges of the artificial turf shall not be loose, and must be maintained with appropriate edging or stakes.
8. Artificial turf must be replaced if it falls into disrepair with fading or holes or loose areas, as determined by Code Compliance. Replacement shall be completed within 60 days of notification by Code Compliance.
9. If maintenance is required on the City right-of-way, or utility easement, it shall be the responsibility of the property owner to remove, replace and repair, at the owner’s expense, any artificial turf that has been placed in the right-of-way or utility easement within 60 days.
10. If maintenance is required on the seawall and/or seawall cap, it shall be the responsibility of the property owner to remove, replace and repair, at the owner’s expense, any artificial turf that has been placed in the rear yard of the property abutting the seawall within 60 days.
11. The City of Punta Gorda shall not be held liable for any damage to any artificial turf or other items placed within the right-of-way, within six feet of the seawall, or within any area covering any city utilities.
Special Exception
Affidavit

I, the undersigned, being first duly sworn, testify and say that I am the owner, attorney, attorney-in-fact, agent, lessee or representative of the owner(s) of all of the property described and which is the subject matter of the proposed hearing; that all answers to the questions in this application, and all sketches, data and other supplementary material attached to and made a part of the application are honest and true to the best of my knowledge and belief. I understand this application must be complete and accurate before the hearing can be advertised, and that I am authorized to sign the application by the owner or owners.

By submitting this application the owner(s) of the subject property does hereby grant his/her consent to the Zoning Official and his/her designee, to enter upon the subject property for the purposes of making any examinations, surveys, measurements, and inspections deemed necessary to evaluate the subject property relative to this application.

Sworn and subscribed before me this __________ day of ______________, 20____.

Signature of Applicant or Authorized Agent  Type of Print Name and Title

Address: ____________________________ Phone: ____________________________

__________________________

STATE OF _____________ )

COUNTY OF _____________ )

The foregoing instrument was acknowledged before me this ______ day of ___

____________________, 20____, by ____________________________, who is

personally known to me or who has produced ____________________________ as identification and who did not take an oath.

__________________________

Notary Public, State of Florida (Seal)

My commission Expires: ____________________
AFFIDAVIT
AUTHORIZATION FOR AGENT

I/We______________________________, property owner(s), hereby authorize ________________________ to act as Agent on our behalf regarding a ______________________ application on the property described as: (legal description) ____________________________________________, a/k/a ____________________________ in Punta Gorda, Florida.

______________________________  __________________
Owner  Date

STATE OF ____________  )
COUNTY OF ____________  )

The foregoing instrument was acknowledged before me this ______ day of ____________, 20__, by ________________________________, who is personally known to me or who has produced ________________ as identification and who did not take an oath.

________________________________________
Notary Public, State of Florida  (Seal)

My commission Expires: ________________
Memorandum
City of Lawrence
Planning & Development Services

TO:       David L. Corliss, City Manager
FROM: Planning Staff
CC:  Scott McCullough, Director of Planning and Development Services
     Sheila Stogsdill, Assistant Planning Director
Date:    For May 3, 2011 City Commission meeting
RE:  Text Amendment Initiation to permit the use of synthetic turf to meet landscaping requirements in Article 10 of the Development Code

A request was made by Paul Werner Architects to initiate a text amendment to the Land Development Code to include ‘synthetic turf’ in the list of landscape materials that may be used to meet the landscape requirements in Article 10 and to revise the definition of ‘Landscaping’ in Article 17 to include ‘synthetic turf’. The request is being made in order to maintain recently installed synthetic turf at the apartment complex being constructed at the intersection of Trail and Frontier, formerly known as the Boardwalk Apartments. While the site plan was approved with code compliant landscape materials (sod, seed), a routine inspection of the site yielded the installation of the synthetic turf. The owner was informed of the non-compliant installation and was provided options to conform to the code, including installing the approved plant material, seeking a variance, or requesting a text amendment to revise the applicable sections of the code. The applicant would like the city to consider revising the Development Code to permit the use of synthetic turf for this and potentially future projects.

The code emphasizes the use of living landscape materials and states the following about landscaping (non-exclusive list):

Section 20-1009 Landscape Material Standards - (b) Artificial Plants - No artificial plants or vegetation may be used to meet any standards of this section.

Section 20-1009 Landscape Material Standards - (e) Grass Seed and Sod - Turf areas shall be planted with species suitable as permanent lawns in Lawrence. Turf areas may be sodded or seeded.

Section 20-1010(a)(2) - All Landscape Material, including trees, plant material and structural elements, shall be in place and healthy prior to issuance of a final Certificate of Occupancy. The Planning Director may authorize issuance of a temporary Certificate
of Occupancy prior to installation of required Landscaping, when seasonal conditions render installation impractical...

Section 20-1701 Definitions

   Landscape Material – Such living material such as trees, Shrubs, Ground Cover/vines, turf grasses, and non-living material such as: ricks, pebbles, sand, bark, brick pavers, earthen mounds (excluding pavement), and/or other items of a decorative or embellishing nature such as: fountains, pools, walls, fencing, sculpture, etc.

   Landscaping – Any combination of living plants such as trees, Shrubs, plants, vegetative Ground Cover or turf grasses...

   Ground Cover – Living Landscape Materials or living low-growing plants other than turf grasses, installed in such a manner so as to provide a continuous cover of the ground surface and which, upon maturity, normally reach an average maximum Height of not greater than 24 inches.

The application noted that synthetic turf is low maintenance and may be appropriate in some locations. The application also identified synthetic turf as a ‘green building option’ as it does not require watering, mowing, or the use of fertilizers or pesticides. The application is attached for your reference.

If the text amendment is approved, it will be necessary to revise the Community Design Manual as well for landscaping requirements within the Commercial and Industrial Zoning Districts for consistency.

Staff recommends that the Commission initiate the amendment so that careful consideration can be given to the request and so that the pros and cons of using synthetic turf to meet the values of landscaping requirements can be discussed by the community stakeholders.

**Action requested:** Initiate a text amendment to Article 10 and Article 17 of the Land Development Code – Code of the City of Lawrence, Kansas regarding landscaping and landscape materials and associated revisions to the Community Design Manual, if appropriate.
REQUEST FOR INITIATION of a TEXT AMENDMENT
APPLICATION FORM

APPLICANT/AGENT INFORMATION
Contact. Joy Rhea
Company. Paul Werner Architects
Address. 1918 Edgelea Road
City. Lawrence
State. KS
ZIP. 66044
Phone. (785) 832-0804
Fax. (785) 832-0890
E-mail. joyr@paulwernerarchitects.com
Mobile/Pager. 
Pre-Application Meeting Date. 4-1-11
Planner. Scott McCullough

Are you submitting any other applications? If so, please state which one(s).

Please identify the section of the Development Code or Subdivision Regulations proposed to be amended.
20-1003(e), 20-1009 (b), 20-1009(e)(4), 20-1701

Please provide proposed amendment. (Attach additional sheets if needed)
20-1003(e) In addition to required Shade Trees and Shrubs, landscape areas within the interior of off-street Parking Areas shall be planted with turf which can be synthetic or natural, Ground Cover, Ornamental Trees, or Shrubs.

20-1009(b) No artificial plants or vegetation other than synthetic turf may be used to meet any standards of this section.

ADD TO DEV CODE 20-1009(e)(4) Synthetic turf areas shall be installed per the manufactures specification as permanent lawns in Lawrence.

20-1701 - Landscaping: Such living material as trees, Shrubs, Ground Cover/vines, turf grasses, and non-living material such as: rocks, pebbles, sand, bark, brick pavers, earthen mounds (excluding pavement), synthetic turf and/or other items of a decorative or embellishing nature such as: fountains, pools, walls, fencing, sculpture, etc.
Please respond to the following questions to the best of your knowledge. In reviewing and making decisions on proposed text amendments review bodies shall consider the following factors. (Attach additional sheets if needed.)

1. **Does the proposed text amendment correct an error or inconsistency in the Development Code or Subdivision Regulations?** If so, please provide the specific error found and/or reference the specific section of the Development Code that is inconsistent with the section identified to be amended above. The amendment does not correct an error or inconsistency but instead provides an alternative option to turf grass. Synthetic turf is a viable option for turf management in the right location. This text amendment would give the Planning Department the ability to approve it.

2. **Does the proposed amendment meet the challenge of a changing condition?**
   If so, please explain.
   With the increased awareness of providing green building options synthetic turf has its benefits which include using no irrigation, fertilizer or pesticides to maintain it. Synthetic turf also reduces emissions since it does not need mowed.

3. **Is the proposed amendment consistent with Horizon 2020? Please explain.**
   Horizon 2020 states on pages 5-22, 5-28 and 6-28, "Encourage the use of high quality materials in the construction of screening and landscape areas to decrease long-term maintenance costs." Synthetic turf falls into this category because it is a high quality material made of partly recycled materials and has no yearly maintenance cost such as irrigation systems, fertilizers or pesticides.

4. **Is the proposed amendment consistent with the stated purpose of the Development Code? See Sec. 20-104 of the Development Code for the stated purpose.**
   This amendment in no way endangers the health, safety and welfare of the public.
SIGNATURE

By execution of my/our signature, I/we do hereby officially apply to request initiation of the proposed text amendment as indicated above.

Signature(s): [Signature] Date 4-18-11

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Application Form Page 6 of 6 Request for Initiation of a Text Amendment 5/5/2009
LETTER OF TRANSMITTAL

FROM: Joy Rhea
TO: Scott McCullough
DATE: April 18, 2011
RE: Text Amendment for synthetic turf

We are Sending:

  X  Attached    ___ Per your request    ___ For your files

Items Transmitted Via:

  ___ US Mail    ___ Overnight    ___ Courier   XOther

Items Transmitted are For Your:

  ___ Information    ___ Use    ___ Approval    X___ Review

Items Transmitted are:

  X___ Originals    ___ Disk (s)    ___ Shop Drawings    ___ Blueprints
                  ___ Specifications    ___ Samples    ___ Other

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REMARKS:

_________________________________________________________________
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LEED 2009 for New Construction and Major Renovations Rating System

USGBC Member Approved November 2008 (Updated May 2011)
The built environment has a profound impact on our natural environment, economy, health, and productivity. Breakthroughs in building science, technology, and operations are now available to designers, builders, operators, and owners who want to build green and maximize both economic and environmental performance.

Through the LEED® green building certification program, the U.S. Green Building Council (USGBC) is transforming the built environment. The green building movement offers an unprecedented opportunity to respond to the most important challenges of our time, including global climate change, dependence on non sustainable and expensive sources of energy, and threats to human health. The work of innovative building professionals is a fundamental driving force in the green building moment. Such leadership is a critical component to achieving USGBC’s mission of a sustainable built environment for all within a generation.

USGBC MEMBERSHIP
USGBC’s greatest strength is the diversity of our membership. USGBC is a balanced, consensus based nonprofit with more than 18,000 member companies and organizations representing the entire building industry. Since its inception in 1993, USGBC has played a vital role in providing a leadership forum and a unique, integrating force for the building industry. USGBC’s programs have three distinguishing characteristics:

Committee-based
The heart of this effective coalition is our committee structure, in which volunteer members design strategies that are implemented by staff and expert consultants. Our committees provide a forum for members to resolve differences, build alliances, and forge cooperative solutions for influencing change in all sectors of the building industry.

Member-driven
Membership is open and balanced and provides a comprehensive platform for carrying out important programs and activities. We target the issues identified by our members as the highest priority. We conduct an annual review of achievements that allows us to set policy, revise strategies, and devise work plans based on members’ needs.

Consensus-focused
We work together to promote green buildings, and in doing so, we help foster greater economic vitality and environmental health at lower costs. We work to bridge ideological gaps between industry segments and develop balanced policies that benefit the entire industry.

Contact the U.S. Green Building Council
2101 L Street, NW
Suite 500
Washington, DC 20037
(800) 795-1747 Office
(202) 828-5110 Fax
www.usgbc.org
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U.S. Green Building Council
2101 L Street, NW
Suite 500
Washington, DC 20037

TRADEMARKS

ACKNOWLEDGMENTS

The LEED 2009 Rating System has been made possible only through the efforts of many dedicated volunteers, staff members, and others in the USGBC community. The Rating System improvement work was managed and implemented by USGBC staff and included review and input by many Technical Advisory Group (TAG) members with oversight by the LEED Steering Committee. We extend our deepest gratitude to all of our LEED committee members who participated in the development of this rating system, for their tireless volunteer efforts and constant support of USGBC’s mission:

**LEED Steering Committee**
- Scot Horst, Chair, LSC  Horst, Inc
- Joel Ann Todd, Vice-Chair, LSC  Joel Ann Todd
- Muscoe Martin  M2 Architecture
- Stuart Carron  JohnsonDiversey, Inc.
- Holley Henderson  H2 Ecodesign, LLC
- Christine Magar  Greenform
- Kristin Shewfelt  Architectural Energy Corporation
- Jessica Millman  Agora DC
- Bryna Dunn  Moseley Architects
- Neal Billetdeaux  JR
- Greg Kats  Managing Good Energies
- Mark Webster  Simpson Gumpertz & Heger
- Bob Thompson  EPA Indoor Environment Management Branch
- Malcolm Lewis  Constructive Technologies Group, Inc.
- John Boecker  7Group
- Sara O’Mara  Choate Construction Company
- Alex Zimmerman  Rep Canada Green Building Council
- Ian Theaker  Rep Canada Green Building Council

**Sustainable Sites TAG**
- Bryna Dunn, Chair  Moseley Architects
- Stewart Comstock, Vice-Chair  Maryland Department of the Environment
- Michele Adams  Cahill Associates
- Gina Baker  Burt Hill
- Ted Bardacke  Global Green USA
- Stephen Benz  Sasaki
- Mark Brumbaugh  Brumbaugh & Associates
- Laura Case  Emory University Campus Services
- Zach Christeson  the HOK Planning Group
- Jay Enck  Commissioning & Green Building Services
- Ron Hand  E/FECT. Sustainable Design Solutions
- Richard Heinisch  Acuity Lighting Group
- Michael Lane  Lighting Design Lab
- Marita Roos  HNTB
- Zolna Russell  Hord Coplan Macht, Inc.
- Alfred Vick  Ecos Environmental Design, Inc.
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<td>Neal Billetdeaux, Chair</td>
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<tr>
<td>John Koeller, Vice-Chair</td>
<td>Alliance for Water Efficiency</td>
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<td>David Carlson</td>
<td>Columbia University</td>
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<td>Bill Hoffman</td>
<td>H.W. Hoffman and Associates, LLC</td>
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<td>Geoff Nara</td>
<td>Civil &amp; Environmental Consultants</td>
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<td>Stephanie Tanner</td>
<td>U.S. Environmental Protection Agency</td>
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<td>Daniel Yeh</td>
<td>University of South Florida</td>
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<td>Winston Huff</td>
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<td>Heather Kinkade</td>
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<td>Shabbir Rawalpindiwala</td>
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<td>Bill Wall</td>
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<td>Nathan Gauthier</td>
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<td>Oregon Department of Energy</td>
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<td>Gord Shymko</td>
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<td>Reusch Design Services</td>
</tr>
<tr>
<td>Nadav Malin</td>
<td>BuildingGreen, LLC.</td>
</tr>
</tbody>
</table>
The LEED 2009 for New Construction Rating System builds on the work of those who helped create previous versions:

**LEED for New Construction Version 2.2 Core Committee**

- James H. Goldman, Chair  
  Turner Construction
- Tom Scarola, Vice-Chair  
  Tishman Speyer Properties
- Lee Burgett  
  Trane Company
- Craig Kneeland  
  NYSERDA
- Joe Higgins  
  Fidelity Real Estate Company
- Harry Gordon  
  Burt Hill Kosar Rittelmann Associates
- Muscoe Martin  
  Wallace Roberts & Todd, LLC
- Chris Dixon  
  Mithun
- Bill Odell  
  HOK Architects
- Chris Schaffner  
  The Green Engineer
- Wayne Trusty  
  Athena Sustainable Materials Institute
- Jerry Yudelson  
  Greenway Consulting Group, LLC
- Charlotte Matthews  
  Bovis Lend Lease
- John McFarland  
  WorkingBuildings LLC
- Prasad Vaidya  
  The Weidt Group
- Aalok Deshmuk  
  The Rocky Mountain Institute
# LEED 2009 for New Construction and Major Renovations Project Checklist

## Sustainable Sites

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prerequisite</strong> 1 Construction Activity Pollution Prevention</td>
<td>Required</td>
</tr>
<tr>
<td>□ Credit 1 Site Selection</td>
<td>1</td>
</tr>
<tr>
<td>□ Credit 2 Development Density and Community Connectivity</td>
<td>5</td>
</tr>
<tr>
<td>□ Credit 3 Brownfield Redevelopment</td>
<td>1</td>
</tr>
<tr>
<td>□ Credit 4.1 Alternative Transportation—Public Transportation Access</td>
<td>6</td>
</tr>
<tr>
<td>□ Credit 4.2 Alternative Transportation—Bicycle Storage and Changing Rooms</td>
<td>1</td>
</tr>
<tr>
<td>□ Credit 4.3 Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles</td>
<td>3</td>
</tr>
<tr>
<td>□ Credit 4.4 Alternative Transportation—Parking Capacity</td>
<td>2</td>
</tr>
<tr>
<td>□ Credit 5.1 Site Development—Protect or Restore Habitat</td>
<td>1</td>
</tr>
<tr>
<td>□ Credit 5.2 Site Development—Maximize Open Space</td>
<td>1</td>
</tr>
<tr>
<td>□ Credit 6.1 Stormwater Design—Quantity Control</td>
<td>1</td>
</tr>
<tr>
<td>□ Credit 6.2 Stormwater Design—Quality Control</td>
<td>1</td>
</tr>
<tr>
<td>□ Credit 7.1 Heat Island Effect—Nonroof</td>
<td>1</td>
</tr>
<tr>
<td>□ Credit 7.2 Heat Island Effect—Roof</td>
<td>1</td>
</tr>
<tr>
<td>□ Credit 8 Light Pollution Reduction</td>
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</tbody>
</table>

## Water Efficiency

<table>
<thead>
<tr>
<th>Requirement</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Prerequisite</strong> 1 Water Use Reduction</td>
<td>Required</td>
</tr>
<tr>
<td>□ Credit 1 Water Efficient Landscaping</td>
<td>2-4</td>
</tr>
<tr>
<td>□ Credit 2 Innovative Wastewater Technologies</td>
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</tr>
<tr>
<td>□ Credit 3 Water Use Reduction</td>
<td>2-4</td>
</tr>
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</table>

## Energy and Atmosphere

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Points</th>
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</thead>
<tbody>
<tr>
<td><strong>Prerequisite</strong> 1 Fundamental Commissioning of Building Energy Systems</td>
<td>Required</td>
</tr>
<tr>
<td><strong>Prerequisite</strong> 2 Minimum Energy Performance</td>
<td>Required</td>
</tr>
<tr>
<td><strong>Prerequisite</strong> 3 Fundamental Refrigerant Management</td>
<td>Required</td>
</tr>
<tr>
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<td>□ Credit 2 On-site Renewable Energy</td>
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<tr>
<td>□ Credit 3 Enhanced Commissioning</td>
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<tr>
<td>□ Credit 4 Enhanced Refrigerant Management</td>
<td>2</td>
</tr>
<tr>
<td>□ Credit 5 Measurement and Verification</td>
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<tr>
<td>□ Credit 6 Green Power</td>
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## Materials and Resources

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<thead>
<tr>
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<th>Points</th>
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</thead>
<tbody>
<tr>
<td><strong>Prerequisite</strong> 1 Storage and Collection of Recyclables</td>
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</tr>
<tr>
<td>□ Credit 1.1 Building Reuse—Maintain Existing Walls, Floors and Roof</td>
<td>1-3</td>
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<tr>
<td>□ Credit 1.2 Building Reuse—Maintain Existing Interior Nonstructural Elements</td>
<td>1</td>
</tr>
<tr>
<td>□ Credit 2 Construction Waste Management</td>
<td>1-2</td>
</tr>
<tr>
<td>□ Credit 3 Materials Reuse</td>
<td>1-2</td>
</tr>
<tr>
<td>□ Credit 4 Recycled Content</td>
<td>1-2</td>
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</tbody>
</table>
LEED 2009 for New Construction and Major Renovations

Innovation in Design 6 Possible Points
- Credit 1 Innovation in Design 1-5
- Credit 2 LEED Accredited Professional 1

Regional Priority 4 Possible Points
- Credit 1 Regional Priority 1-4

LEED 2009 for New Construction and Major Renovations
100 base points; 6 possible Innovation in Design and 4 Regional Priority points
- Certified 40–49 points
- Silver 50–59 points
- Gold 60–79 points
- Platinum 80 points and above
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Credit 3  Enhanced Commissioning  
Credit 4  Enhanced Refrigerant Management  
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<td>Storage and Collection of Recyclables</td>
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<td>Credit 1.1</td>
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<td>Credit 1.2</td>
<td>Building Reuse—Maintain Interior Nonstructural Elements</td>
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<td>Construction Waste Management</td>
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<td>Materials Reuse</td>
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<td>Credit 4</td>
<td>Recycled Content</td>
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<tr>
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<td>Regional Materials</td>
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<td>Credit 6</td>
<td>Rapidly Renewable Materials</td>
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<td>Credit 7</td>
<td>Certified Wood</td>
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<tr>
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<td>Prerequisite 1</td>
<td>Minimum Indoor Air Quality Performance</td>
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<td>Prerequisite 2</td>
<td>Environmental Tobacco Smoke (ETS) Control</td>
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<tr>
<td>Credit 1</td>
<td>Outdoor Air Delivery Monitoring</td>
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<tr>
<td>Credit 2</td>
<td>Increased Ventilation</td>
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<tr>
<td>Credit 3.1</td>
<td>Construction Indoor Air Quality Management Plan—During Construction</td>
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<tr>
<td>Credit 3.2</td>
<td>Construction Indoor Air Quality Management Plan—Before Occupancy</td>
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<tr>
<td>Credit 4.1</td>
<td>Low-Emitting Materials—Adhesives and Sealants</td>
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<td>Credit 4.2</td>
<td>Low-Emitting Materials—Paints and Coatings</td>
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<td>Low-Emitting Materials—Flooring Systems</td>
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<td>Low-Emitting Materials—Composite Wood and Agrifiber Products</td>
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<td>Indoor Chemical and Pollutant Source Control</td>
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<td>Controllability of Systems—Lighting</td>
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<td>Controllability of Systems—Thermal Comfort</td>
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<tbody>
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<td>Credit 1</td>
<td>Innovation in Design</td>
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<tr>
<td>Credit 2</td>
<td>LEED® Accredited Professional</td>
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<th><strong>Regional Priority (RP)</strong></th>
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<tr>
<td>Credit 1</td>
<td>Regional Priority</td>
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I. LEED® GREEN BUILDING RATING SYSTEM

Background on LEED®

Following the formation of the U.S. Green Building Council (USGBC) in 1993, the organization’s members quickly realized that the sustainable building industry needed a system to define and measure “green buildings.” USGBC began to research existing green building metrics and rating systems. Less than a year after formation, the members acted on the initial findings by establishing a committee to focus solely on this topic. The composition of the committee was diverse; it included architects, real estate agents, a building owner, a lawyer, an environmentalist, and industry representatives. This cross section of people and professions added a richness and depth both to the process and to the ultimate product.

The first LEED Pilot Project Program, also referred to as LEED Version 1.0, was launched at the USGBC Membership Summit in August 1998. After extensive modifications, LEED Green Building Rating System Version 2.0 was released in March 2000, with LEED Version 2.1 following in 2002 and LEED Version 2.2 following in 2005.

As LEED has evolved and matured, the program has undertaken new initiatives. In addition to a rating system specifically devoted to building operational and maintenance issues (LEED for Existing Buildings: Operations & Maintenance), LEED addresses the different project development and delivery processes that exist in the U.S. building design and construction market, through rating systems for specific building typologies, sectors, and project scopes: LEED for Core & Shell, LEED for New Construction, LEED for Schools, LEED for Neighborhood Development, LEED for Retail, LEED for Healthcare, LEED for Homes, and LEED for Commercial Interiors.

Project teams interact with the Green Building Certification Institute (GBCI) for project registration and certification. GBCI was established in 2008 as a separately incorporated entity with the support of the U.S. Green Building Council. GBCI administers credentialing and certification programs related to green building practice. These programs support the application of proven strategies for increasing and measuring the performance of buildings and communities as defined by industry systems such as LEED.

The green building field is growing and changing daily. New technologies and products are being introduced into the marketplace, and innovative designs and practices are proving their effectiveness. The LEED rating systems and reference guides will evolve as well. Project teams must comply with the version of the rating system that is current at the time of their registration.

USGBC will highlight new developments on its website on a continual basis at www.usgbc.org.

Features of LEED®

The LEED Green Building Rating Systems are voluntary, consensus-based, and market-driven. Based on existing and proven technology, they evaluate environmental performance from a whole building perspective over a building’s life cycle, providing a definitive standard for what constitutes a green building in design, construction, and operation.

The LEED rating systems are designed for rating new and existing commercial, institutional, and residential buildings. They are based on accepted energy and environmental principles and strike a balance between known, established practices and emerging concepts. Each rating system is organized into 5 environmental categories:
Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, and Indoor Environmental Quality. An additional category, Innovation in Design, addresses sustainable building expertise as well as design measures not covered under the 5 environmental categories. Regional bonus points are another feature of LEED and acknowledge the importance of local conditions in determining best environmental design and construction practices.

The LEED Credit Weightings

In LEED 2009, the allocation of points between credits is based on the potential environmental impacts and human benefits of each credit with respect to a set of impact categories. The impacts are defined as the environmental or human effect of the design, construction, operation, and maintenance of the building, such as greenhouse gas emissions, fossil fuel use, toxins and carcinogens, air and water pollutants, indoor environmental conditions. A combination of approaches, including energy modeling, life-cycle assessment, and transportation analysis, is used to quantify each type of impact. The resulting allocation of points among credits is called credit weighting.

LEED 2009 uses the U.S. Environmental Protection Agency's TRACI1 environmental impact categories as the basis for weighting each credit. TRACI was developed to assist with impact evaluation for life-cycle assessment, industrial ecology, process design, and pollution prevention.

LEED 2009 also takes into consideration the weightings developed by the National Institute of Standards and Technology (NIST); these compare impact categories with one another and assign a relative weight to each. Together, the 2 approaches provide a solid foundation for determining the point value of each credit in LEED 2009.

The LEED 2009 credit weightings process is based on the following parameters, which maintain consistency and usability across rating systems:

- All LEED credits are worth a minimum of 1 point.
- All LEED credits are positive, whole numbers; there are no fractions or negative values.
- All LEED credits receive a single, static weight in each rating system; there are no individualized scorecards based on project location.
- All LEED rating systems have 100 base points; Innovation in Design (or Operations) and Regional Priority credits provide opportunities for up to 10 bonus points.

Given the above criteria, the LEED 2009 credit weightings process involves 3 steps:

1. A reference building is used to estimate the environmental impacts in 13 categories associated with a typical building pursuing LEED certification.
2. The relative importance of building impacts in each category are set to reflect values based on the NIST weightings.2
3. Data that quantify building impacts on environmental and human health are used to assign points to individual credits.

Each credit is allocated points based on the relative importance of the building-related impacts that it addresses. The result is a weighted average that combines building impacts and the relative value of the impact categories. Credits that most directly address the most important impacts are given the greatest weight, subject to the system design parameters described above. Credit weights also reflect a decision by LEED to recognize the market implications of point allocation. The result is a significant change in allocation of points compared with previous LEED rating systems. Overall, the changes increase the relative emphasis on the reduction of energy consumption and greenhouse gas emissions associated with building systems, transportation, the embodied energy of water, the embodied energy of materials, and where applicable, solid waste.
The details of the weightings process vary slightly among individual rating systems. For example, LEED for Existing Buildings: Operations & Maintenance includes credits related to solid waste management but LEED for New Construction does not. This results in a difference in the portion of the environmental footprint addressed by each rating system and the relative allocation of points. The weightings process for each rating system is fully documented in a weightings workbook.

The credit weightings process will be reevaluated over time to incorporate changes in values ascribed to different building impacts and building types, based on both market reality and evolving scientific knowledge related to buildings. A complete explanation of the LEED credit weightings system is available on the USGBC website, at www.usgbc.org.

Regional Priority Credits
To provide incentive to address geographically specific environmental issues, USGBC regional councils and chapters have identified 6 credits per rating system that are of particular importance to specific areas. Each regional priority credit is worth an additional 1 point, and a total of 4 regional priority points may be earned. Upon project registration, LEED Online automatically determines a project’s regional priority credits based on its zip code. If the project achieves more than 4 regional priority credits, the team can choose the credits for which these points will apply. The USGBC website also contains a searchable database of regional priority credits.

II. OVERVIEW AND PROCESS

The LEED 2009 Green Building Rating System for New Construction and Major Renovations is a set of performance standards for certifying the design and construction of commercial or institutional buildings and high-rise residential buildings of all sizes, both public and private. The intent is to promote healthful, durable, affordable, and environmentally sound practices in building design and construction.

Prerequisites and credits in the LEED 2009 for New Construction and Major Renovations addresses 7 topics:

- Sustainable Sites (SS)
- Water Efficiency (WE)
- Energy and Atmosphere (EA)
- Materials and Resources (MR)
- Indoor Environmental Quality (IEQ)
- Innovation in Design (ID)
- Regional Priority (RP)

LEED 2009 for New Construction and Major Renovations certifications are awarded according to the following scale:

- Certified  40–49 points
- Silver  50–59 points
- Gold  60–79 points
- Platinum  80 points and above

GBCI will recognize buildings that achieve 1 of these rating levels with a formal letter of certification.
When to Use LEED 2009 for New Construction

LEED for New Construction was designed primarily for new commercial office buildings, but it has been applied to many other building types by LEED practitioners. All commercial buildings, as defined by standard building codes, are eligible for certification as LEED for New Construction buildings. Examples of commercial occupancies include offices, institutional buildings (libraries, museums, churches, etc.), hotels, and residential buildings of 4 or more habitable stories.

LEED for New Construction addresses design and construction activities for both new buildings and major renovations of existing buildings. If the project scope does not involve significant design and construction activities and focuses more on operations and maintenance activities, LEED for Existing Buildings: Operations & Maintenance is more appropriate because it addresses operational and maintenance issues of working buildings.

Please see the Rating System Selection Policy, located in the LEED resources section of www.usgbc.org, for more information about choosing a rating system.

Registration

Project teams interested in earning LEED certification for their buildings must first register the project with GBCI. Projects can be registered on the GBCI website (www.gbc.org). The website also has information on registration costs for USGBC national members as well as nonmembers. Registration is an important step that establishes contact with GBCI and provides access to software tools, errata, critical communications, and other essential information.

Certification

To earn LEED certification, the applicant project must satisfy all the prerequisites and qualify for a minimum number of points to attain the established project ratings as listed below. Having satisfied the basic prerequisites of the program, applicant projects are then rated according to their degree of compliance within the rating system.

LEED 2009 for New Construction provides the option of splitting a certification application into two phases: design and construction. Documentation for design phase credits, identified in LEED-Online, can be submitted for review at the end of the design phase; the submittals for these credits can be fully evaluated based on documentation available during this phase of the project. For example, if a project site meets the requirements of LEED for New Construction SS Credit 3, Brownfield Redevelopment, the likelihood of credit achievement can be assessed before construction is complete. The LEED credit itself, however, is not awarded at the design review stage.


III. MINIMUM PROGRAM REQUIREMENTS

The LEED 2009 Minimum Program Requirements (MPRs) define the minimum characteristics that a project must possess in order to be eligible for certification under LEED 2009. These requirements define the categories of buildings that the LEED rating systems were designed to evaluate, and taken together serve three goals: to give clear guidance to customers, to protect the integrity of the LEED program, and to reduce challenges that occur during the LEED certification process. It is expected that MPRs will evolve over time along with LEED rating system improvements. The requirements will apply only to those projects registering under LEED 2009.

To view the MPRs and the MPR Supplemental Guidance, visit the LEED Resources and Tools section of www.usgbc.org/projecttools.
IV. EXEMPLARY PERFORMANCE STRATEGIES

Exemplary performance strategies result in performance that greatly exceeds the performance level or expands the scope required by an existing LEED 2009 for New Construction credit. To earn exemplary performance credits, teams must meet the performance level defined by the next step in the threshold progression. For credits with more than 1 compliance path, an Innovation in Design point can be earned by satisfying more than 1 compliance path if their benefits are additive.

The credits for which exemplary performance points are available through expanded performance or scope are noted in the LEED Reference Guide for Green Design & Construction, 2009 Edition and in LEED Online.

Endnotes
SS Prerequisite 1: Construction Activity Pollution Prevention

Required

Intent
To reduce pollution from construction activities by controlling soil erosion, waterway sedimentation and airborne dust generation.

Requirements
Create and implement an erosion and sedimentation control plan for all construction activities associated with the project. The plan must conform to the erosion and sedimentation requirements of the 2003 EPA Construction General Permit OR local standards and codes, whichever is more stringent. The plan must describe the measures implemented to accomplish the following objectives:

- To prevent loss of soil during construction by stormwater runoff and/or wind erosion, including protecting topsoil by stockpiling for reuse.
- To prevent sedimentation of storm sewers or receiving streams.
- To prevent pollution of the air with dust and particulate matter.

The EPA’s construction general permit outlines the provisions necessary to comply with Phase I and Phase II of the National Pollutant Discharge Elimination System (NPDES) program. While the permit only applies to construction sites greater than 1 acre, the requirements are applied to all projects for the purposes of this prerequisite. Information on the EPA construction general permit is available at [http://cfpub.epa.gov/npdes/stormwater/cgp.cfm](http://cfpub.epa.gov/npdes/stormwater/cgp.cfm).

Potential Technologies & Strategies
Create an erosion and sedimentation control plan during the design phase of the project. Consider employing strategies such as temporary and permanent seeding, mulching, earthen dikes, silt fencing, sediment traps and sediment basins.
SS Credit 1: Site Selection

1 Point

Intent
To avoid the development of inappropriate sites and reduce the environmental impact from the location of a building on a site.

Requirements
Do not develop buildings, hardscape, roads or parking areas on portions of sites that meet any of the following criteria:

- Prime farmland as defined by the U.S. Department of Agriculture in the United States Code of Federal Regulations, Title 7, Volume 6, Parts 400 to 699, Section 657.5 (citation 7CFR657.5)
- Previously undeveloped land whose elevation is lower than 5 feet above the elevation of the 100-year flood as defined by the Federal Emergency Management Agency (FEMA)
- Land specifically identified as habitat for any species on federal or state threatened or endangered lists
- Land within 100 feet of any wetlands as defined by the U.S. Code of Federal Regulations 40 CFR, Parts 230-233 and Part 22, and isolated wetlands or areas of special concern identified by state or local rule, OR within setback distances from wetlands prescribed in state or local regulations, as defined by local or state rule or law, whichever is more stringent
- Previously undeveloped land that is within 50 feet of a water body, defined as seas, lakes, rivers, streams and tributaries that support or could support fish, recreation or industrial use, consistent with the terminology of the Clean Water Act
- Land that prior to acquisition for the project was public parkland, unless land of equal or greater value as parkland is accepted in trade by the public landowner (park authority projects are exempt).

Potential Technologies & Strategies
During the site selection process, give preference to sites that do not include sensitive elements or restrictive land types. Select a suitable building location and design the building with a minimal footprint to minimize disruption of the environmentally sensitive areas identified above.
SS Credit 2: Development Density and Community Connectivity

5 Points

Intent
To channel development to urban areas with existing infrastructure, protect greenfields, and preserve habitat and natural resources.

Requirements

OPTION 1. Development Density
Construct or renovate a building on a previously developed site AND in a community with a minimum density of 60,000 square feet per acre net. The density calculation is based on a typical two-story downtown development and must include the area of the project being built.

OR

OPTION 2. Community Connectivity
Construct or renovate a building on a site that meets the following criteria:

- Is located on a previously developed site
- Is within 1/2 mile of a residential area or neighborhood with an average density of 10 units per acre net
- Is within 1/2 mile of at least 10 basic services
- Has pedestrian access between the building and the services

For mixed-use projects, no more than 1 service within the project boundary may be counted as 1 of the 10 basic services, provided it is open to the public. No more than 2 of the 10 services required may be anticipated (i.e., at least 8 must be existing and operational). In addition, the anticipated services must demonstrate that they will be operational in the locations indicated within 1 year of occupation of the applicant project.

Examples of basic services include the following:

- Bank
- Place of Worship
- Convenience Grocery
- Day Care Center
- Cleaners
- Fire Station
- Beauty Salon
- Hardware
- Laundry
- Library
- Medical or Dental Office
- Senior Care Facility
- Park
- Pharmacy
- Post Office
- Restaurant
- School
- Supermarket
- Theater
- Community Center
- Fitness Center
- Museum
Proximity is determined by drawing a 1/2-mile radius around a main building entrance on a site map and counting the services within that radius.

**Potential Technologies & Strategies**

During the site selection process, give preference to urban sites with pedestrian access to a variety of services.
SS Credit 3: Brownfield Redevelopment

1 Point

**Intent**
To rehabilitate damaged sites where development is complicated by environmental contamination and to reduce pressure on undeveloped land.

**Requirements**

**OPTION 1**
Develop on a site documented as contaminated (by means of an ASTM E1903-97 Phase II Environmental Site Assessment or a local voluntary cleanup program).

**OR**

**OPTION 2**
Develop on a site defined as a brownfield by a local, state, or federal government agency.

For projects where asbestos is found and remediated also earn this credit. Testing should be done in accordance with EPA Reg 40CFR part 763, when applicable.

**Potential Technologies & Strategies**
During the site selection process, give preference to brownfield sites. Identify tax incentives and property cost savings. Coordinate site development plans with remediation activity, as appropriate.
SS Credit 4.1: Alternative Transportation—Public Transportation Access

6 Points

**Intent**
To reduce pollution and land development impacts from automobile use.

**Requirements**

OPTION 1. Rail Station Proximity
Locate the project within 1/2-mile walking distance (measured from a main building entrance) of an existing or planned and funded commuter rail, light rail or subway station.

OR

OPTION 2. Bus Stop Proximity
Locate the project within 1/4-mile walking distance (measured from a main building entrance) of 1 or more stops for 2 or more public, campus, or private bus lines usable by building occupants.

**Potential Technologies & Strategies**
Perform a transportation survey of future building occupants to identify transportation needs. Locate the building near mass transit.
SS Credit 4.2: Alternative Transportation—Bicycle Storage and Changing Rooms
1 Point

**Intent**
To reduce pollution and land development impacts from automobile use.

**Requirements**

**CASE 1. Commercial or Institutional Projects**
- Provide secure bicycle racks and/or storage within 200 yards of a building entrance for 5% or more of all building users (measured at peak periods)
- Provide shower and changing facilities in the building, or within 200 yards of a building entrance, for 0.5% of full-time equivalent (FTE) occupants.

**CASE 2. Residential Projects**
- Provide covered storage facilities for securing bicycles for 15% or more of building occupants.

**Potential Technologies & Strategies**
Design the building with transportation amenities such as bicycle racks and shower/changing facilities.
SS Credit 4.3: Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles

3 Points

Intent
To reduce pollution and land development impacts from automobile use.

Requirements

OPTION 1
Provide preferred parking¹ for low-emitting and fuel-efficient vehicles² for 5% of the total vehicle parking capacity of the site. Providing a discounted parking rate is an acceptable substitute for preferred parking for low-emitting/fuel-efficient vehicles. To establish a meaningful incentive in all potential markets, the parking rate must be discounted at least 20%. The discounted rate must be available to all customers (i.e., not limited to the number of customers equal to 5% of the vehicle parking capacity), publicly posted at the entrance of the parking area and available for a minimum of 2 years.

OR

OPTION 2
Install alternative-fuel fueling stations for 3% of the total vehicle parking capacity of the site. Liquid or gaseous fueling facilities must be separately ventilated or located outdoors.

OR

OPTION 3
Provide low-emitting and fuel-efficient vehicles² for 3% of full-time equivalent (FTE) occupants. Provide preferred parking¹ for these vehicles.

OR

OPTION 4
Provide building occupants access to a low-emitting or fuel-efficient vehicle-sharing program. The following requirements must be met:

- One low-emitting or fuel-efficient vehicle must be provided per 3% of FTE occupants, assuming that 1 shared vehicle can carry 8 persons (i.e., 1 vehicle per 267 FTE occupants). For buildings with fewer than 267 FTE occupants, at least 1 low emitting or fuel-efficient vehicle must be provided.

- A vehicle-sharing contract must be provided that has an agreement of at least 2 years.

¹ For the purposes of this credit “preferred parking” refers to the parking spots that are closest to the main entrance of the project (exclusive of spaces designated for handicapped persons) or parking passes provided at a discounted price.

² For the purposes of this credit, low-emitting and fuel-efficient vehicles are defined as vehicles that are either classified as Zero Emission Vehicles (ZEV) by the California Air Resources Board or have achieved a minimum green score of 40 on the American Council for an Energy Efficient Economy (ACEEE) annual vehicle rating guide.
- The estimated number of customers served per vehicle must be supported by documentation.
- A narrative explaining the vehicle-sharing program and its administration must be submitted.
- Parking for low-emitting and fuel-efficient vehicles must be located in the nearest available spaces in the nearest available parking area. Provide a site plan or area map clearly highlighting the walking path from the parking area to the project site and noting the distance.

**Potential Technologies & Strategies**
Provide transportation amenities such as alternative-fuel refueling stations. Consider sharing the costs and benefits of refueling stations with neighbors.
SS Credit 4.4: Alternative Transportation—Parking Capacity
2 Points

Intent
To reduce pollution and land development impacts from automobile use.

Requirements

CASE 1. Non-Residential Projects

OPTION 1
Size parking capacity to meet but not exceed minimum local zoning requirements.
Provide preferred parking for carpool or vanpool for 5% of the total parking spaces.

OR

OPTION 2
For projects that provide parking for less than 5% of full-time equivalent (FTE) building occupants:
Provide preferred parking for carpool or vanpool, marked as such, for 5% of total parking spaces.
Providing a discounted parking rate is an acceptable substitute for preferred parking for carpool or vanpool vehicles. To establish a meaningful incentive in all potential markets, the parking rate must be discounted at least 20%. The discounted rate must be available to all customers (i.e., not limited to the number of customers equal to 5% of the vehicle parking capacity), publicly posted at the entrance of the parking area, and available for a minimum of 2 years.

OR

OPTION 3
Provide no new parking.

OR

OPTION 4
For projects that have no minimum local zoning requirements, provide 25% fewer parking spaces than the applicable standard listed in the 2003 Institute of Transportation Engineers (ITE) “Parking Generation” study at http://www.ite.org.

CASE 2. Residential Projects

OPTION 1
Size parking capacity to meet but not exceed minimum local zoning requirements
Provide infrastructure and support programs to facilitate shared vehicle use such as carpool drop-off areas, designated parking for vanpools, car-share services, ride boards and shuttle services to mass transit.

1 For the purposes of this credit “preferred parking” refers to the parking spots that are closest to the main entrance of the project (exclusive of spaces designated for handicapped persons) or parking passes provided at a discounted price.
OR

OPTION 2
Provide no new parking.

CASE 3. Mixed Use (Residential with Commercial/Retail) Projects

OPTION 1
Mixed-use buildings with less than 10% commercial area must be considered residential and adhere to
the residential requirements in Case 2. For mixed-use buildings with more than 10% commercial area, the
commercial space must adhere to non-residential requirements in Case 1 and the residential component
must adhere to residential requirements in Case 2.

OR

OPTION 2
Provide no new parking.

Potential Technologies & Strategies
Minimize parking lot/garage size. Consider sharing parking facilities with adjacent buildings. Consider alternatives
that will limit the use of single occupancy vehicles.
SS Credit 5.1: Site Development—Protect or Restore Habitat

1 Point

Intent
To conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.

Requirements

CASE 1. Greenfield Sites
Limit all site disturbance to the following parameters:
- 40 feet beyond the building perimeter;
- 10 feet beyond surface walkways, patios, surface parking and utilities less than 12 inches in diameter;
- 15 feet beyond primary roadway curbs and main utility branch trenches;
- 25 feet beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater detention facilities and playing fields) that require additional staging areas to limit compaction in the constructed area.

CASE 2. Previously Developed Areas or Graded Sites
Restore or protect a minimum of 50% of the site (excluding the building footprint) or 20% of the total site area (including building footprint), whichever is greater, with native or adapted vegetation. Projects earning SS Credit 2: Development Density and Community Connectivity may include vegetated roof surface in this calculation if the plants are native or adapted, provide habitat, and promote biodiversity. Projects with limited landscape opportunities may also donate offsite land in perpetuity, equal to 60% of the previously developed area (including the building footprint), to a land trust within the same EPA Level III Ecoregion identified for the project site. The land trust must adhere to the Land Trust Alliance ‘Land Trust Standards and Practices’ 2004 Revision.

Potential Technologies & Strategies
Survey greenfield sites to identify site elements and adopt a master plan for developing the project site. Carefully site the building to minimize disruption to existing ecosystems and design the building to minimize its footprint. Establish clearly-marked construction boundaries to minimize disturbance of the existing site and restore previously degraded areas to their natural state. For previously developed sites, use local and regional governmental agencies, consultants, educational facilities and native plant societies as resources for the selection of appropriate native or adapted plants. Prohibit plants listed as invasive or noxious weed species. Once established, native/adapted plants require minimal or no irrigation; do not require active maintenance such as mowing or chemical inputs such as fertilizers, pesticides or herbicides; and provide habitat value and promote biodiversity through avoidance of monoculture plantings.

1 Greenfield sites are those that are not previously developed or graded and remain in a natural state.
2 Previously developed areas are those that previously contained buildings, roadways, parking lots or were graded or altered by direct human activities.
3 Native or adapted plants are plants indigenous to a locality or cultivars of native plants that are adapted to the local climate and are not considered invasive species or noxious weeds.
SS Credit 5.2: Site Development—Maximize Open Space

1 Point

Intent
To promote biodiversity by providing a high ratio of open space to development footprint.

Requirements

CASE 1. Sites with Local Zoning Open Space Requirements
Reduce the development footprint¹ and/or provide vegetated open space within the project boundary such that the amount of open space exceeds local zoning requirements by 25%.

CASE 2. Sites with No Local Zoning Requirements (e.g. some university campuses, military bases)
Provide a vegetated open space area adjacent to the building that is equal in area to the building footprint.

CASE 3. Sites with Zoning Ordinances but No Open Space Requirements
Provide vegetated open space equal to 20% of the project site area.

ALL CASES
For projects in urban areas that earn SS Credit 2: Development Density and Community Connectivity, vegetated roof areas can contribute to credit compliance.

For projects in urban areas that earn SS Credit 2: Development Density and Community Connectivity, pedestrian-oriented hardscape areas can contribute to credit compliance. For such projects, a minimum of 25% of the open space counted must be vegetated.

Wetlands or naturally designed ponds may count as open space and the side slope gradients average 1:4 (vertical: horizontal) or less and are vegetated.

Potential Technologies & Strategies
Perform a site survey to identify site elements and adopt a master plan for developing the project site. Select a suitable building location and design the building footprint to minimize site disruption. Strategies include stacking the building program, tuck-under parking and sharing parking facilities with neighbors to maximize the amount of open space on the site.

¹ Development footprint is defined as the total area of the building footprint, hardscape, access roads and parking.
SS Credit 6.1: Stormwater Design—Quantity Control

1 Point

Intent
To limit disruption of natural hydrology by reducing impervious cover, increasing on-site infiltration, reducing or eliminating pollution from stormwater runoff and eliminating contaminants.

Requirements
CASE 1. Sites with Existing Imperviousness 50% or Less

OPTION 1
Implement a stormwater management plan that prevents the postdevelopment peak discharge rate and quantity from exceeding the predevelopment peak discharge rate and quantity for the 1- and 2-year 24-hour design storms.

OR

OPTION 2
Implement a stormwater management plan that protects receiving stream channels from excessive erosion. The stormwater management plan must include stream channel protection and quantity control strategies.

CASE 2. Sites with Existing Imperviousness Greater Than 50%
Implement a stormwater management plan that results in a 25% decrease in the volume of stormwater runoff from the 2-year 24-hour design storm.

Potential Technologies & Strategies
Design the project site to maintain natural stormwater flows by promoting infiltration. Specify vegetated roofs, pervious paving and other measures to minimize impervious surfaces. Reuse stormwater for non-potable uses such as landscape irrigation, toilet and urinal flushing, and custodial uses.
SS Credit 6.2: Stormwater Design—Quality Control

1 Point

**Intent**
To limit disruption and pollution of natural water flows by managing stormwater runoff.

**Requirements**
Implement a stormwater management plan that reduces impervious cover, promotes infiltration and captures and treats the stormwater runoff from 90% of the average annual rainfall using acceptable best management practices (BMPs).

BMPs used to treat runoff must be capable of removing 80% of the average annual postdevelopment total suspended solids (TSS) load based on existing monitoring reports. BMPs are considered to meet these criteria if:

- They are designed in accordance with standards and specifications from a state or local program that has adopted these performance standards,
- OR
- There exists infield performance monitoring data demonstrating compliance with the criteria. Data must conform to accepted protocol (e.g., Technology Acceptance Reciprocity Partnership [TARP], Washington State Department of Ecology) for BMP monitoring.

**Potential Technologies & Strategies**
Use alternative surfaces (e.g., vegetated roofs, pervious pavement, grid pavers) and nonstructural techniques (e.g., rain gardens, vegetated swales, disconnection of imperviousness, rainwater recycling) to reduce imperviousness and promote infiltration and thereby reduce pollutant loadings.

Use sustainable design strategies (e.g., low-impact development, environmentally sensitive design) to create integrated natural and mechanical treatment systems such as constructed wetlands, vegetated filters and open channels to treat stormwater runoff.

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1 There are 3 distinct climates in the United States that influence the nature and amount of annual rainfall. Humid watersheds are defined as those that receive at least 40 inches of rainfall each year. Semiarid watersheds receive between 20 and 40 inches of rainfall per year, and arid watersheds receive less than 20 inches of rainfall per year. For this credit, 90% of the average annual rainfall is equivalent to treating the runoff from the following (based on climate):
- Humid Watersheds — 1 inch of rainfall
- Semiarid Watersheds — 0.75 inches of rainfall
- Arid Watersheds — 0.5 inches of rainfall
SS Credit 7.1: Heat Island Effect—Nonroof

1 Point

Intent
To reduce heat islands¹ to minimize impacts on microclimates and human and wildlife habitats.

Requirements

OPTION 1
Use any combination of the following strategies for 50% of the site hardscape (including roads, sidewalks, courtyards and parking lots):

- Provide shade from the existing tree canopy or within 5 years of landscape installation. Landscaping (trees) must be in place at the time of occupancy.
- Provide shade from structures covered by solar panels that produce energy used to offset some nonrenewable resource use.
- Provide shade from architectural devices or structures that have a solar reflectance index² (SRI) of at least 29.
- Use hardscape materials with an SRI of at least 29.
- Use an open-grid pavement system (at least 50% pervious).

OR

OPTION 2
Place a minimum of 50% of parking spaces under cover³. Any roof used to shade or cover parking must have an SRI of at least 29, be a vegetated green roof or be covered by solar panels that produce energy used to offset some nonrenewable resource use.

Potential Technologies & Strategies
Employ strategies, materials and landscaping techniques that reduce the heat absorption of exterior materials. Use shade (calculated on June 21, noon solar time) from native or adapted trees and large shrubs, vegetated trellises or other exterior structures supporting vegetation. Consider using new coatings and integral colorants for asphalt to achieve light-colored surfaces instead of blacktop. Position photovoltaic cells to shade impervious surfaces.

Consider replacing constructed surfaces (e.g., roof, roads, sidewalks, etc.) with vegetated surfaces such as vegetated roofs and open grid paving or specify high-albedo materials, such as concrete, to reduce heat absorption.

¹ Heat islands are defined as thermal gradient differences between developed and undeveloped areas.
² The solar reflectance index (SRI) is a measure of the constructed surface’s ability to reflect solar heat, as shown by a small temperature rise. It is defined so that a standard black surface (reflectance 0.05, emittance 0.90) is 0 and a standard white surface (reflectance 0.80, emittance 0.90) is 100. To calculate the SRI for a given material, obtain the reflectance value and emittance value for the material. SRI is calculated according to ASTM E 1980. Reflectance is measured according to ASTM E 903, ASTM E 1918, or ASTM C 1549. Emittance is measured according to ASTM E 408 or ASTM C 1371.
³ For the purposes of this credit, under cover parking is defined as parking underground, under deck, under roof, or under a building.
SS Credit 7.2: Heat Island Effect—Roof
1 Point

Intent
To reduce heat islands¹ to minimize impacts on microclimates and human and wildlife habitats.

Requirements

OPTION 1
Use roofing materials with a solar reflectance index² (SRI) equal to or greater than the values in the table below for a minimum of 75% of the roof surface.

Roofing materials having a lower SRI value than those listed below may be used if the weighted rooftop SRI average meets the following criteria:

<table>
<thead>
<tr>
<th>Roof Type</th>
<th>Slope</th>
<th>SRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-sloped roof</td>
<td>≤ 2:12</td>
<td>78</td>
</tr>
<tr>
<td>Steep-sloped roof</td>
<td>&gt; 2:12</td>
<td>29</td>
</tr>
</tbody>
</table>

OR

OPTION 2
Install a vegetated roof that covers at least 50% of the roof area.

OR

OPTION 3
Install high-albedo and vegetated roof surfaces that, in combination, meet the following criteria:

<table>
<thead>
<tr>
<th>Roof Type</th>
<th>Slope</th>
<th>SRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-sloped roof</td>
<td>≤ 2:12</td>
<td>78</td>
</tr>
<tr>
<td>Steep-sloped roof</td>
<td>&gt; 2:12</td>
<td>29</td>
</tr>
</tbody>
</table>

¹ Heat islands are defined as thermal gradient differences between developed and undeveloped areas.
² The solar reflectance index (SRI) is a measure of the constructed surface’s ability to reflect solar heat, as shown by a small temperature rise. It is defined so that a standard black surface (reflectance 0.05, emittance 0.90) is 0 and a standard white surface (reflectance 0.80, emittance 0.90) is 100. To calculate the SRI for a given material, obtain the reflectance value and emittance value for the material. SRI is calculated according to ASTM E 1980. Reflectance is measured according to ASTM E 903, ASTM E 1918 or ASTM C 1549. Emittance is measured according to ASTM E 408 or ASTM C 1371.
Potential Technologies & Strategies
SS Credit 8: Light Pollution Reduction

1 Point

**Intent**

To minimize light trespass from the building and site, reduce sky-glow to increase night sky access, improve nighttime visibility through glare reduction and reduce development impact from lighting on nocturnal environments.

**Requirements**

Project teams must comply with 1 of the 2 options for interior lighting AND the requirement for exterior lighting.

**For Interior Lighting**

**OPTION 1**

Reduce the input power (by automatic device) of all nonemergency interior luminaires with a direct line of sight to any openings in the envelope (translucent or transparent) by at least 50% between 11 p.m. and 5 a.m. After-hours override may be provided by a manual or occupant-sensing device provided the override lasts no more than 30 minutes.

**OR**

**OPTION 2**

All openings in the envelope (translucent or transparent) with a direct line of sight to any nonemergency luminaires must have shielding (controlled/closed by automatic device for a resultant transmittance of less than 10% between 11 p.m. and 5 a.m.).

**For Exterior Lighting**

Light areas only as required for safety and comfort. Exterior lighting power densities shall not exceed those specified in ANSI/ASHRAE/IESNA Standard 90.1-2007 with Addenda 1 for the documented lighting zone. Justification shall be provided for the selected lighting zone. Lighting controls for all exterior lighting shall comply with section 9.4.1.3 of ANSI/ASHRAE/IESNA Standard 90.1-2007, without amendments.

Classify the project under 1 of the following zones, as defined in IESNA RP-33, and follow all the requirements for that zone:

**LZ1: Dark (developed areas within national parks, state parks, forest land and rural areas)**

Design exterior lighting so that all site and building-mounted luminaires produce a maximum initial illuminance value no greater than 0.01 horizontal and vertical footcandles at the site boundary and beyond. Document that 0% of the total initial designed fixture lumens (sum total of all fixtures on site) are emitted at an angle of 90 degrees or higher from nadir (straight down).

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1 The requirement to use ASHRAE Addenda I is unique to this credit and does not obligate Project teams to use ASHRAE approved addenda for other credits.
LZ2: Low (primarily residential zones, neighborhood business districts, light industrial areas with limited nighttime use and residential mixed-use areas)
Design exterior lighting so that all site and building-mounted luminaires produce a maximum initial illuminance value no greater than 0.10 horizontal and vertical footcandles at the site boundary and no greater than 0.01 horizontal footcandles 10 feet beyond the site boundary. Document that no more than 2% of the total initial designed fixture lumens (sum total of all fixtures on site) are emitted at an angle of 90 degrees or higher from nadir (straight down).

LZ3: Medium (all other areas not included in LZ1, LZ2 or LZ4, such as commercial/industrial, and high-density residential)
Design exterior lighting so that all site and building-mounted luminaires produce a maximum initial illuminance value no greater than 0.20 horizontal and vertical footcandles at the site boundary and no greater than 0.01 horizontal footcandles 15 feet beyond the site. Document that no more than 5% of the total initial designed fixture lumens (sum total of all fixtures on site) are emitted at an angle of 90 degrees or higher from nadir (straight down).

LZ4: High² (high-activity commercial districts in major metropolitan areas)
Design exterior lighting so that all site and building-mounted luminaires produce a maximum initial illuminance value no greater than 0.60 horizontal and vertical footcandles at the site boundary and no greater than 0.01 horizontal footcandles 15 feet beyond the site. Document that no more than 10% of the total initial designed fixture lumens (sum total of all fixtures on site) are emitted at an angle of 90 degrees or higher from nadir (straight down).

LZ2, LZ3 and LZ4 - For site boundaries that abut public rights-of-way, light trespass requirements may be met relative to the curb line instead of the site boundary.

For All Zones
Illuminance generated from a single luminaire placed at the intersection of a private vehicular driveway and public roadway accessing the site is allowed to use the centerline of the public roadway as the site boundary for a length of 2 times the driveway width centered at the centerline of the driveway.

Potential Technologies & Strategies
Adopt site lighting criteria to maintain safe light levels while avoiding off-site lighting and night sky pollution. Minimize site lighting where possible, and use computer software to model the site lighting. Technologies to reduce light pollution include full cutoff luminaires, low-reflectance surfaces and low-angle spotlights.

² To be LZ4, the area must be so designated by an organization with local jurisdiction, such as the local zoning authority.
WE Prerequisite 1: Water Use Reduction

Required

**Intent**
To increase water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.

**Requirements**
Employ strategies that in aggregate use 20% less water than the water use baseline calculated for the building (not including irrigation).

Calculate the baseline according to the commercial and/or residential baselines outlined below. Calculations are based on estimated occupant usage and must include only the following fixtures and fixture fittings (as applicable to the project scope): water closets, urinals, lavatory faucets, showers, kitchen sink faucets and prerinse spray valves.

<table>
<thead>
<tr>
<th>Commercial Fixtures, Fittings, and Appliances</th>
<th>Current Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial toilets</td>
<td>1.6 gallons per flush (gpf)*&lt;br&gt;Except blow-out fixtures: 3.5 (gpf)</td>
</tr>
<tr>
<td>Commercial urinals</td>
<td>1.0 (gpf)</td>
</tr>
<tr>
<td>Commercial lavatory (restroom) faucets</td>
<td>2.2 gallons per minute (gpm) at 60 pounds per square inch (psi), private applications only (hotel or motel guest rooms, hospital patient rooms)&lt;br&gt;0.5 (gpm) at 60 (psi)** all others except private applications&lt;br&gt;0.25 gallons per cycle for metering faucets</td>
</tr>
<tr>
<td>Commercial prerinse spray valves (for food service applications)</td>
<td>Flow rate ≤ 1.6 (gpm)&lt;br&gt;(no pressure specified; no performance requirement)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Residential Fixtures, Fittings, and Appliances</th>
<th>Current Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential toilets</td>
<td>1.6 (gpf)***</td>
</tr>
<tr>
<td>Residential lavatory (bathroom) faucets</td>
<td>2.2 (gpm) at 60 psi</td>
</tr>
<tr>
<td>Residential kitchen faucet</td>
<td></td>
</tr>
<tr>
<td>Residential showerheads</td>
<td>2.5 (gpm) at 80 (psi) per shower stall****</td>
</tr>
</tbody>
</table>

* EPAct 1992 standard for toilets applies to both commercial and residential models.
** In addition to EPAct requirements, the American Society of Mechanical Engineers standard for public lavatory faucets is 0.5 gpm at 60 psi (ASME A112.18.1-2005). This maximum has been incorporated into the national Uniform Plumbing Code and the International Plumbing Code.
*** EPAct 1992 standard for toilets applies to both commercial and residential models.
**** Residential shower compartment (stall) in dwelling units: The total allowable flow rate from all flowing showerheads at any given time, including rain systems, waterfalls, bodysprays, bodyspas and jets, must be limited to the allowable showerhead flow rate as specified above (2.5 gpm) per shower compartment, where the floor area of the shower compartment is less than 2,500 square inches. For each increment of 2,500 square inches of floor area thereafter or part thereof, an additional showerhead with total allowable flow rate from all flowing devices equal to or less than the allowable flow rate as specified above must be allowed. Exception: Showers that emit recirculated nonpotable water originating from within the shower compartment while operating are allowed to exceed the maximum as long as the total potable water flow does not exceed the flow rate as specified above.

1 Tables adapted from information developed and summarized by the U.S. Environmental Protection Agency (EPA) Office of Water based on requirements of the Energy Policy Act (EPAct) of 1992 and subsequent rulings by the Department of Energy, requirements of the EPAct of 2005, and the plumbing code requirements as stated in the 2006 editions of the Uniform Plumbing Code or International Plumbing Code pertaining to fixture performance.
The following fixtures, fittings and appliances are outside the scope of the water use reduction calculation:

- Commercial Steam Cookers
- Commercial Dishwashers
- Automatic Commercial Ice Makers
- Commercial (family sized) Clothes Washers
- Residential Clothes Washers
- Standard and Compact Residential Dishwashers

**Potential Technologies & Strategies**

WaterSense-certified fixtures and fixture fittings should be used where available. Use high-efficiency fixtures (e.g., water closets and urinals) and dry fixtures, such as toilets attached to composting systems, to reduce potable water demand. Consider using alternative on-site sources of water (e.g., rainwater, stormwater, and air conditioner condensate) and graywater for nonpotable applications such as custodial uses and toilet and urinal flushing. The quality of any alternative source of water used must be taken into consideration based on its application or use.
WE Credit 1: Water Efficient Landscaping

2–4 Points

Intent
To limit or eliminate the use of potable water or other natural surface or subsurface water resources available on or near the project site for landscape irrigation.

Requirements

OPTION 1. Reduce by 50% (2 points)
Reduce potable water consumption for irrigation by 50% from a calculated midsummer baseline case.
Reductions must be attributed to any combination of the following items:

- Plant species, density and microclimate factor
- Irrigation efficiency
- Use of captured rainwater
- Use of recycled wastewater
- Use of water treated and conveyed by a public agency specifically for nonpotable uses

Groundwater seepage that is pumped away from the immediate vicinity of building slabs and foundations may be used for landscape irrigation to meet the intent of this credit. However, the project team must demonstrate that doing so does not affect site stormwater management systems.

OR

OPTION 2. No Potable Water Use or Irrigation1 (4 points)
Meet the requirements for Option 1.

AND

PATH 1
Use only captured rainwater, recycled wastewater, recycled graywater or water treated and conveyed by a public agency specifically for nonpotable uses for irrigation.

OR

PATH 2
Install landscaping that does not require permanent irrigation systems. Temporary irrigation systems used for plant establishment are allowed only if removed within a period not to exceed 18 months of installation.

1 If the percent reduction of potable water is 100% AND the percent reduction of total water is equal to or greater than 50%, then Option 2 is earned, for a total of 4 points.
Potential Technologies & Strategies
Perform a soil/climate analysis to determine appropriate plant material and design the landscape with native or adapted plants to reduce or eliminate irrigation requirements. Where irrigation is required, use high-efficiency equipment and/or climate-based controllers.
WE Credit 2: Innovative Wastewater Technologies

2 Points

**Intent**
To reduce wastewater generation and potable water demand while increasing the local aquifer recharge.

**Requirements**

**OPTION 1**
Reduce potable water use for building sewage conveyance by 50% through the use of water-conserving fixtures (e.g., water closets, urinals) or nonpotable water (e.g., captured rainwater, recycled graywater, on-site or municipally treated wastewater).

**OR**

**OPTION 2**
Treat 50% of wastewater on-site to tertiary standards. Treated water must be infiltrated or used on-site.

**Potential Technologies & Strategies**
Specify high-efficiency fixtures and dry fixtures (e.g., composting toilet systems, nonwater-using urinals) to reduce wastewater volumes. Consider reusing stormwater or graywater for sewage conveyance or on-site mechanical and/or natural wastewater treatment systems. Options for on-site wastewater treatment include packaged biological nutrient removal systems, constructed wetlands and high-efficiency filtration systems.
WE Credit 3: Water Use Reduction
2–4 Points

Intent
To further increase water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.

Requirements
Employ strategies that in aggregate use less water than the water use baseline calculated for the building (not including irrigation). The minimum water savings percentage for each point threshold is as follows:

<table>
<thead>
<tr>
<th>Percentage Reduction</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>30%</td>
<td>2</td>
</tr>
<tr>
<td>35%</td>
<td>3</td>
</tr>
<tr>
<td>40%</td>
<td>4</td>
</tr>
</tbody>
</table>

Calculate the baseline according to the commercial and/or residential baselines outlined below. Calculations are based on estimated occupant usage and must include only the following fixtures and fixture fittings (as applicable to the project scope): water closets, urinals, lavatory faucets, showers, kitchen sink faucets and pre-rinse spray valves.

### Commercial Fixtures, Fittings, and Appliances

<table>
<thead>
<tr>
<th>Fixtures, Fittings, and Appliances</th>
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</tr>
<tr>
<td></td>
<td>Except blow-out fixtures: 3.5 (gpf)</td>
</tr>
<tr>
<td>Commercial urinals</td>
<td>1.0 (gpf)</td>
</tr>
<tr>
<td>Commercial lavatory (restroom) faucets</td>
<td>2.2 gallons per minute (gpm) at 60 pounds per square inch (psi), private applications only (hotel or motel guest rooms, hospital patient rooms) 0.5 (gpm) at 60 (psi)** all others except private applications 0.25 gallons per cycle for metering faucets</td>
</tr>
<tr>
<td>Commercial pre-rinse spray valves (for food service applications)</td>
<td>Flow rate ≤ 1.6 (gpm) (no pressure specified; no performance requirement)</td>
</tr>
</tbody>
</table>

### Residential Fixtures, Fittings, and Appliances

<table>
<thead>
<tr>
<th>Fixtures, Fittings, and Appliances</th>
<th>Current Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential toilets</td>
<td>1.6 (gpf)***</td>
</tr>
<tr>
<td>Residential lavatory (bathroom) faucets</td>
<td>2.2 (gpm) at 60 psi</td>
</tr>
<tr>
<td>Residential kitchen faucet</td>
<td></td>
</tr>
<tr>
<td>Residential showerheads</td>
<td>2.5 (gpm) at 80 (psi) per shower stall****</td>
</tr>
</tbody>
</table>

* EPAct 1992 standard for toilets applies to both commercial and residential models.
** In addition to EPAct requirements, the American Society of Mechanical Engineers standard for public lavatory faucets is 0.5 gpm at 60 psi (ASME A112.18.1-2005). This maximum has been incorporated into the national Uniform Plumbing Code and the International Plumbing Code.
*** EPAct 1992 standard for toilets applies to both commercial and residential models.
**** Residential shower compartment (stall) in dwelling units: The total allowable flow rate from all flowing showerheads at any given time, including rain systems, waterfalls, bodysprays, bodyspas and jets, must be limited to the allowable showerhead flow rate as specified above (2.5 gpm) per shower compartment, where the floor area of the shower compartment is less than 2,500 square inches. For each increment of 2,500 square inches of floor area thereafter or part thereof, an additional showerhead with total allowable flow rate from all flowing devices equal to or less than the allowable flow rate as specified above must be allowed. Exception: Showers that emit recirculated nonpotable water originating from within the shower compartment while operating are allowed to exceed the maximum as long as the total potable water flow does not exceed the flow rate as specified above.

1 Tables adapted from information developed and summarized by the U.S. Environmental Protection Agency (EPA) Office of Water based on requirements of the Energy Policy Act (EPAct) of 1992 and subsequent rulings by the Department of Energy, requirements of the EPAct of 2005, and the plumbing code requirements as stated in the 2006 editions of the Uniform Plumbing Code or International Plumbing Code pertaining to fixture performance.

LEED 2009 FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS
The following fixtures, fittings and appliances are outside the scope of the water use reduction calculation:

- Commercial Steam Cookers
- Commercial Dishwashers
- Automatic Commercial Ice Makers
- Commercial (family-sized) Clothes Washers
- Residential Clothes Washers
- Standard and Compact Residential Dishwashers

**Potential Technologies & Strategies**

Use WaterSense-certified fixtures and fixture fittings where available. Use high-efficiency fixtures (e.g., water closets and urinals) and dry fixtures, such as toilets attached to composting systems, to reduce the potable water demand. Consider using alternative on-site sources of water (e.g., rainwater, stormwater, and air conditioner condensate, graywater) for nonpotable applications (e.g., toilet and urinal flushing, custodial uses). The quality of any alternative source of water being used must be taken into consideration based on its application or use.
EA Prerequisite 1: Fundamental Commissioning of Building Energy Systems

Required

Intent
To verify that the project’s energy-related systems are installed, and calibrated to perform according to the owner’s project requirements, basis of design and construction documents.

Benefits of commissioning include reduced energy use, lower operating costs, fewer contractor callbacks, better building documentation, improved occupant productivity and verification that the systems perform in accordance with the owner’s project requirements.

Requirements
The following commissioning process activities must be completed by the project team:

- Designate an individual as the commissioning authority (CxA) to lead, review and oversee the completion of the commissioning process activities.
  - The CxA must have documented commissioning authority experience in at least 2 building projects.
  - The individual serving as the CxA must be independent of the project design and construction management, though the CxA may be an employee of any firm providing those services. The CxA may be a qualified employee or consultant of the owner.
  - The CxA must report results, findings and recommendations directly to the owner.
  - For projects smaller than 50,000 gross square feet, the CxA may be a qualified person on the design or construction team who has the required experience.

- The owner must document the owner’s project requirements. The design team must develop the basis of design. The CxA must review these documents for clarity and completeness. The owner and design team must be responsible for updates to their respective documents.

- Develop and incorporate commissioning requirements into the construction documents.

- Develop and implement a commissioning plan.

- Verify the installation and performance of the systems to be commissioned.

- Complete a summary commissioning report.

Commissioned Systems
Commissioning process activities must be completed for the following energy-related systems, at a minimum:

- Heating, ventilating, air conditioning and refrigeration (HVAC&R) systems (mechanical and passive) and associated controls
- Lighting and daylighting controls
- Domestic hot water systems
- Renewable energy systems (e.g., wind, solar)
Potential Technologies & Strategies

Engage a CxA as early as possible in the design process. Determine the owner’s project requirements, develop and maintain a commissioning plan for use during design and construction and incorporate commissioning requirements in bid documents. Assemble the commissioning team, and prior to occupancy verify the performance of energy consuming systems. Complete the commissioning reports with recommendations prior to accepting the commissioned systems.

Owners are encouraged to seek out qualified individuals to lead the commissioning process. Qualified individuals are identified as those who possess a high level of experience in the following areas:

- Energy systems design, installation and operation
- Commissioning planning and process management
- Hands-on field experience with energy systems performance, interaction, start-up, balancing, testing, troubleshooting, operation and maintenance procedures
- Energy systems automation control knowledge

Owners are encouraged to consider including water-using systems, building envelope systems, and other systems in the scope of the commissioning plan as appropriate. The building envelope is an important component of a facility that impacts energy consumption, occupant comfort and indoor air quality. While this prerequisite does not require building envelope commissioning, an owner can achieve significant financial savings and reduce risk of poor indoor air quality by including it in the commissioning process.

The LEED Reference Guide for Green Building Design and Construction, 2009 Edition provides guidance on the rigor expected for this prerequisite for the following:

- Owner’s project requirements
- Basis of design
- Commissioning plan
- Commissioning specification
- Performance verification documentation
- Commissioning report
EA Prerequisite 2: Minimum Energy Performance

Required

Intent
To establish the minimum level of energy efficiency for the proposed building and systems to reduce environmental and economic impacts associated with excessive energy use.

Requirements

OPTION 1. Whole Building Energy Simulation

Demonstrate a 10% improvement in the proposed building performance rating for new buildings, or a 5% improvement in the proposed building performance rating for major renovations to existing buildings, compared with the baseline building performance rating.

Calculate the baseline building performance rating according to the building performance rating method in Appendix G of ANSI/ASHRAE/IESNA Standard 90.1-2007 (with errata but without addenda) using a computer simulation model for the whole building project.

Appendix G of Standard 90.1-2007 requires that the energy analysis done for the building performance rating method include all energy costs associated with the building project. To achieve points using this credit, the proposed design must meet the following criteria:

- Comply with the mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) in Standard 90.1-2007 (with errata but without addenda).
- Include all energy costs associated with the building project.
- Compare against a baseline building that complies with Appendix G of Standard 90.1-2007 (with errata but without addenda). The default process energy cost is 25% of the total energy cost for the baseline building. If the building’s process energy cost is less than 25% of the baseline building energy cost, the LEED submittal must include documentation substantiating that process energy inputs are appropriate.

For the purpose of this analysis, process energy is considered to include, but is not limited to, office and general miscellaneous equipment, computers, elevators and escalators, kitchen cooking and refrigeration, laundry washing and drying, lighting exempt from the lighting power allowance (e.g., lighting integral to medical equipment) and other (e.g., waterfall pumps).

Regulated (non-process) energy includes lighting (for the interior, parking garage, surface parking, façade, or building grounds, etc. except as noted above), heating, ventilation and air conditioning (HVAC) (for space heating, space cooling, fans, pumps, toilet exhaust, parking garage ventilation, kitchen hood exhaust, etc.), and service water heating for domestic or space heating purposes.

Process loads must be identical for both the baseline building performance rating and the proposed building performance rating. However, project teams may follow the exceptional calculation method (ANSI/ASHRAE/IESNA Standard 90.1-2007 G2.5) to document measures that reduce process loads. Documentation of process

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Project teams wishing to use ASHRAE approved addenda for the purposes of this credit may do so at their discretion. Addenda must be applied consistently across all LEED credits.
load energy savings must include a list of the assumptions made for both the base and the proposed design, and theoretical or empirical information supporting these assumptions.


OR

Comply with the prescriptive measures of the ASHRAE Advanced Energy Design Guide appropriate to the project scope, outlined below. Project teams must comply with all applicable criteria as established in the Advanced Energy Design Guide for the climate zone in which the building is located.

The building must meet the following requirements:
- Less than 20,000 square feet.
- Office occupancy.

The building must meet the following requirements:
- Less than 20,000 square feet.
- Retail occupancy.

The building must meet the following requirements:
- Less than 50,000 square feet.
- Warehouse or self-storage occupancy.

OR

Comply with the prescriptive measures identified in the Advanced Buildings™ Core Performance™ Guide developed by the New Buildings Institute. The building must meet the following requirements:
- Less than 100,000 square feet.
- Comply with Section 1: Design Process Strategies, and Section 2: Core Performance Requirements.
- Health care, warehouse and laboratory projects are ineligible for this path.
**Potential Technologies & Strategies**

Design the building envelope and systems to meet baseline requirements. Use a computer simulation model to assess the energy performance and identify the most cost-effective energy efficiency measures. Quantify energy performance compared with a baseline building.

If local code has demonstrated quantitative and textual equivalence following, at a minimum, the U.S. Department of Energy (DOE) standard process for commercial energy code determination, then the results of that analysis may be used to correlate local code performance with ANSI/ASHRAE/IESNA Standard 90.1-2007. Details on the DOE process for commercial energy code determination can be found at [http://www.energycodes.gov/implement/determinations_com.stm](http://www.energycodes.gov/implement/determinations_com.stm).
**EA Prerequisite 3: Fundamental Refrigerant Management**

**Required**

**Intent**  
To reduce stratospheric ozone depletion.

**Requirements**  
Zero use of chlorofluorocarbon (CFC)-based refrigerants in new base building heating, ventilating, air conditioning and refrigeration (HVAC&R) systems. When reusing existing base building HVAC equipment, complete a comprehensive CFC phase-out conversion prior to project completion. Phase-out plans extending beyond the project completion date will be considered on their merits.

Existing small HVAC units (defined as containing less than 0.5 pounds of refrigerant) and other equipment, such as standard refrigerators, small water coolers and any other equipment that contains less than 0.5 pounds of refrigerant, are not considered part of the base building system and are not subject to the requirements of this prerequisite.

**Potential Technologies & Strategies**  
When reusing existing HVAC systems, conduct an inventory to identify equipment that uses CFC-based refrigerants and provide a replacement schedule for these refrigerants. For new buildings, specify new HVAC equipment in the base building that uses no CFC-based refrigerants.
EA Credit 1: Optimize Energy Performance
1–19 Points

Intent
To achieve increasing levels of energy performance beyond the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use.

Requirements
Select 1 of the 3 compliance path options described below. Project teams documenting achievement using any of the 3 options are assumed to be in compliance with EA Prerequisite 2: Minimum Energy Performance.

OPTION 1. Whole Building Energy Simulation (1–19 points)
Demonstrate a percentage improvement in the proposed building performance rating compared with the baseline building performance rating. Calculate the baseline building performance according to Appendix G of ANSI/ASHRAE/IESNA Standard 90.1-2007 (with errata but without addenda) using a computer simulation model for the whole building project. The minimum energy cost savings percentage for each point threshold is as follows:

<table>
<thead>
<tr>
<th>New Buildings</th>
<th>Existing Building Renovations</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>12%</td>
<td>8%</td>
<td>1</td>
</tr>
<tr>
<td>14%</td>
<td>10%</td>
<td>2</td>
</tr>
<tr>
<td>16%</td>
<td>12%</td>
<td>3</td>
</tr>
<tr>
<td>18%</td>
<td>14%</td>
<td>4</td>
</tr>
<tr>
<td>20%</td>
<td>16%</td>
<td>5</td>
</tr>
<tr>
<td>22%</td>
<td>18%</td>
<td>6</td>
</tr>
<tr>
<td>24%</td>
<td>20%</td>
<td>7</td>
</tr>
<tr>
<td>26%</td>
<td>22%</td>
<td>8</td>
</tr>
<tr>
<td>28%</td>
<td>24%</td>
<td>9</td>
</tr>
<tr>
<td>30%</td>
<td>26%</td>
<td>10</td>
</tr>
<tr>
<td>32%</td>
<td>28%</td>
<td>11</td>
</tr>
<tr>
<td>34%</td>
<td>30%</td>
<td>12</td>
</tr>
<tr>
<td>36%</td>
<td>32%</td>
<td>13</td>
</tr>
<tr>
<td>38%</td>
<td>34%</td>
<td>14</td>
</tr>
<tr>
<td>40%</td>
<td>36%</td>
<td>15</td>
</tr>
<tr>
<td>42%</td>
<td>38%</td>
<td>16</td>
</tr>
<tr>
<td>44%</td>
<td>40%</td>
<td>17</td>
</tr>
<tr>
<td>46%</td>
<td>42%</td>
<td>18</td>
</tr>
<tr>
<td>48%</td>
<td>44%</td>
<td>19</td>
</tr>
</tbody>
</table>

Project teams wishing to use ASHRAE approved addenda for the purposes of this credit may do so at their discretion. Addenda must be applied consistently across all LEED credits.
Appendix G of Standard 90.1-2007 requires that the energy analysis done for the building performance rating method include all the energy costs associated with the building project. To achieve points under this credit, the proposed design must meet the following criteria:

- Compliance with the mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) in Standard 90.1-2007 (with errata but without addenda).
- Inclusion of all the energy costs within and associated with the building project.
- Comparison against a baseline building that complies with Appendix G of Standard 90.1-2007 (with errata but without addenda). The default process energy cost is 25% of the total energy cost for the baseline building. If the building’s process energy cost is less than 25% of the baseline building energy cost, the LEED submittal must include documentation substantiating that process energy inputs are appropriate.

For the purpose of this analysis, process energy is considered to include, but is not limited to, office and general miscellaneous equipment, computers, elevators and escalators, kitchen cooking and refrigeration, laundry washing and drying, lighting exempt from the lighting power allowance (e.g., lighting integral to medical equipment) and other (e.g., waterfall pumps).

Regulated (non-process) energy includes lighting (e.g., for the interior, parking garage, surface parking, façade, or building grounds, etc. except as noted above), heating, ventilating, and air conditioning (HVAC) (e.g., for space heating, space cooling, fans, pumps, toilet exhaust, parking garage ventilation, kitchen hood exhaust, etc.), and service water heating for domestic or space heating purposes.

For this credit, process loads must be identical for both the baseline building performance rating and the proposed building performance rating. However, project teams may follow the exceptional calculation method (ANSI/ASHRAE/IESNA Standard 90.1-2007 G2.5) to document measures that reduce process loads. Documentation of process load energy savings must include a list of the assumptions made for both the base and proposed design, and theoretical or empirical information supporting these assumptions.


OR

OPTION 2. Prescriptive Compliance Path: ASHRAE Advanced Energy Design Guide (1 point)
Comply with the prescriptive measures of the ASHRAE Advanced Energy Design Guide appropriate to the project scope, outlined below. Project teams must comply with all applicable criteria as established in the Advanced Energy Design Guide for the climate zone in which the building is located.

The building must meet the following requirements:
- Less than 20,000 square feet.
- Office occupancy.

**PATH 2. ASHRAE Advanced Energy Design Guide for Small Retail Buildings 2006**
The building must meet the following requirements:
- Less than 20,000 square feet.
- Retail occupancy.

The building must meet the following requirements:

- Less than 50,000 square feet.
- Warehouse or self-storage occupancy.

OR


Comply with the prescriptive measures identified in the Advanced Buildings™ Core Performance™ Guide developed by the New Buildings Institute. The building must meet the following requirements:

- Less than 100,000 square feet.
- Comply with Section 1: Design Process Strategies, and Section 2: Core Performance Requirements.
- Health care, warehouse or laboratory projects are ineligible for this path.

Points achieved under Option 3 (1 point):

- 1 point is available for all projects (office, school, public assembly, and retail projects) less than 100,000 square feet that comply with Sections 1 and 2 of the Core Performance Guide.
- Up to 2 additional points are available to projects that implement performance strategies listed in Section 3, Enhanced Performance. For every 3 strategies implemented from this section, 1 point is available.
- The following strategies are addressed by other aspects of LEED and are not eligible for additional points under EA Credit 1:
  - 3.1 — Cool Roofs
  - 3.8 — Night Venting
  - 3.13 — Additional Commissioning

Potential Technologies & Strategies

Design the building envelope and systems to maximize energy performance. Use a computer simulation model to assess the energy performance and identify the most cost-effective energy efficiency measures. Quantify energy performance compared with a baseline building.

If local code has demonstrated quantitative and textual equivalence following, at a minimum, the U.S. Department of Energy (DOE) standard process for commercial energy code determination, the results of that analysis may be used to correlate local code performance with ANSI/ASHRAE/IESNA Standard 90.1-2007. Details on the DOE process for commercial energy code determination can be found at http://www.energycodes.gov/implement/determinations_com.stm.
EA Credit 2: On-site Renewable Energy

1–7 Points

Intent
To encourage and recognize increasing levels of on-site renewable energy self-supply to reduce environmental and economic impacts associated with fossil fuel energy use.

Requirements
Use on-site renewable energy systems to offset building energy costs. Calculate project performance by expressing the energy produced by the renewable systems as a percentage of the building’s annual energy cost and use the table below to determine the number of points achieved.

Use the building annual energy cost calculated in EA Credit 1: Optimize Energy Performance or the U.S. Department of Energy’s Commercial Buildings Energy Consumption Survey database to determine the estimated electricity use.

The minimum renewable energy percentage for each point threshold is as follows:

<table>
<thead>
<tr>
<th>Percentage Renewable Energy</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1%</td>
<td>1</td>
</tr>
<tr>
<td>3%</td>
<td>2</td>
</tr>
<tr>
<td>5%</td>
<td>3</td>
</tr>
<tr>
<td>7%</td>
<td>4</td>
</tr>
<tr>
<td>9%</td>
<td>5</td>
</tr>
<tr>
<td>11%</td>
<td>6</td>
</tr>
<tr>
<td>13%</td>
<td>7</td>
</tr>
</tbody>
</table>

Potential Technologies & Strategies
Assess the project for nonpolluting and renewable energy potential including solar, wind, geothermal, low-impact hydro, biomass and bio-gas strategies. When applying these strategies, take advantage of net metering with the local utility.
EA Credit 3: Enhanced Commissioning

2 Points

Intent
To begin the commissioning process early in the design process and execute additional activities after systems performance verification is completed.

Requirements
Implement, or have a contract in place to implement, the following additional commissioning process activities in addition to the requirements of EA Prerequisite 1: Fundamental Commissioning of Building Energy Systems and in accordance with the LEED Reference Guide for Green Building Design and Construction, 2009 Edition:

- Prior to the start of the construction documents phase, designate an independent commissioning authority (CxA) to lead, review and oversee the completion of all commissioning process activities.
  - The CxA must have documented commissioning authority experience in at least 2 building projects.
  - The individual serving as the CxA:
    - Must be independent of the work of design and construction.
    - Must not be an employee of the design firm, though he or she may be contracted through them.
    - Must not be an employee of, or contracted through, a contractor or construction manager holding construction contracts.
    - May be a qualified employee or consultant of the owner.
  - The CxA must report results, findings and recommendations directly to the owner.

- The CxA must conduct, at a minimum, 1 commissioning design review of the owner’s project requirements basis of design, and design documents prior to the mid-construction documents phase and back-check the review comments in the subsequent design submission.

- The CxA must review contractor submittals applicable to systems being commissioned for compliance with the owner’s project requirements and basis of design. This review must be concurrent with the review of the architect or engineer of record and submitted to the design team and the owner.

- The CxA or other project team members must develop a systems manual that gives future operating staff the information needed to understand and optimally operate the commissioned systems.

- The CxA or other project team members must verify that the requirements for training operating personnel and building occupants have been completed.

- The CxA must be involved in reviewing the operation of the building with operations and maintenance (O&M) staff and occupants within 10 months after substantial completion. A plan for resolving outstanding commissioning-related issues must be included.
**Potential Technologies & Strategies**

Although it is preferable that the CxA be contracted by the owner, for the enhanced commissioning credit the CxA may also be contracted through the design firms or construction management firms not holding construction contracts.

The LEED Reference Guide for Green Building Design and Construction, 2009 Edition provides detailed guidance on the rigor expected for the following process activities:

- Commissioning design review
- Commissioning submittal review
- Systems manual.
EA Credit 4: Enhanced Refrigerant Management

2 Points

Intent
To reduce ozone depletion and support early compliance with the Montreal Protocol while minimizing direct contributions to climate change.

Requirements
OPTION 1
Do not use refrigerants.

OR

OPTION 2
Select refrigerants and heating, ventilation, air conditioning and refrigeration (HVAC&R) equipment that minimize or eliminate the emission of compounds that contribute to ozone depletion and climate change. The base building HVAC&R equipment must comply with the following formula, which sets a maximum threshold for the combined contributions to ozone depletion and global warming potential:

\[
\text{LCGWP} + \text{LCODP} \times 10^3 \leq 100
\]

Calculation definitions for \( \text{LCGWP} + \text{LCODP} \times 10^3 \leq 100 \)

- \( \text{LCODP} \): Lifecycle Ozone Depletion Potential (lb CFC 11/Ton-Year)
- \( \text{LCGWP} \): Lifecycle Direct Global Warming Potential (lb CO2/Ton-Year)
- \( \text{GWPr} \): Global Warming Potential of Refrigerant (0 to 12,000 lb CO2/lbr)
- \( \text{ODPr} \): Ozone Depletion Potential of Refrigerant (0 to 0.2 lb CFC 11/lbr)
- \( \text{Lr} \): Refrigerant Leakage Rate (0.5% to 2.0%; default of 2% unless otherwise demonstrated)
- \( \text{Mr} \): End-of-life Refrigerant Loss (2% to 10%; default of 10% unless otherwise demonstrated)
- \( \text{Rc} \): Refrigerant Charge (0.5 to 5.0 lbs of refrigerant per ton of gross ARI rated cooling capacity)
- \( \text{Life} \): Equipment Life (10 years; default based on equipment type, unless otherwise demonstrated)

For multiple types of equipment, a weighted average of all base building HVAC&R equipment must be calculated using the following formula:

\[
\sum \left( \frac{\text{LCGWP} + \text{LCODP} \times 10^3}{\text{Qtotal}} \right) \times \text{Qunit} \leq 100
\]
Calculation definitions for \( \frac{\sum (L_{\text{GWP}} + L_{\text{CODP}} \times 10^9) \times Q_{\text{unit}}}{Q_{\text{total}}} = 100 \)

<table>
<thead>
<tr>
<th>Q_{\text{unit}}</th>
<th>Gross ARI rated cooling capacity of an individual HVAC or refrigeration unit (Tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q_{\text{total}}</td>
<td>Total gross ARI rated cooling capacity of all HVAC or refrigeration systems</td>
</tr>
</tbody>
</table>

Small HVAC units (defined as containing less than 0.5 pounds of refrigerant) and other equipment, such as standard refrigerators, small water coolers and any other cooling equipment that contains less than 0.5 pounds of refrigerant, are not considered part of the base building system and are not subject to the requirements of this credit.

Do not operate or install fire suppression systems that contain ozone-depleting substances such as CFCs, hydrochlorofluorocarbons (HCFCs) or halons.

**Potential Technologies & Strategies**

Design and operate the facility without mechanical cooling and refrigeration equipment. Where mechanical cooling is used, utilize base building HVAC&R systems for the refrigeration cycle that minimize direct impact on ozone depletion and global climate change. Select HVAC&R equipment with reduced refrigerant charge and increased equipment life. Maintain equipment to prevent leakage of refrigerant to the atmosphere. Use fire suppression systems that do not contain HCFCs or halons.
EA Credit 5: Measurement and Verification

3 Points

Intent
To provide for the ongoing accountability of building energy consumption over time.

Requirements

OPTION 1

The M&V period must cover at least 1 year of post-construction occupancy.

Provide a process for corrective action if the results of the M&V plan indicate that energy savings are not being achieved.

OR

OPTION 2

The M&V period must cover at least 1 year of post-construction occupancy.

Provide a process for corrective action if the results of the M&V plan indicate that energy savings are not being achieved.

OR

OPTION 3 (1 point)
Meet MPR 6 through compliance Option1: Energy and Water Data Release Form. Projects must register an account in ENERGY STAR’s Portfolio Manager tool and share the project file with the USGBC master account.

Potential Technologies & Strategies
Develop an M&V plan to evaluate building and/or energy system performance. Characterize the building and/or energy systems through energy simulation or engineering analysis. Install the necessary metering equipment to measure energy use. Track performance by comparing predicted performance to actual performance, broken down by component or system as appropriate. Evaluate energy efficiency by comparing actual performance to baseline performance.
While the IPMVP describes specific actions for verifying savings associated with energy conservation measures (ECMs) and strategies, this LEED credit expands upon typical IPMVP M&V objectives. Measurement & verification activities should not necessarily be confined to energy systems where ECMs or energy conservation strategies have been implemented. The IPMVP provides guidance on M&V strategies and their appropriate applications for various situations. These strategies should be used in conjunction with monitoring and trend logging of significant energy systems to provide for the ongoing accountability of building energy performance.

For the corrective action process, consider installing diagnostics within the control system to alert the staff when equipment is not being optimally operated. Conditions that might warrant alarms to alert staff could include:

- Leaking valves in the cooling and heating coils within air handling units;
- Missed economizer opportunities (e.g., faulty economizer damper controls);
- Software and manual overrides allowing equipment to operate 24 hours a day/7 days a week;
- Equipment operation during unusual circumstances (e.g., boiler on when outside air temperature is above 65 °F).

Besides control diagnostics, consider employing retro-commissioning services or dedicating staff to investigate increases in energy usage (such a staff member is usually a resource conservation manager — see [http://www.energy.state.or.us/rcm/rcmhm.htm](http://www.energy.state.or.us/rcm/rcmhm.htm) for additional information).
EA Credit 6: Green Power
2 Points

**Intent**
To encourage the development and use of grid-source, renewable energy technologies on a net zero pollution basis.

**Requirements**
Engage in at least a 2-year renewable energy contract to provide at least 35% of the building's electricity from renewable sources, as defined by the Center for Resource Solutions' Green-e Energy product certification requirements.

All purchases of green power shall be based on the quantity of energy consumed, not the cost.

**OPTION 1. Determine Baseline Electricity Use**
Use the annual electricity consumption from the results of EA Credit 1: Optimize Energy Performance.

**OR**

**OPTION 2. Estimate Baseline Electricity Use**
Use the U.S. Department of Energy's Commercial Buildings Energy Consumption Survey database to determine the estimated electricity use.

**Potential Technologies & Strategies**
Determine the energy needs of the building and investigate opportunities to engage in a green power contract. Green power is derived from solar, wind, geothermal, biomass or low-impact hydro sources. Visit [http://www.green-e.org/energy](http://www.green-e.org/energy) for details about the Green-e Energy program. The green power product purchased to comply with credit requirements need not be Green-e Energy certified. Other sources of green power are eligible if they satisfy the Green-e Energy program's technical requirements. Renewable energy certificates (RECs), tradable renewable certificates (TRCs), green tags and other forms of green power that comply with the technical requirements of the Green-e Energy program may be used to document compliance with this credit.
MR Prerequisite 1: Storage and Collection of Recyclables

Required

Intent
To facilitate the reduction of waste generated by building occupants that is hauled to and disposed of in landfills.

Requirements
Provide an easily-accessible dedicated area or areas for the collection and storage of materials for recycling for the entire building. Materials must include, at a minimum: paper, corrugated cardboard, glass, plastics and metals.

Potential Technologies & Strategies
Designate an area for recyclable collection and storage that is appropriately sized and located in a convenient area. Identify local waste handlers and buyers for glass, plastic, metals, office paper, newspaper, cardboard and organic wastes. Instruct occupants on recycling procedures. Consider employing cardboard balers, aluminum can crushers, recycling chutes and other waste management strategies to further enhance the recycling program.
MR Credit 1.1: Building Reuse—Maintain Existing Walls, Floors and Roof
1–3 Points

Intent
To extend the lifecycle of existing building stock, conserve resources, retain cultural resources, reduce waste and reduce environmental impacts of new buildings as they relate to materials manufacturing and transport.

Requirements
Maintain the existing building structure (including structural floor and roof decking) and envelope (the exterior skin and framing, excluding window assemblies and non-structural roofing material). The minimum percentage building reuse for each point threshold is as follows:

<table>
<thead>
<tr>
<th>Building Reuse</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>55%</td>
<td>1</td>
</tr>
<tr>
<td>75%</td>
<td>2</td>
</tr>
<tr>
<td>95%</td>
<td>3</td>
</tr>
</tbody>
</table>

Hazardous materials that are remediated as a part of the project must be excluded from the calculation of the percentage maintained. If the project includes an addition that is more than 2 times the square footage of the existing building, this credit is not applicable.

Potential Technologies & Strategies
Consider reusing existing, previously-occupied building structures, envelopes and elements. Remove elements that pose a contamination risk to building occupants and upgrade components that would improve energy and water efficiency such as windows, mechanical systems and plumbing fixtures.
MR Credit 1.2: Building Reuse—Maintain Interior Nonstructural Elements

1 Point

**Intent**
To extend the lifecycle of existing building stock, conserve resources, retain cultural resources, reduce waste and reduce environmental impacts of new buildings as they relate to materials manufacturing and transport.

**Requirements**
Use existing interior nonstructural elements (e.g., interior walls, doors, floor coverings and ceiling systems) in at least 50% (by area) of the completed building, including additions. If the project includes an addition with square footage more than 2 times the square footage of the existing building, this credit is not applicable.

**Potential Technologies & Strategies**
Consider reusing existing building structures, envelopes and interior nonstructural elements. Remove elements that pose a contamination risk to building occupants, and upgrade components that would improve energy and water efficiency such as mechanical systems and plumbing fixtures. Quantify the extent of building reuse.
MR Credit 2: Construction Waste Management

1–2 Points

**Intent**
To divert construction and demolition debris from disposal in landfills and incineration facilities. Redirect recyclable recovered resources back to the manufacturing process and reusable materials to appropriate sites.

**Requirements**
Recycle and/or salvage nonhazardous construction and demolition debris. Develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether the materials will be sorted on-site or comingled. Excavated soil and land-clearing debris do not contribute to this credit. Calculations can be done by weight or volume, but must be consistent throughout. The minimum percentage debris to be recycled or salvaged for each point threshold is as follows:

<table>
<thead>
<tr>
<th>Recycled or Salvaged</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%</td>
<td>1</td>
</tr>
<tr>
<td>75%</td>
<td>2</td>
</tr>
</tbody>
</table>

**Potential Technologies & Strategies**
Establish goals for diversion from disposal in landfills and incineration facilities and adopt a construction waste management plan to achieve these goals. Consider recycling cardboard, metal, brick, mineral fiber panel, concrete, plastic, clean wood, glass, gypsum wallboard, carpet and insulation. Construction debris processed into a recycled content commodity that has an open market value (e.g., wood derived fuel [WDF], alternative daily cover material, etc.) may be applied to the construction waste calculation. Designate a specific area(s) on the construction site for segregated or comingled collection of recyclable materials, and track recycling efforts throughout the construction process. Identify construction haulers and recyclers to handle the designated materials. Note that diversion may include donation of materials to charitable organizations and salvage of materials on-site.
MR Credit 3: Materials Reuse
1–2 Points

Intent
To reuse building materials and products to reduce demand for virgin materials and reduce waste, thereby lessening impacts associated with the extraction and processing of virgin resources.

Requirements
Use salvaged, refurbished or reused materials, the sum of which constitutes at least 5% or 10%, based on cost, of the total value of materials on the project. The minimum percentage materials reused for each point threshold is as follows:

<table>
<thead>
<tr>
<th>Reused Materials</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>5%</td>
<td>1</td>
</tr>
<tr>
<td>10%</td>
<td>2</td>
</tr>
</tbody>
</table>

Mechanical, electrical and plumbing components and specialty items such as elevators and equipment cannot be included in this calculation. Include only materials permanently installed in the project. Furniture may be included if it is included consistently in MR Credit 3: Materials Reuse through MR Credit 7: Certified Wood.

Potential Technologies & Strategies
Identify opportunities to incorporate salvaged materials into the building design, and research potential material suppliers. Consider salvaged materials such as beams and posts, flooring, paneling, doors and frames, cabinetry and furniture, brick, and decorative items.
MR Credit 4: Recycled Content
1–2 Points

**Intent**
To increase demand for building products that incorporate recycled content materials, thereby reducing impacts resulting from extraction and processing of virgin materials.

**Requirements**
Use materials with recycled content\(^1\) such that the sum of postconsumer\(^2\) recycled content plus 1/2 of the preconsumer\(^3\) content constitutes at least 10% or 20%, based on cost, of the total value of the materials in the project. The minimum percentage materials recycled for each point threshold is as follows:

<table>
<thead>
<tr>
<th>Recycled Content</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>1</td>
</tr>
<tr>
<td>20%</td>
<td>2</td>
</tr>
</tbody>
</table>

The recycled content value of a material assembly is determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

Mechanical, electrical and plumbing components and specialty items such as elevators cannot be included in this calculation. Include only materials permanently installed in the project. Furniture may be included if it is included consistently in MR Credit 3: Materials Reuse through MR Credit 7: Certified Wood.

**Potential Technologies & Strategies**
Establish a project goal for recycled content materials, and identify material suppliers that can achieve this goal. During construction, ensure that the specified recycled content materials are installed. Consider a range of environmental, economic and performance attributes when selecting products and materials.

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1 Recycled content is defined in accordance with the International Organization of Standards document, ISO 14021 — Environmental labels and declarations — Self-declared environmental claims (Type II environmental labeling).
2 Postconsumer material is defined as waste material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product, which can no longer be used for its intended purpose.
3 Preconsumer material is defined as material diverted from the waste stream during the manufacturing process. Reutilization of materials (i.e., rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it) is excluded.
MR Credit 5: Regional Materials

1–2 Points

Intent
To increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting from transportation.

Requirements
Use building materials or products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site for a minimum of 10% or 20%, based on cost, of the total materials value. If only a fraction of a product or material is extracted, harvested, or recovered and manufactured locally, then only that percentage (by weight) can contribute to the regional value. The minimum percentage regional materials for each point threshold is as follows:

<table>
<thead>
<tr>
<th>Regional Materials</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>1</td>
</tr>
<tr>
<td>20%</td>
<td>2</td>
</tr>
</tbody>
</table>

Mechanical, electrical and plumbing components and specialty items such as elevators and equipment must not be included in this calculation. Include only materials permanently installed in the project. Furniture may be included if it is included consistently in MR Credit 3: Materials Reuse through MR Credit 7: Certified Wood.

Potential Technologies & Strategies
Establish a project goal for locally sourced materials, and identify materials and material suppliers that can achieve this goal. During construction, ensure that the specified local materials are installed, and quantify the total percentage of local materials installed. Consider a range of environmental, economic and performance attributes when selecting products and materials.
MR Credit 6: Rapidly Renewable Materials

1 Point

Intent
To reduce the use and depletion of finite raw materials and long-cycle renewable materials by replacing them with rapidly renewable materials.

Requirements
Use rapidly renewable building materials and products for 2.5% of the total value of all building materials and products used in the project, based on cost. Rapidly renewable building materials and products are made from plants that are typically harvested within a 10-year or shorter cycle.

Potential Technologies & Strategies
Establish a project goal for rapidly renewable materials, and identify products and suppliers that can support achievement of this goal. Consider materials such as bamboo, wool, cotton insulation, agrifiber, linoleum, wheatboard, strawboard and cork. During construction, ensure that the specified renewable materials are installed.
MR Credit 7: Certified Wood

1 Point

Intent
To encourage environmentally responsible forest management.

Requirements
Use a minimum of 50% (based on cost) of wood-based materials and products that are certified in accordance with the Forest Stewardship Council’s principles and criteria, for wood building components. These components include at a minimum, structural framing and general dimensional framing, flooring, sub-flooring, wood doors and finishes.

Include only materials permanently installed in the project. Wood products purchased for temporary use on the project (e.g., formwork, bracing, scaffolding, sidewalk protection, and guard rails) may be included in the calculation at the project team’s discretion. If any such materials are included, all such materials must be included in the calculation. If such materials are purchased for use on multiple projects, the applicant may include these materials for only one project, at its discretion. Furniture may be included if it is included consistently in MR Credits 3, Materials Reuse, through MR Credit 7, Certified Wood.

Potential Technologies & Strategies
Establish a project goal for FSC-certified wood products and identify suppliers that can achieve this goal. During construction, ensure that the FSC-certified wood products are installed and quantify the total percentage of FSC-certified wood products installed.
IEQ Prerequisite 1: Minimum Indoor Air Quality Performance

Required

Intent
To establish minimum indoor air quality (IAQ) performance to enhance indoor air quality in buildings, thus contributing to the comfort and well-being of the occupants.

Requirements
Meet the minimum requirements of Sections 4 through 7 of ASHRAE Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality (with errata but without addenda1).

AND

CASE 1. Mechanically Ventilated Spaces
 Mechanical ventilation systems must be designed using the ventilation rate procedure or the applicable local code, whichever is more stringent.

CASE 2. Naturally Ventilated Spaces
 Naturally ventilated buildings must comply with ASHRAE Standard 62.1-2007, Paragraph 5.1 (with errata but without addenda1).

Potential Technologies & Strategies
Design ventilation systems to meet or exceed the minimum outdoor air ventilation rates as described in the ASHRAE standard. Balance the impacts of ventilation rates on energy use and indoor air quality to optimize for energy efficiency and occupant comfort. Use the ASHRAE Standard 62.1-2007 Users Manual (with errata but without addenda1) for detailed guidance on meeting the referenced requirements.

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1 Project teams wishing to use ASHRAE approved addenda for the purposes of this prerequisite may do so at their discretion. Addenda must be applied consistently across all LEED credits.
IEQ Prerequisite 2: Environmental Tobacco Smoke (ETS) Control

Required

Intent
To prevent or minimize exposure of building occupants, indoor surfaces and ventilation air distribution systems to environmental tobacco smoke (ETS).

Requirements

OPTION 1
Prohibit smoking in the building.
Prohibit on-property smoking within 25 feet of entries, outdoor air intakes and operable windows. Provide signage to allow smoking in designated areas, prohibit smoking in designated areas or prohibit smoking on the entire property.

OR

OPTION 2

CASE 1. Non-Residential Projects
Prohibit smoking in the building except in designated smoking areas.
Prohibit on-property smoking within 25 feet of entries, outdoor air intakes and operable windows. Provide signage to allow smoking in designated areas, prohibit smoking in designated areas or prohibit smoking on the entire property.

Provide designated smoking rooms designed to contain, capture and remove ETS from the building. At a minimum, the smoking room must be directly exhausted to the outdoors, away from air intakes and building entry paths, with no recirculation of ETS-containing air to nonsmoking areas and enclosed with impermeable deck-to-deck partitions. Operate exhaust sufficient to create a negative pressure differential with the surrounding spaces of at least an average of 5 Pascals (Pa) (0.02 inches of water gauge) and a minimum of 1 Pa (0.004 inches of water gauge) when the doors to the smoking rooms are closed.

Verify performance of the smoking rooms' differential air pressures by conducting 15 minutes of measurement, with a minimum of 1 measurement every 10 seconds, of the differential pressure in the smoking room with respect to each adjacent area and in each adjacent vertical chase with the doors to the smoking room closed. Conduct the testing with each space configured for worst-case conditions of transport of air from the smoking rooms (with closed doors) to adjacent spaces.
CASE 2. Residential and Hospitality Projects

Prohibit smoking in all common areas of the building.

Locate any exterior designated smoking areas, including balconies where smoking is permitted, at least 25 feet from entries, outdoor air intakes and operable windows opening to common areas.

Prohibit on-property smoking within 25 feet of entries, outdoor air intakes and operable windows. Provide signage to allow smoking in designated areas, prohibit smoking in designated areas or prohibit smoking on the entire property.

Weather-strip all exterior doors and operable windows in the residential units to minimize leakage from outdoors.

Minimize uncontrolled pathways for ETS transfer between individual residential units by sealing penetrations in walls, ceilings and floors in the residential units and by sealing vertical chases adjacent to the units.

Weather-strip all doors in the residential units leading to common hallways to minimize air leakage into the hallway¹.

Demonstrate acceptable sealing of residential units by a blower door test conducted in accordance with ANSI/ASTM-E779-03, Standard Test Method for Determining Air Leakage Rate By Fan Pressurization.

Use the progressive sampling methodology defined in Chapter 4 (Compliance Through Quality Construction) of the Residential Manual for Compliance with California's 2001 Energy Efficiency Standards. Residential units must demonstrate less than 1.25 square inches leakage area per 100 square feet of enclosure area (i.e., sum of all wall, ceiling and floor areas).

Potential Technologies & Strategies

Prohibit smoking in commercial buildings or effectively control the ventilation air in smoking rooms. For residential buildings, prohibit smoking in common areas and design building envelope and systems to minimize ETS transfer among dwelling units.

¹ If the common hallways are pressurized with respect to the residential units then doors in the residential units leading to the common hallways need not be weather-stripped provided that the positive differential pressure is demonstrated as in Option 2, Case 1 above, considering the residential unit as the smoking room.
IEQ Credit 1: Outdoor Air Delivery Monitoring

1 Point

Intent
To provide capacity for ventilation system monitoring to help promote occupant comfort and well-being.

Requirements
Install permanent monitoring systems to ensure that ventilation systems maintain design minimum requirements. Configure all monitoring equipment to generate an alarm when airflow values or carbon dioxide (CO2) levels vary by 10% or more from the design values via either a building automation system alarm to the building operator or a visual or audible alert to the building occupants

AND

CASE 1. Mechanically Ventilated Spaces
Monitor CO2 concentrations within all densely occupied spaces (those with a design occupant density of 25 people or more per 1,000 square feet). CO2 monitors must be between 3 and 6 feet above the floor.

Provide a direct outdoor airflow measurement device capable of measuring the minimum outdoor air intake flow with an accuracy of plus or minus 15% of the design minimum outdoor air rate, as defined by ASHRAE 62.1-2007 (with errata but without addenda1) for mechanical ventilation systems where 20% or more of the design supply airflow serves nondensely occupied spaces.

CASE 2. Naturally Ventilated Spaces
Monitor CO2 concentrations within all naturally ventilated spaces. CO2 monitors must be between 3 and 6 feet above the floor. One CO2 sensor may be used to monitor multiple nondensely occupied spaces if the natural ventilation design uses passive stack(s) or other means to induce airflow through those spaces equally and simultaneously without intervention by building occupants.

Potential Technologies & Strategies
Install CO2 and airflow measurement equipment and feed the information to the heating, ventilating and air conditioning (HVAC) system and/or building automation system (BAS) to trigger corrective action, if applicable. If such automatic controls are not feasible with the building systems, use the measurement equipment to trigger alarms that inform building operators or occupants of a possible deficiency in outdoor air delivery.

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1 Project teams wishing to use addenda approved by ASHRAE for the purposes of this credit may do so at their discretion. Addenda must be applied consistently across all LEED credits.
IEQ Credit 2: Increased Ventilation

1 Point

**Intent**
To provide additional outdoor air ventilation to improve indoor air quality (IAQ) and promote occupant comfort, well-being and productivity.

**Requirements**

CASE 1. Mechanically Ventilated Spaces
   Increase breathing zone outdoor air ventilation rates to all occupied spaces by at least 30% above the minimum rates required by ASHRAE Standard 62.1-2007 (with errata but without addenda1) as determined by IEQ Prerequisite 1: Minimum Indoor Air Quality Performance.

CASE 2. Naturally Ventilated Spaces
   Determine that natural ventilation is an effective strategy for the project by following the flow diagram process shown in Figure 2.8 of the CIBSE Applications Manual 10: 2005, Natural Ventilation in Non-domestic Buildings.

   AND

   OPTION 1
   Show that the natural ventilation systems design meets the recommendations set forth in the CIBSE manuals appropriate to the project space.
   PATH 2. CIBSE AM 13:2000, Mixed Mode Ventilation

   OR

   OPTION 2
   Use a macroscopic, multizone, analytic model to predict that room-by-room airflows will effectively naturally ventilate, defined as providing the minimum ventilation rates required by ASHRAE 62.1-2007 Chapter 6 (with errata but without addenda1), for at least 90% of occupied spaces.

**Potential Technologies & Strategies**

For mechanically ventilated spaces: Use heat recovery, where appropriate, to minimize the additional energy consumption associated with higher ventilation rates.

For naturally ventilated spaces, follow the 8 design steps described in the Carbon Trust Good Practice Guide 237:

- Develop design requirements.
- Plan airflow paths.

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1 Project teams wishing to use ASHRAE approved addenda for the purposes of this credit may do so at their discretion. Addenda must be applied consistently across all LEED credits.
- Identify building uses and features that might require special attention.
- Determine ventilation requirements.
- Estimate external driving pressures.
- Select types of ventilation devices.
- Size ventilation devices.
- Analyze the design.

Use public domain software such as NIST's CONTAM, Multizone Modeling Software, along with LoopDA, Natural Ventilation Sizing Tool, to analytically predict room-by-room airflows.
IEQ Credit 3.1: Construction Indoor Air Quality Management Plan—During Construction

1 Point

Intent
To reduce indoor air quality (IAQ) problems resulting from construction or renovation and promote the comfort and well-being of construction workers and building occupants.

Requirements
Develop and implement an IAQ management plan for the construction and preoccupancy phases of the building as follows:

- During construction, meet or exceed the recommended control measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines For Occupied Buildings Under Construction, 2nd Edition 2007, ANSI/SMACNA 008-2008 (Chapter 3).

- Protect stored on-site and installed absorptive materials from moisture damage.

- If permanently installed air handlers are used during construction, filtration media with a minimum efficiency reporting value (MERV) of 8 must be used at each return air grille, as determined by ASHRAE Standard 52.2-1999 (with errata but without addenda¹). Replace all filtration media immediately prior to occupancy.

Potential Technologies & Strategies
Adopt an IAQ management plan to protect the heating, ventilating and air conditioning (HVAC) system during construction, control pollutant sources and interrupt contamination pathways. Sequence the installation of materials to avoid contamination of absorptive materials, such as insulation, carpeting, ceiling tile and gypsum wallboard. Coordinate with IEQ Credit 3.2: Construction IAQ Management Plan — Before Occupancy and IEQ Credit 5: Indoor Chemical & Pollutant Source Control to determine the appropriate specifications and schedules for filtration media.

If possible, avoid using permanently installed air handlers for temporary heating/cooling during construction. Consult the LEED Reference Guide for Green Building Design and Construction, 2009 Edition for more detailed information on how to ensure the well-being of construction workers and building occupants if permanently installed air handlers must be used during construction.

¹ Project teams wishing to use ASHRAE approved addenda for the purposes of this credit may do so at their discretion. Addenda must be applied consistently across all LEED credits.
IEQ Credit 3.2: Construction Indoor Air Quality Management Plan—Before Occupancy

1 Point

Intent
To reduce indoor air quality (IAQ) problems resulting from construction or renovation to promote the comfort and well-being of construction workers and building occupants.

Requirements
Develop an IAQ management plan and implement it after all finishes have been installed and the building has been completely cleaned before occupancy.

OPTION 1. Flush-Out

PATH 1
After construction ends, prior to occupancy and with all interior finishes installed, install new filtration media and , perform a building flush-out by supplying a total air volume of 14,000 cubic feet of outdoor air per square foot of floor area while maintaining an internal temperature of at least 60° F and relative humidity no higher than 60%.

OR

PATH 2
If occupancy is desired prior to completion of the flush-out, the space may be occupied following delivery of a minimum of 3,500 cubic feet of outdoor air per square foot of floor area. Once the space is occupied, it must be ventilated at a minimum rate of 0.30 cubic feet per minute (cfm) per square foot of outside air or the design minimum outside air rate determined in IEQ Prerequisite 1: Minimum Indoor Air Quality Performance, whichever is greater. During each day of the flush-out period, ventilation must begin a minimum of 3 hours prior to occupancy and continue during occupancy. These conditions must be maintained until a total of 14,000 cubic feet per square foot of outside air has been delivered to the space.

OR

OPTION 2. Air Testing
Conduct baseline IAQ testing after construction ends and prior to occupancy using testing protocols consistent with the EPA Compendium of Methods for the Determination of Air Pollutants in Indoor Air or the ISO method listed in the table below. Testing must be done in accordance with one standard; project teams may not mix requirements from the EPA Compendium of Methods with ISO.

1 All finishes must be installed prior to flush-out.
Demonstrate that the contaminant maximum concentration levels listed below are not exceeded:

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>Maximum Concentration</th>
<th>EPA Compendium method</th>
<th>ISO method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formaldehyde</td>
<td>27 parts per billion</td>
<td>IP-6</td>
<td>ISO 16000-3</td>
</tr>
<tr>
<td>Particulates (PM10)</td>
<td>50 micrograms per cubic meter</td>
<td>IP-10</td>
<td>ISO 7708</td>
</tr>
<tr>
<td>Total volatile organic compounds (TVOCs)</td>
<td>500 micrograms per cubic meter</td>
<td>IP-1</td>
<td>ISO 16000-6</td>
</tr>
<tr>
<td>4-Phenylcyclohexene (4-PCH) *</td>
<td>6.5 micrograms per cubic meter</td>
<td>IP-1</td>
<td>ISO 16000-6</td>
</tr>
<tr>
<td>Carbon monoxide (CO)</td>
<td>9 parts per million and no greater than 2 parts per million above outdoor levels</td>
<td>IP-3</td>
<td>ISO 4224</td>
</tr>
</tbody>
</table>

*This test is required only if carpets and fabrics with styrene butadiene rubber (SBR) latex backing are installed as part of the base building systems.

For each sampling point where the maximum concentration limits are exceeded, conduct an additional flush-out with outside air and retest the noncompliant concentrations. Repeat until all requirements are met. When retesting noncompliant building areas, take samples from the same locations as in the first test, although it is not required.

Conduct the air sample testing as follows:

- All measurements must be conducted prior to occupancy, but during normal occupied hours with the building ventilation system started at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the test.
- All interior finishes must be installed, including but not limited to millwork, doors, paint, carpet and acoustic tiles. Movable furnishings such as workstations and partitions should be in place for the testing, although it is not required.
- The number of sampling locations will depend on the size of the building and number of ventilation systems. The number of sampling locations must include the entire building and all representative situations. Include areas with the least ventilation and greatest presumed source strength.
- Air samples must be collected between 3 and 6 feet from the floor to represent the breathing zone of occupants, and over a minimum 4-hour period.

**Potential Technologies & Strategies**

Prior to occupancy, perform a building flush-out or test the air contaminant levels in the building. The flush-out is often used where occupancy is not required immediately upon substantial completion of construction. IAQ testing can minimize schedule impacts but may be more costly. Coordinate with IEQ Credit 3.1: Construction IAQ Management Plan — During Construction and IEQ Credit 5: Indoor Chemical & Pollutant Source Control to determine the appropriate specifications and schedules for filtration media.

The intent of this credit is to eliminate IAQ problems that occur as a result of construction. Architectural finishes used in tenant build-outs constitute a significant source of air pollutants and must be addressed to qualify for this credit.
IEQ Credit 4.1: Low-Emitting Materials—Adhesives and Sealants

1 Point

Intent
To reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.

Requirements
All adhesives and sealants used on the interior of the building (i.e., inside of the weatherproofing system and applied on-site) must comply with the following requirements as applicable to the project scope:

- Adhesives, Sealants and Sealant Primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168. Volatile organic compound (VOC) limits listed in the table below correspond to an effective date of July 1, 2005 and rule amendment date of January 7, 2005.

<table>
<thead>
<tr>
<th>Architectural Applications</th>
<th>VOC Limit (g/L less water)</th>
<th>Specialty Applications</th>
<th>VOC Limit (g/L less water)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indoor carpet adhesives</td>
<td>50</td>
<td>PVC welding</td>
<td>510</td>
</tr>
<tr>
<td>Carpet pad adhesives</td>
<td>50</td>
<td>CPVC welding</td>
<td>490</td>
</tr>
<tr>
<td>Wood flooring adhesives</td>
<td>100</td>
<td>ABS welding</td>
<td>325</td>
</tr>
<tr>
<td>Rubber floor adhesives</td>
<td>60</td>
<td>Plastic cement welding</td>
<td>250</td>
</tr>
<tr>
<td>Subfloor adhesives</td>
<td>50</td>
<td>Adhesive primer for plastic</td>
<td>550</td>
</tr>
<tr>
<td>Ceramic tile adhesives</td>
<td>65</td>
<td>Contact adhesive</td>
<td>80</td>
</tr>
<tr>
<td>VCT and asphalt adhesives</td>
<td>50</td>
<td>Special purpose contact adhesive</td>
<td>250</td>
</tr>
<tr>
<td>Drywall and panel adhesives</td>
<td>50</td>
<td>Structural wood member adhesive</td>
<td>140</td>
</tr>
<tr>
<td>Cove base adhesives</td>
<td>50</td>
<td>Sheet applied rubber lining operations</td>
<td>850</td>
</tr>
<tr>
<td>Multipurpose construction adhesives</td>
<td>70</td>
<td>Top and trim adhesive</td>
<td>250</td>
</tr>
<tr>
<td>Structural glazing adhesives</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Substrate Specific Applications</th>
<th>VOC Limit (g/L less water)</th>
<th>Sealants</th>
<th>VOC Limit (g/L less water)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal to metal</td>
<td>30</td>
<td>Architectural</td>
<td>250</td>
</tr>
<tr>
<td>Plastic foams</td>
<td>50</td>
<td>Roadway</td>
<td>250</td>
</tr>
<tr>
<td>Porous material (except wood)</td>
<td>50</td>
<td>Other</td>
<td>420</td>
</tr>
<tr>
<td>Wood</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fiberglass</td>
<td>80</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sealant Primers</th>
<th>VOC Limit (g/L less water)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architectural, nonporous</td>
<td>250</td>
</tr>
<tr>
<td>Architectural, porous</td>
<td>775</td>
</tr>
<tr>
<td>Other</td>
<td>750</td>
</tr>
</tbody>
</table>

This table excludes adhesives and sealants integral to the water-proofing system or that are not building related.

1 The use of a VOC budget is permissible for compliance with this credit.

<table>
<thead>
<tr>
<th>Aerosol Adhesives</th>
<th>VOC Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>General purpose mist spray</td>
<td>65% VOCs by weight</td>
</tr>
<tr>
<td>General purpose web spray</td>
<td>55% VOCs by weight</td>
</tr>
<tr>
<td>Special purpose aerosol adhesives (all types)</td>
<td>70% VOCs by weight</td>
</tr>
</tbody>
</table>

**Potential Technologies & Strategies**
Specify low-VOC materials in construction documents. Ensure that VOC limits are clearly stated in each section of the specifications where adhesives and sealants are addressed. Common products to evaluate include general construction adhesives, flooring adhesives, fire-stopping sealants, caulking, duct sealants, plumbing adhesives and cove base adhesives. Review product cut sheets, material safety data (MSD) sheets, signed attestations or other official literature from the manufacturer clearly identifying the VOC contents or compliance with referenced standards.
IEQ Credit 4.2: Low-Emitting Materials—Paints and Coatings

1 Point

Intent
To reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.

Requirements
Paints and coatings used on the interior of the building (i.e., inside of the weatherproofing system and applied on-site) must comply with the following criteria as applicable to the project scope:

- Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates must not exceed the VOC content limit of 250 g/L established in Green Seal Standard GC-03, Anti-Corrosive Paints, 2nd Edition, January 7, 1997.
- Clear wood finishes, floor coatings, stains, primers, sealers, and shellacs applied to interior elements must not exceed the VOC content limits established in South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, rules in effect on January 1, 2004.

Potential Technologies & Strategies
Specify low-VOC paints and coatings in construction documents. Ensure that VOC limits are clearly stated in each section of the specifications where paints and coatings are addressed. Track the VOC content of all interior paints and coatings during construction.

1 The use of a VOC budget is permissible for compliance with this credit.
IEQ Credit 4.3: Low-Emitting Materials—Flooring Systems

1 Point

Intent
To reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.

Requirements

OPTION 1
All flooring must comply with the following as applicable to the project scope:

- All carpet installed in the building interior must meet the testing and product requirements of the Carpet and Rug Institute Green Label Plus program.
- All carpet cushion installed in the building interior must meet the requirements of the Carpet and Rug Institute Green Label program.
- All carpet adhesive must meet the requirements of IEQ Credit 4.1: Adhesives and Sealants, which includes a volatile organic compound (VOC) limit of 50 g/L.
- All hard surface flooring must meet the requirements of the FloorScore standard (current as of the date of this rating system, or more stringent version) as shown with testing by an independent third-party. Mineral-based finish flooring products such as tile, masonry, terrazzo, and cut stone without integral organic-based coatings and sealants and unfinished/untreated solid wood flooring qualify for credit without any IAQ testing requirements. However, associated site-applied adhesives, grouts, finishes and sealers must be compliant for a mineral-based or unfinished/untreated solid wood flooring system to qualify for credit.
- Concrete, wood, bamboo and cork floor finishes such as sealer, stain and finish must meet the requirements of South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, rules in effect on January 1, 2004.
- Tile setting adhesives and grout must meet South Coast Air Quality Management District (SCAQMD) Rule 1168. VOC limits correspond to an effective date of July 1, 2005 and rule amendment date of January 7, 2005.

OR

OPTION 2
All flooring elements installed in the building interior must meet the testing and product requirements of the California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions.

1 The Green Label Plus program for carpets and its associated VOC emission criteria in micrograms per square meter per hour, along with information on testing method and sample collection developed by the Carpet & Rug Institute (CRI) in coordination with California's Sustainable Building Task Force and the California Department of Public Health, are described in Section 9, Acceptable Emissions Testing for Carpet, DHS Standard Practice CA/DHS/EHLB/R-174, dated 07/15/04. This document is available at http://www.dhs.ca.gov/ps/deode/ehlb/jag/VOCS/Section01350_7_15_2004_FINAL_PLUS_ADDENDUM-2004-01.pdf (also published as Section 01350 Section 9 dated 2004) by the Collaborative for High Performance Schools (http://www.chps.net/).

2 FloorScore is a voluntary, independent certification program that tests and certifies hard surface flooring and associated products for compliance with criteria adopted in California for indoor air emissions of VOCs with potential health effects. The program uses a small-scale chamber test protocol and incorporates VOC emissions criteria, which are widely known as Section 1350, developed by the California Department of Health Services.
from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda. Mineral-based finish flooring products such as tile, masonry, terrazzo, and cut stone without integral organic-based coatings and sealants and unfinished/untreated solid wood flooring qualify for credit without any IAQ testing requirements. However, associated site-applied adhesives, grouts, finishes and sealers must be compliant for a mineral-based or unfinished/untreated solid wood flooring system to qualify for credit.

**Potential Technologies & Strategies**
Clearly specify requirements for product testing and/or certification in the construction documents. Select products that are either certified under the Green Label Plus program or for which testing has been done by qualified independent laboratories in accordance with the appropriate requirements.
IEQ Credit 4.4: Low-Emitting Materials—Composite Wood and Agrifiber Products

1 Point

Intent
To reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.

Requirements
Composite wood and agrifiber products used on the interior of the building (i.e., inside the weatherproofing system) must contain no added urea-formaldehyde resins. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies must not contain added urea-formaldehyde resins.

Composite wood and agrifiber products are defined as particleboard, medium density fiberboard (MDF), plywood, wheatboard, strawboard, panel substrates and door cores. Materials considered fixtures, furniture and equipment (FF&E) are not considered base building elements and are not included.

Potential Technologies & Strategies
Specify wood and agrifiber products that contain no added urea-formaldehyde resins. Specify laminating adhesives for field and shop-applied assemblies that contain no added urea-formaldehyde resins. Review product cut sheets, material safety data (MSD) sheets, signed attestations or other official literature from the manufacturer.
IEQ Credit 5: Indoor Chemical and Pollutant Source Control

1 Point

Intent
To minimize building occupant exposure to potentially hazardous particulates and chemical pollutants.

Requirements
Design to minimize and control the entry of pollutants into buildings and later cross-contamination of regularly occupied areas through the following strategies:

- Employ permanent entryway systems at least 10 feet long in the primary direction of travel to capture dirt and particulates entering the building at regularly used exterior entrances. Acceptable entryway systems include permanently installed grates, grills and slotted systems that allow for cleaning underneath. Roll-out mats are acceptable only when maintained on a weekly basis by a contracted service organization.

- Sufficiently exhaust each space where hazardous gases or chemicals may be present or used (e.g., garages, housekeeping and laundry areas, copying and printing rooms) to create negative pressure with respect to adjacent spaces when the doors to the room are closed. For each of these spaces, provide self-closing doors and deck-to-deck partitions or a hard-lid ceiling. The exhaust rate must be at least 0.50 cubic feet per minute (cfm) per square foot with no air recirculation. The pressure differential with the surrounding spaces must be at least 5 Pascals (Pa) (0.02 inches of water gauge) on average and 1 Pa (0.004 inches of water) at a minimum when the doors to the rooms are closed.

- In mechanically ventilated buildings, each ventilation system that supplies outdoor air shall comply with the following:
  - Particle filters or air cleaning devices shall be provided to clean the outdoor air at any location prior to its introduction to occupied spaces.
  - These filters or devices shall be rated a minimum efficiency reporting value (MERV) of 13 or higher in accordance with ASHRAE Standard 52.2.
  - Clean air filtration media shall be installed in all air systems after completion of construction and prior to occupancy.

Potential Technologies & Strategies
Design facility cleaning and maintenance areas with isolated exhaust systems for contaminants. Maintain physical isolation from the rest of the regularly occupied areas of the building. Install permanent architectural entryway systems such as grills or grates to prevent occupant-borne contaminants from entering the building. Install high-level filtration systems in air handling units processing outside supply air. Ensure that air handling units can accommodate required filter sizes and pressure drops.
IEQ Credit 6.1: Controllability of Systems—Lighting

1 Point

Intent
To provide a high level of lighting system control by individual occupants or groups in multi-occupant spaces (e.g., classrooms and conference areas) and promote their productivity, comfort and well-being.

Requirements
Provide individual lighting controls for 90% (minimum) of the building occupants to enable adjustments to suit individual task needs and preferences.
Provide lighting system controls for all shared multi-occupant spaces to enable adjustments that meet group needs and preferences.

Potential Technologies & Strategies
Design the building with occupant controls for lighting. Strategies to consider include lighting controls and task lighting. Integrate lighting systems controllability into the overall lighting design, providing ambient and task lighting while managing the overall energy use of the building.
IEQ Credit 6.2: Controllability of Systems—Thermal Comfort

1 Point

Intent
To provide a high level of thermal comfort system control by individual occupants or groups in multi-occupant spaces (e.g., classrooms or conference areas) and promote their productivity, comfort and well-being.

Requirements
Provide individual comfort controls for 50% (minimum) of the building occupants to enable adjustments to meet individual needs and preferences. Operable windows may be used in lieu of controls for occupants located 20 feet inside and 10 feet to either side of the operable part of a window. The areas of operable window must meet the requirements of ASHRAE Standard 62.1-2007 paragraph 5.1 Natural Ventilation (with errata but without addenda). Provide comfort system controls for all shared multi-occupant spaces to enable adjustments that meet group needs and preferences.

Conditions for thermal comfort are described in ASHRAE Standard 55-2004 (with errata but without addenda) and include the primary factors of air temperature, radiant temperature, air speed and humidity.

Potential Technologies & Strategies
Design the building and systems with comfort controls to allow adjustments to suit individual needs or those of groups in shared spaces. ASHRAE Standard 55-2004 (with errata but without addenda) identifies the factors of thermal comfort and a process for developing comfort criteria for building spaces that suit the needs of the occupants involved in their daily activities. Control strategies can be developed to expand on the comfort criteria and enable individuals to make adjustments to suit their needs and preferences. These strategies may involve system designs incorporating operable windows, hybrid systems integrating operable windows and mechanical systems, or mechanical systems alone. Individual adjustments may involve individual thermostat controls, local diffusers at floor, desk or overhead levels, control of individual radiant panels or other means integrated into the overall building, thermal comfort systems and energy systems design. Designers should evaluate the closely tied interactions between thermal comfort as required by ASHRAE Standard 55-2004 (with errata but without addenda) and acceptable indoor air quality as required by ASHRAE Standard 62.1-2007 (with errata but without addenda), whether natural or mechanical ventilation.

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1 For the purposes of this credit, comfort system control is defined as control over at least 1 of the following primary factors in the occupant’s vicinity: air temperature, radiant temperature, air speed and humidity.

2 Project teams wishing to use ASHRAE approved addenda for the purposes of this credit may do so at their discretion. Addenda must be applied consistently across all LEED credits.
IEQ Credit 7.1: Thermal Comfort—Design

1 Point

Intent
To provide a comfortable thermal environment that promotes occupant productivity and well-being.

Requirements
Design heating, ventilating and air conditioning (HVAC) systems and the building envelope to meet the requirements of ASHRAE Standard 55-2004, Thermal Comfort Conditions for Human Occupancy (with errata but without addenda¹). Demonstrate design compliance in accordance with the Section 6.1.1 documentation.

Potential Technologies & Strategies
Establish comfort criteria according to ASHRAE 55-2004 (with errata but without addenda) that support the desired quality and occupant satisfaction with building performance. Design the building envelope and systems with the capability to meet the comfort criteria under expected environmental and use conditions. Evaluate air temperature, radiant temperature, air speed and relative humidity in an integrated fashion, and coordinate these criteria with IEQ Prerequisite 1: Minimum IAQ Performance, IEQ Credit 1: Outdoor Air Delivery Monitoring, and IEQ Credit 2: Increased Ventilation.

¹ Project teams wishing to use ASHRAE approved addenda for the purposes of this credit may do so at their discretion. Addenda must be applied consistently across all LEED credits.
IEQ Credit 7.2: Thermal Comfort—Verification

1 point in addition to IEQ credit 7.1

**Intent**
To provide for the assessment of building occupant thermal comfort over time.

**Requirements**
Achieve IEQ Credit 7.1: Thermal Comfort—Design

Provide a permanent monitoring system to ensure that building performance meets the desired comfort criteria as determined by IEQ Credit 7.1: Thermal Comfort—Design.

Agree to conduct a thermal comfort survey of building occupants within 6 to 18 months after occupancy. This survey should collect anonymous responses about thermal comfort in the building, including an assessment of overall satisfaction with thermal performance and identification of thermal comfort-related problems. Agree to develop a plan for corrective action if the survey results indicate that more than 20% of occupants are dissatisfied with thermal comfort in the building. This plan should include measurement of relevant environmental variables in problem areas in accordance with ASHRAE Standard 55-2004 (with errata but without addenda).

Residential projects are not eligible for this credit.

**Potential Technologies & Strategies**
ASHRAE 55-2004 provides guidance for establishing thermal comfort criteria and documenting and validating building performance to the criteria. While the standard is not intended for purposes of continuous monitoring and maintenance of the thermal environment, the principles expressed in the standard provide a basis for the design of monitoring and corrective action systems.

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1 Project teams wishing to use ASHRAE approved addenda for the purposes of this credit may do so at their discretion. Addenda must be applied consistently across all LEED credits.
IEQ Credit 8.1: Daylight and Views—Daylight

1 Point

Intent
To provide for the building occupants with a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.

Requirements
Through 1 of the 4 options, achieve daylighting in at least the following spaces:

<table>
<thead>
<tr>
<th>Regularly Occupied Spaces</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>75%</td>
<td>1</td>
</tr>
</tbody>
</table>

OPTION 1. Simulation
Demonstrate through computer simulations that the applicable spaces achieve daylight illuminance levels of a minimum of 10 footcandles (fc) and a maximum of 500 fc in a clear sky condition on September 21 at 9 a.m. and 3 p.m. Provide glare control devices to avoid high-contrast situations that could impede visual tasks. However, designs that incorporate view-preserving automated shades for glare control may demonstrate compliance for only the minimum 10 fc illuminance level.

OR

OPTION 2. Prescriptive
For side-lighting zones:

- Achieve a value, calculated as the product of the visible light transmittance (VLT) and window-to-floor area ratio (WFR) between 0.150 and 0.180.

\[
0.150 < VLT \times WFR < 0.180
\]

- The window area included in the calculation must be at least 30 inches above the floor.

- In section, the ceiling must not obstruct a line that extends from the window-head to a point on the floor that is located twice the height of the window-head from the exterior wall as measured perpendicular to the glass (see diagram on next page).

1 Exceptions for areas where tasks would be hindered by the use of daylight will be considered on their merits.
- Provide glare control devices to avoid high-contrast situations that could impede visual tasks. However, designs that incorporate view-preserving automated shades for glare control may demonstrate compliance for only the minimum 0.150 value.

For top-lighting zones:

- The top-lighting zone under a skylight is the outline of the opening beneath the skylight, plus in each direction the lesser of (see diagram below):
  - 70% of the ceiling height,
  - 1/2 the distance to the edge of the nearest skylight,
  - The distance to any permanent partition that is closer than 70% of the distance between the top of the partition and the ceiling.
- Achieve skylight coverage for the applicable space (containing the top-lighting zone) between 3% and 6% of the total floor area.

- The skylight must have a minimum 0.5 VLT.

- A skylight diffuser, if used, must have a measured haze value of greater than 90% when tested according to ASTM D1003.

OR

**OPTION 3. Measurement**

Demonstrate through records of indoor light measurements that a minimum daylight illumination level of 10 fc and a maximum of 500 fc has been achieved in the applicable spaces. Measurements must be taken on a 10-foot grid and shall be recorded on building floor plans.

Provide glare control devices to avoid high-contrast situations that could impede visual tasks. However, designs that incorporate view-preserving automated shades for glare control may demonstrate compliance for only the minimum 10 fc illuminance level.

OR

**OPTION 4. Combination**

Any of the above calculation methods may be combined to document the minimum daylight illumination in the applicable spaces.

**Potential Technologies & Strategies**

Design the building to maximize interior daylighting. Strategies to consider include building orientation, shallow floor plates, increased building perimeter, exterior and interior permanent shading devices, high-performance glazing, and high-ceiling reflectance values; by, additionally, automatic photocell-based controls can help to reduce energy use. Predict daylight factors via manual calculations or model daylighting strategies with a physical or computer model to assess footcandle levels and daylight factors achieved.
IEQ Credit 8.2: Daylight and Views—Views

1 Point

**Intent**
To provide building occupants a connection to the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.

**Requirements**
Achieve a direct line of sight to the outdoor environment via vision glazing between 30 inches and 90 inches above the finish floor for building occupants in 90% of all regularly occupied areas. Determine the area with a direct line of sight by totaling the regularly occupied square footage that meets the following criteria:

- In plan view, the area is within sight lines drawn from perimeter vision glazing.
- In section view, a direct sight line can be drawn from the area to perimeter vision glazing.

The line of sight may be drawn through interior glazing. For private offices, the entire square footage of the office may be counted if 75% or more of the area has a direct line of sight to perimeter vision glazing. For multi-occupant spaces, the actual square footage with a direct line of sight to perimeter vision glazing is counted.

**Potential Technologies & Strategies**
Design the space to maximize daylighting and view opportunities. Strategies to consider include lower partitions, interior shading devices, interior glazing and automatic photocell-based controls.
ID Credit 1: Innovation in Design
1–5 Points

Intent
To provide design teams and projects the opportunity to achieve exceptional performance above the requirements set by the LEED Green Building Rating System and/or innovative performance in Green Building categories not specifically addressed by the LEED Green Building Rating System.

Requirements
Credit can be achieved through any combination of the Innovation in Design and Exemplary Performance paths as described below:

PATH 1. Innovation in Design (1-5 points)
Achieve significant, measurable environmental performance using a strategy not addressed in the LEED 2009 for New Construction and Major Renovations Rating System.

One point is awarded for each innovation achieved. No more than 5 points under IDc1 may be earned through PATH 1—Innovation in Design.

Identify the following in writing:
- The intent of the proposed innovation credit.
- The proposed requirement for compliance.
- The proposed submittals to demonstrate compliance.
- The design approach (strategies) used to meet the requirements.

PATH 2. Exemplary Performance (1-3 points)
Achieve exemplary performance in an existing LEED 2009 for New Construction and Major Renovations prerequisite or credit that allows exemplary performance as specified in the LEED Reference Guide for Green Building Design & Construction, 2009 Edition. An exemplary performance point may be earned for achieving double the credit requirements and/or achieving the next incremental percentage threshold of an existing credit in LEED.

One point is awarded for each exemplary performance achieved. No more than 3 points under IDc1 may be earned through PATH 2—Exemplary Performance.

PATH 3. Pilot Credit (1-5 points)
Attempt a pilot credit available in the Pilot Credit Library at www.usgbc.org/pilotcreditlibrary. Register as a pilot credit participant and complete the required documentation. Projects may pursue up to 5 Pilot Credits total.

Potential Technologies & Strategies
Substantially exceed a LEED 2009 for New Construction and Major Renovations performance credit such as energy performance or water efficiency. Apply strategies or measures that demonstrate a comprehensive approach and quantifiable environment and/or health benefits.
ID Credit 2: LEED Accredited Professional

1 Point

**Intent**
To support and encourage the design integration required by LEED to streamline the application and certification process.

**Requirements**
At least 1 principal participant of the project team shall be a LEED Accredited Professional (AP).

**Potential Technologies & Strategies**
Educate the project team members about green building design and construction, the LEED requirements and application process early in the life of the project. Consider assigning integrated design and construction process facilitation to the LEED AP.
RP Credit 1: Regional Priority
1–4 Points

Intent
To provide an incentive for the achievement of credits that address geographically-specific environmental priorities.

Requirements
Earn 1-4 of the 6 Regional Priority credits identified by the USGBC regional councils and chapters as having environmental importance for a project’s region. A database of Regional Priority credits and their geographic applicability is available on the USGBC website, http://www.usgbc.org.

One point is awarded for each Regional Priority credit achieved; no more than 4 credits identified as Regional Priority credits may be earned. The USGBC has prioritized credits for projects located in the U.S., Puerto Rico, the U.S. Virgin Islands, and Guam. All other international projects should check the database for eligible Regional Priority credits.

Potential Technologies & Strategies
Determine and pursue the prioritized credits for the project location.
FACT SHEET
Crumb-Rubber Infilled Synthetic Turf Athletic Fields
August 2008

PURPOSE
There are several kinds of synthetic turf surfaces (e.g., surfaces that use a fill material (“infill”) between the blades of artificial grass and those that do not), and synthetic turf may be installed for different uses (e.g., single or multiple sport athletic fields, landscaping, golf applications). The focus of this fact sheet is athletic fields with crumb rubber infilled synthetic turf. This fact sheet was developed to assist people in making decisions about installing or using this kind of synthetic turf athletic field. Considerations related to other kinds of synthetic turf fields are not addressed in this fact sheet.

BACKGROUND
The first well-publicized use of AstroTurf, a synthetic turf for athletic fields, was at the Houston Astrodome in 1966. This first generation of synthetic turf was essentially a short pile carpet with a foam backing. Since then, design changes have resulted in a greater variety of synthetic turf athletic fields. One type of synthetic turf is fabricated using synthetic fibers, manufactured to resemble natural grass, and a base material that stabilizes and cushions the playing surface. The fibers are typically made from nylon, polypropylene or polyethylene and are connected to a backing material. The base material, also called infill, consists of one or more granular materials that are worked in between the fibers during the installation process. Commonly used base materials are granulated crumb rubber (usually from used tires), flexible plastic pellets, sand, and rubber-coated sand. A combination of sand and crumb rubber is often used.

Crumb rubber is produced by grinding used tires. Steel and fiber tire components are removed during the process and the rubber pellets are sorted by size. Pellet sizes ranging from about one-sixteenth to one-quarter inch in diameter are used on synthetic turf. Crumb rubber is typically applied at a rate of two to three pounds per square foot of field surface.

HEALTH AND SAFETY CONSIDERATIONS
Some potential health and safety considerations related to synthetic turf have generated public concern. These include:
- Heat stress
- Injury
- Infection
- Latex allergy
- Chemical exposure
**Heat Stress**

Synthetic turf fields absorb heat, resulting in surface temperatures that are much higher than the temperatures of the surrounding air. In June 2002 at Brigham Young University (BYU) in Utah, the average surface temperature on a synthetic turf field was reported to be 117°F while the average surface temperatures on natural turf and asphalt were 78°F and 110°F, respectively. A maximum surface temperature of 200°F on the BYU synthetic turf field was reported. A turfgrass specialist at the University of Missouri reported measuring an air temperature of 138°F at “head-level” height on the university’s synthetic turf field on a sunny 98°F day. The surface temperature of the field was reported to be 178°F. A study conducted at Penn State University measured surface temperatures on experimental plots of nine different types of infilled turf. Temperature measurements were made on three occasions. The average air temperatures reported were 79°, 78°, and 85°F. The corresponding average surface temperatures reported for the synthetic turf plots are 120°, 130° and 146°F.

Water can be applied to synthetic turf to reduce the surface temperatures on warm days. A study at BYU found that watering synthetic turf lowered the surface temperature from 174°F to 85°F, but the temperature rose to 120°F in five minutes and to 164°F in twenty minutes. A study conducted by Penn State University on experimental synthetic turf plots examined the effect of watering synthetic turf on surface temperature. Measurements were made on three occasions. For one monitoring period, surface temperatures ranging from about 130° to 160°F were lowered initially to about 75°F, but increased within 30 minutes to temperatures ranging from about 90° to 120°F, where they remained fairly stable for the three-hour monitoring period.

The surface temperatures reported on synthetic turf fields can get high enough to reach levels of discomfort and may contribute to heat stress among users of the fields. While watering synthetic turf may reduce surface temperatures, other factors are likely to influence its effectiveness. At the present time, NYSDOH is unaware of any studies that have examined the role of synthetic turf in contributing to heat stress or that have compared the occurrence of heat stress among athletes playing on natural turf and synthetic turf.

Because of the potential for high temperatures on infilled synthetic turf fields, it is important that people who play or work on the fields be provided with adequate warnings regarding the potential for heat stress. People should also be advised to remain hydrated and to seek relief from the heat in shaded areas. The potential for and frequency of high surface temperatures warrant consideration when making decisions about installing and using a synthetic turf field.

**Injury**

There is a common perception that there are more sports injuries on synthetic than on natural turf athletic fields. Many factors influence the rate of sports injuries, including the type of playing surface. The many kinds of synthetic turf surfaces and changes in the turf products over the years complicate the assessment of how the playing surface affects injury rates. Other risk factors have been implicated in injury rates among athletes, in addition to the type of playing surface. These risk factors include level of competition, skill level, age, shoe type, previous injury and rehabilitation, and a number of individual physical characteristics. We identified five studies that compared injury (e.g., sprains, lacerations, fractures) rates among athletes when playing on infilled synthetic turf and natural turf fields. Although the ability of the studies to detect differences in the injury rates was limited by the small number of injuries reported, the
studies concluded that there were no major differences in overall injury rates between natural and infilled synthetic turf. Although each study found some differences in specific injury types, there was no consistent pattern across the studies.

The potential for head injuries from contact with the surfaces has been assessed by determining the ability of the surfaces to absorb impacts. Tests have shown that the force of impact on asphalt surfaces is much higher than the level generally accepted to be associated with serious head injury. The force of impact on many types of natural turf and all types of synthetic turf tested are below this level. The force of impact on frozen natural turf is typically above the acceptable level. No data are available for the force of impact on frozen synthetic turf.

The abrasiveness of synthetic turf fibers may contribute to the injury risk among athletes, particularly for abrasions or “turf burns.” The degree of abrasiveness appears to be dependent on the composition and shape of the turf fibers. A study conducted at Penn State University suggests that synthetic turf with nylon fibers is more abrasive than synthetic turf with other types of fibers.

**Infection Risk**
Some people have expressed concern that infections, including methicillin-resistant *Staphylococcus aureus* (MRSA), may be more common among users of synthetic turf fields than users of natural turf fields. This possibility has not been studied systematically, and no definitive statements can be made about differences in risk between the two surfaces.

At least two questions are important in evaluating the risk of infection. Does skin damage occur more frequently on synthetic turf than natural turf, thus providing a place where infections are more likely to occur? Are there more germs on synthetic turf than natural turf?

While injury studies have not consistently identified differences in abrasion and laceration risks between natural and infilled synthetic turf, some types of synthetic turf may result in more skin abrasions. Although very few tests have been performed, the available data do not suggest the widespread presence of infectious agents, such as MRSA, on synthetic turf fields. Also, the available information indicates that outdoor or indoor synthetic turf surfaces are no more likely to harbor infectious agents than other surfaces in those same environments. Disease outbreak investigations conducted in response to illnesses caused by a variety of germs (e.g., MRSA, *Campylobacter*, meningococcus, echovirus, herpes simplex virus, hepatitis virus, coxsackie virus) have not identified playing fields, either natural or synthetic, as likely to increase the risk of transmitting infections.

Skin cuts and abrasions that may result from contact with athletic fields, including both natural and synthetic fields, are susceptible to infection. Athletes and others developing skin abrasions should clean the wounds and seek prompt medical attention. Athletes should avoid sharing towels (on and off the field), equipment, razors, soap and other objects with others, because sharing these items can spread germs.

**Latex Allergy**
Latex, a substance found in natural rubber, contains substances called “latex allergens,” which can cause an allergic response in some people. About 6 percent of the general population is allergic to the substances in latex. Tire rubber contains the latex allergen, although at much lower levels than in latex
gloves and other consumer products. People playing on synthetic turf may be exposed to latex allergens through direct contact with the skin (dermal exposure) and inhalation of small rubber particles suspended in the air.

A study conducted for the California Environmental Protection Agency tested samples of tire rubber on the skin of guinea pigs. None of the animals developed any rashes or allergic reactions from contact with the rubber.

Whether crumb rubber can cause an allergic response in people is not known. NYSDOH is unaware of any occurrences of latex allergy associated with contact with crumb rubber or synthetic turf fields.

**Chemical Exposure**

Exposure to a chemical requires contact with it. Contact with a chemical occurs in three ways: swallowing it (ingestion exposure), breathing it (inhalation exposure), and having it come in contact with the skin (dermal exposure) or eyes (ocular exposure). The potential for harmful effects from exposure to a chemical depends on the amount of the chemical a person contacts, how the chemical enters the body (ingestion, inhalation, dermal, or ocular), how often contact occurs, and the toxic properties of the chemical. The ability of a chemical to be released from a substance (e.g., crumb rubber) is an important factor in determining how much exposure actually occurs. Other factors that can influence a person’s risk for adverse health effects from environmental chemicals include age, gender, general health, genetic differences, exposure to other chemicals and lifestyle choices.

Tires are manufactured from natural and synthetic rubbers along with numerous chemical additives, including zinc, sulfur, carbon black, and oils that contain polyaromatic hydrocarbons (PAHs) and volatile organic chemicals. Because crumb rubber is manufactured from used tires, it probably contains the same chemicals as tire rubber.

Studies have been conducted by the California Environmental Protection Agency Office of Environmental Health Hazard Assessment and the Norwegian Institute of Public Health to assess the potential for ingestion exposure to the chemicals in crumb rubber by children playing on synthetic turf. Both studies concluded that health risks to children resulting from the ingestion of crumb rubber are low.

The Norwegian Institute of Public Health also collected data to assess potential health risks resulting from dermal and inhalation exposures to chemicals contained in synthetic turf fields. Health assessments were conducted for adults and children. The researchers concluded that adverse health effects resulting from dermal exposures to crumb rubber or from inhalation exposures to organic chemicals released from the fields are unlikely. No health assessment of the concentrations of rubber particles in the air was made.

A French study measured the concentrations of organic chemicals emitted as gases (known as volatile organic compounds or VOCs) from crumb rubber under laboratory conditions. The data were used by the French National Institute for Industrial Environment and Risks to evaluate possible health effects from inhaling VOCs released from synthetic turf. The study authors concluded that the concentrations of organic compounds emitted did not pose a health concern for athletes, officials or spectators.

Some types of synthetic turf fibers contain elevated levels of lead (e.g., in the range of about 2,000 to 9,000 parts per million). Degradation of these fibers can form a dust that presents a potential source of
lead exposure to users of the fields. The Centers for Disease Control and Prevention and the Agency for Toxic Substances and Disease Registry addressed the potential for lead exposures from synthetic turf fibers in a June 2008 Health Advisory (http://www.cdc.gov/nceh/lead/artificialturf.htm). For new or replacement installations, select synthetic turf products that do not have elevated lead levels.

Our review of the available information on crumb rubber and crumb rubber infilled turf fields indicates that ingestion, dermal or inhalation exposures to chemicals in or released from crumb rubber do not pose a significant public health concern.

**OTHER CONSIDERATIONS**
A number of other factors may need to be considered when installing and using synthetic turf.

**Use:** Synthetic turf is more durable than natural turf and can be used without the rest periods that natural turf requires to keep the turf healthy. The New York City Department of Parks and Recreation (NYCDPR) estimates that on an annual basis, permitted use (hours per year) for synthetic turf athletic fields is 28 percent higher than for natural grass fields.

**Installation:** Installation costs of synthetic turf vary depending on the amount of site preparation required and the specific field design. The installation costs of synthetic turf are generally much higher than the installation costs of natural turf.

**Maintenance:** The maintenance costs of synthetic turf will vary depending on the field’s use and design, but are typically estimated to be lower than the maintenance costs of natural turf. Natural turf requires regular mowing, fertilizer application, pest control and possibly watering. Synthetic turf requires replacing infill materials, repairing seams and removing weeds and moss. Specialized equipment, which may or may not be included in the field’s purchase price, is required for these activities.

**Lifetime:** NYCDPR estimates that the lifetime of a natural turf field is on the order of five years. The synthetic turf industry estimates that the lifetime of an infilled synthetic turf athletic field is eight to ten years, depending on care during installation and use. NYCDPR and other New York entities have seen similar lifetimes.
# SUMMARY OF INFORMATION FOR CRUMB-RUBBER INFILLED SYNTHETIC TURF ATHLETIC FIELDS

<table>
<thead>
<tr>
<th>Category</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat stress</td>
<td>Surface temperatures on crumb-rubber infilled synthetic turf fields can reach levels of discomfort and may contribute to heat stress. This warrants consideration when making decisions about installing and using a synthetic turf field. While watering synthetic turf may briefly reduce surface temperatures, a number of factors may influence its effectiveness. People using these fields should be advised to remain hydrated and to seek relief from the heat in shaded areas.</td>
</tr>
<tr>
<td>Injury</td>
<td>Overall, studies have found no consistent differences in injury rates between natural and crumb-rubber infilled synthetic turf.</td>
</tr>
<tr>
<td>Infection</td>
<td>Skin cuts and abrasions that may result from contact with athletic fields (natural and synthetic turf) are susceptible to infection. Athletes and others developing skin abrasions should clean the wounds and seek prompt medical attention. Athletes should avoid sharing equipment, razors, towels, soap and other objects with others, because these items can spread germs.</td>
</tr>
<tr>
<td>Latex allergy</td>
<td>At the present time, NYSDOH is unaware of any occurrences of latex allergy resulting from contact with crumb rubber or synthetic turf fields.</td>
</tr>
<tr>
<td>Chemical exposures</td>
<td>Based on the available information, chemical exposures from crumb rubber in synthetic turf do not pose a public health hazard.</td>
</tr>
</tbody>
</table>
WHERE CAN I GET MORE INFORMATION?

If you have any questions about the information in this fact sheet or would like to know more about in-filled synthetic turf athletic fields, please call the NYSDOH at 1-800-458-1158 or write to the following address:

New York State Department of Health
Bureau of Toxic Substance Assessment
Flanigan Square, 547 River St.
Troy, NY 12180-2216

SOME RELEVANT REFERENCES

Temperature of In-filled Synthetic Turf Athletic Fields
Adamson, C, Feature Research: Synthetic Turf Playing Fields Present Unique Dangers; University of Missouri, Columbia, College of Agriculture, Food, and Natural Resources,
http://cafnr.missouri.edu/research/turfgrass.php

McNitt S., Petrunak D., Evaluation of Playing Surface Characteristics of Various In-filled Systems; Penn State Department of Crop and Soil Sciences; http://cropsoil.psu.edu/mcnitt/infill.cfm

Williams F.C., Pulley G.E.; Synthetic Surface Heat Studies; Brigham Young University;

Injuries


Infection Risk


McNitt S., Petrunak D.; Evaluation of Playing Surface Characteristics of Various In-Filled Systems; Penn State Department of Crop and Soil Sciences; [http://cropsoil.psu.edu/mcnitt/infill.cfm](http://cropsoil.psu.edu/mcnitt/infill.cfm)


Latex Allergy


Chemical Exposures


Other Considerations


“Synthetic Surface Heat Studies”  
*C. Frank Williams and Gilbert E. Pulley*  
*Brigham Young University*

Synthetic turf surfaces have long been regarded as a lower maintenance alternative to natural turf. However, synthetic surfaces like natural turf have their shortcomings. In the spring of 2002 a Field Turf synthetic surface was installed on one half of Brigham Young University’s Football Practice Field. The other half of the installation is a sand-based natural turf field. Shortly after the Field Turf was installed football camps were started. The coaches noticed the surface of the synthetic turf was very hot. One of the coaches got blisters on the bottom of his feet through his tennis shoes. An investigation was launched to determine the range of the temperatures, the effect water for cooling of the surfaces, and how the temperatures compared to other surfaces.

On June of 2002 preliminary temperatures were taken at five feet and six inches above the surface and at the surface with an infrared thermometer of the synthetic turf, natural turf, bare soil, asphalt and concrete. A soil thermometer was used to measure the temperature at two inches below the surface of the synthetic turf. Also, water was used to cool the surface of the natural and artificial turf. It was determined that the natural turf did not heat up very quickly after the irrigation so only the artificial turf was tracked at five and twenty minutes after wetting. The results of the preliminary study are shocking. The surface temperature of the synthetic turf was 37º F higher than asphalt and 86.5º F hotter than natural turf. Two inches below the synthetic turf surface was 28.5º F hotter than natural turf at the surface. Irrigation of the synthetic turf had a significant result cooling the surface from 174º F to 85º F but after five minutes the temperature rebounded to 120º F. The temperature rebuilt to 164º F after only twenty minutes. These preliminary findings led to a more comprehensive look at the factors involved in heating of the artificial turf.

Three aspects of light were measured along with relative humidity. The synthetic surface was treated as two areas, the soccer field and the football field and the natural turf was one area. Four randomly selected sampling spots were marked with a measuring tape from reference points on the fields so it could be accessed for subsequent data collection. Bare soil, concrete, and asphalt sampling areas were selected and marked in a similar manner. The results are shown in table form below:

<table>
<thead>
<tr>
<th>Surface</th>
<th>Average Surface Temperature between 7:00 AM and 7:00 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soccer</td>
<td>117.38º F high 157º F</td>
</tr>
<tr>
<td>Football</td>
<td>117.04º F high 156º F</td>
</tr>
<tr>
<td>Natural Turf</td>
<td>78.19º F high 88.5º F</td>
</tr>
<tr>
<td>Concrete</td>
<td>94.08º F</td>
</tr>
<tr>
<td>Asphalt</td>
<td>109.62º F</td>
</tr>
<tr>
<td>Bare Soil</td>
<td>98.23º F</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Two inch depth</th>
<th>Average Soil Temperature between 7:00 AM and 7:00 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soccer</td>
<td>95.33º F high 116º F</td>
</tr>
<tr>
<td>Football</td>
<td>96.48º F high 116.75º F</td>
</tr>
<tr>
<td>Natural Turf</td>
<td>80.42º F high 90.75º F</td>
</tr>
<tr>
<td>Bare Soil</td>
<td>90.08º F</td>
</tr>
</tbody>
</table>
Table 3.

<table>
<thead>
<tr>
<th>Shade</th>
<th>Average Temperature between 9:00 AM and 2:00 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Temperature of Natural Turf</td>
<td>66.35° F          high 75° F</td>
</tr>
<tr>
<td>Surface Temperature of Artificial Turf</td>
<td>75.89° F          high 99° F</td>
</tr>
<tr>
<td>Average Air Temperature</td>
<td>81.42° F</td>
</tr>
</tbody>
</table>

Surface Temperature of A.T. (Artificial Turf) is significantly higher than air or soil temperature of A.T. The amount of light (electromagnetic radiation) has a greater impact on temperature of A.T. than air temperature. The hottest surface temperature recorded was 200° F on a 98° F day. Even in October the surface temperature reached 112.4° F. This is 32.4° F higher than the air temperature. White lines and shaded areas are less affected because of reflection and intensity of light. Natural grass areas have the lowest surface and subsurface temperatures than other surfaces measured. Cooling with water could be a good strategy but the volume of water needed to dissipate the heat is greatly lessened by poor engineering (infiltration and percolation).

Average air temperature over natural turf in the late afternoon is lower than other surfaces. Soil temperature of A.T. is greater than bare soil and natural turf. Humidity appears to be inversely related to surface and soil temperature. It is likely that energy is absorbed from the sunlight by the water vapor.

The heating characteristics of the A.T. make cooling during events a priority. The Safety Office at B.Y.U. set 120° F as the maximum temperature that the surface could reach. When temperature reaches 122° F it takes less than 10 minutes to cause injury to skin. At this temperature the surface had to be cooled before play was allowed to continue on the surface. The surface is monitored constantly and watered when temperatures reach the maximum. The heat control adds many maintenance dollars to the maintenance budget.

A budget comparison was made using actual dollars spent and for every dollar spent on the A.T. maintenance one dollar and thirty cents was spent on the natural turf (N.T.) practice field. While construction costs are very unbalanced, for every dollar spent on the N.T. eleven dollars and seventy-seven dollars were spent on the A.T.

The area under the carpet of BYU’s installation is designed to move water from the surface and into an extensive drain mat system. This part of the installation is two thirds of the overall cost of the A.T. Thus, for a 2.5 million dollars installation approximately 1.7 million dollars go for the subsurface and drainage. The most interesting thing about this is that the drain mat probably sees little or no water. The surface is hydrophobic and the undersurface is poorly engineered to favor water retention rather than drainage. That seems like a high price to pay for something that does not work!

Artificial turf surfaces have their place in the turf industry. They can work in environments where grass will not grow and are marginal. However, they are costly and not maintenance free. It is important to take all the factors into consideration before making a large investment. Don’t take the manufacturer’s word for the factors of concern i.e. don’t let the fox guard the hen house. The propaganda on BYU’s installation is charts with surface temperatures less than the air temperature and claims for drainage of 60 inches per hour. The question still remains is A.T. 11.47 times better than natural turf?
Synthetic Turf Playing Fields Present Unique Dangers

By Chuck Adamson

Brad Fresenburg made a disturbing discovery when he took surface temperatures of artificial playing turf on a summer afternoon.

The University of Missouri turfgrass expert found that on a 98-degree day at MU's Faurot Field the surface temperature on the synthetic grass was 173 degrees. Nearby natural grass showed a temperature of just 105 degrees.

When Fresenburg took the temperature at head-level height over the faux turf, the thermometer registered 138 degrees.

Fresenburg said there's a national trend toward high schools and municipal recreation departments replacing grass with artificial turf – once the almost exclusive purview of college and professional sports teams – and he wants coaches and parents to know how to keep players safe.

"If they are going to have artificial fields, we need coaches, parents and players to know that temperatures on these fields are going to be anywhere from 150 to 170 degrees on some days," Fresenburg said. "You might as well be sitting in an oven somewhere."

The new generation of synthetic turfs are as safe, even safer in some ways, as natural grass, concluded Michael Meyers, a professor at West Texas A&M University. He has tracked playing field injuries in Texas high schools for eight years now.

Athletes tend to suffer injuries at roughly the same frequency on natural and synthetic turfs, but different surfaces tend to result in different types of injuries, he said.

"There is more torque, more velocity and more traction" on artificial turf, Meyers said.
There is more torque, more velocity and more traction on artificial turf, Meyers said.

That can lead to more muscle strains and spasms.

But natural grass has its own hazards, such as slippery mud or unseen potholes, and possibly in arid areas, harder surfaces. More concussions per games played occurred on natural grass fields.

The newer generation of synthetic turfs is "far superior," said Meyers, to previous types like the former industry standard Astroturf, which he described as basically a carpet and carpet pad laid over concrete. Now fields are built over surfaces in-filled with recycled rubber pellets and other materials that make for softer falls, mimicking natural grass and soil playing conditions.

The drawback, said Fresenburg, is that all those rubber and plastic materials amplify sunlight to cause near unbearable temperatures at certain times of the day.

Rex Sharp, MU's head athletic trainer, said he believes synthetic turf to be just as safe as grass. But he agrees that outdoor fields will get hotter under certain conditions. In his experience the artificial fields get at least 10 to 15 degrees hotter under the afternoon sun, he said.

University staff constantly monitors field temperatures during practices, Sharp said.

Fresenburg suggested that sports teams schedule morning and evening practices, times when playing surfaces are cool. In the hot afternoon hours of August and September he said teams should seek out natural grass alternatives.

Under any workout conditions, hydration of athletes should be closely monitored, he said.

MU has two artificial turf fields, the indoor field in the Devine Pavilion and the outdoor Faurot Field in Memorial Stadium.

The older-generation turf used at Devine Pavilion is more tacky and prone to cause twisting-related injuries, Sharp said. The football players wear special cleats when practicing there. Faurot Field has the newer-generation FieldTurf brand surface. He said players can wear regular grass cleats there, and he believes that the surface is just as safe as natural grass.

Fresenburg is not so sure.

Tests Fresenburg has done show increased potential pressure on joints and bones from the inability of a fully planted cleat-wearing foot to divot or twist out, an action that releases force.

The traction on synthetic turf is much greater, he said.

"Grounds managers prefer artificial turf over natural because when teams play on grass, they leave divots and rip out grass," Fresenburg said. "Most people see those areas as
damaged turf. I like to say those divots are a sign that the field is doing its job – yielding to the athletes' cleats."

Fresenburg tested four turf types, three natural grasses and MU’s Faurot Field using a contraption of cleats, weights to simulate an athlete’s weight and a torque wrench-like tool. When a cleat was completely planted in Faurot Field, it needed an average of 110 foot-pounds – a foot-pound is a measured unit of applied force – of torque to twist free. That was compared to 81 to 85 foot-pounds needed on the natural surfaces.

"In some areas of Faurot Field, we maxed out the instrument at 120 foot-pounds," Fresenburg said. "The cleated foot simply wouldn't shear. That's not good."

The good news is that the difference only occurred when a cleat was fully planted in the field. When only a portion of the cleat simulating the ball of a foot was planted, the force needed to twist free was the about the same on all surfaces.

The hidden danger on an artificial field is the threat of bacterial infections, Fresenburg said. He said disinfectant should be sprayed as needed if there's a known infection risk, but Fresenburg said he doesn't know what procedures are necessary to prevent bacterial contamination in the first place.

"Natural grass has a microbial system. It's self-cleaning. These synthetic fields don't have that," Fresenburg said. "There's warmth. There's moisture. Bacteria can thrive in there. There's sweat, spit and blood."

Sharp said players need to immediately report any "turf-burns," abrasions so named for their similarity to rug burns. Turf burns are common on certain types of synthetic turf. They must be immediately washed with soap and water to prevent infection, Sharp said.

Often young athletes are inclined to ignore seemingly minor injuries, Sharp said.

"We have done a good job of educating our students on turf burns," Sharp said. "We've had to educate our kids to let us clean and treat those."

Anyone interested in more tips on turfgrass safety can contact Fresenburg at 573-442-4893.

"Many schools or communities may only look at the maintenance chores of natural grass when deciding to switch to artificial turf," Fresenburg said. "They should look beyond that. They need to look at all the differences between the two surfaces."
Artificial Turf

Recent tests by the New Jersey Department of Health and Senior Services (NJDHSS) of artificial turf playing fields in that state have found these fields contain potentially unhealthy levels of lead dust. The initial tests were conducted on a limited number of playing fields. NJDHSS sampling of additional athletic fields and other related commercial products indicates that artificial turf made of nylon or nylon/polyethylene blend fibers contains levels of lead that pose a potential public health concern. Tests of artificial turf fields made with only polyethylene fibers showed that these fields contained very low levels of lead.

Information provided by NJDHSS to CDC and ATSDR indicates that some of the fields with elevated lead in either dust and/or turf fiber samples were weathered and visibly dusty. Fields that are old, that are used frequently, and that are exposed to the weather break down into dust as the turf fibers are worn or demonstrate progressive signs of weathering, including fibers that are abraded, faded or broken. These factors should be considered when evaluating the potential for harmful lead exposures from a given field.

The risk for harmful lead exposure is low from new fields with elevated lead levels in their turf fibers because the turf fibers are still intact and the lead is unlikely to be available for harmful exposures to occur. As the turf ages and weatheres, lead is released in dust that could then be ingested or inhaled, and the risk for harmful exposure increases. If exposures do occur, CDC currently does not know how much lead the body will absorb; however, if enough lead is absorbed, it can cause neurological development symptoms (e.g. deficits in IQ). Additional tests are being performed by NJDHSS to help us better understand the absorption of lead from these products.

Learn About Lead Contamination in Artificial Turf

Potential Exposure to Lead in Artificial Turf
CDC Health Alert Network (HAN) Advisory from June 18, 2008, 16:10 EDT.

New Jersey Artificial Turf Investigation
Additional information about testing, dust suppression measures, and other topics related to New Jersey's artificial turf investigation.

Learn About Lead

CDC's Lead Poisoning Prevention Program
Learn more about the CDC's efforts to eliminate childhood lead poisoning in the United States.

ToxFAQs™
Frequently asked questions from the Agency for Toxic Substances & Disease Registry (ATSDR).

Toxicological Profile

http://www.cdc.gov/nceh/lead/tips/artificialturf.htm
Toxicologic & adverse health effects information from the Agency for Toxic Substances & Disease Registry (ATSDR).
Artificial Turf Field Investigation in Connecticut
Final Report

Prepared By

Nancy Simcox, MS
Anne Bracker, MPH, CIH

John Meyer, MD, MPH
Section of Occupational and Environmental Medicine
University of Connecticut Health Center

July 27, 2010
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ACKNOWLEDGMENTS

We would like to extend a special appreciation to Tara Kurland, a masters student in Environmental Science and Policy at Clark University, who completed her summer internship with us on this project. We especially thank her for contributing to all aspects of the field sampling. We also thank Paula Schenck, the University of Connecticut Health Center, for careful review of this report. Funding for this project was provided by the Connecticut Department of Environmental Protection.
1.0 Executive Summary

The primary purpose of this project was to characterize the concentrations of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), rubber-related chemicals (e.g. benzothiazole), and particulate matter less than 10 micron (PM$_{10}$) and its constituents in ambient air at selected crumb rubber fields in Connecticut under conditions of active field use.

This project employed a cross-sectional environmental sampling strategy of synthetic crumb rubber turf fields to capture a range of chemical exposures during the summer season when ambient air temperatures are above 75-80°F. Three general types of fields were targeted: outdoor crumb rubber fields, indoor facilities with crumb rubber turf, and an outdoor grass field in a suburban area. Sampling goals were to collect air samples on old and new turf fields during active field use and to collect air samples at background sites upwind and off of each field. A special focus of the design study included personal air sampling of many of the chemicals reported in previous studies (e.g. VOCs and benzothiazole), and other chemicals of potential concern, such as a volatile nitrosamine reported to be part of rubber manufacture. The sampling strategy also included the collection of area air samples for chemicals at different heights on the turf to assess a vertical profile of release. These air samples were collected in areas on the turf field near active play and areas on the turf away from active play. Because crumb rubber includes some amount of dusts and small particles, particulate matter air monitoring was incorporated into the stationary sampling plan (using sampling at a single height only). Bulk samples of turf grass and crumb rubber were also collected, and meteorological data (e.g. air direction, wind speed and ambient air temperature) were recorded.

Industrial hygienists from the Section of Occupational and Environmental Medicine at the University of Connecticut Health Center (OEM UCHC) conducted the field sampling and managed the analytical components of this exposure investigation. This report summarizes the data collected by OEM UCHC. This report identifies and measures chemicals across several synthetic crumb rubber turf fields and background locations. The measurements collected from background locations are necessary to better understand the data because many of these chemicals are present in ambient air as a result of general air pollution.

CT DEP recruited six fields: 4 outdoor turf fields (Fields A-D), 1 indoor turf field (Field K) and 1 outdoor suburban grass area (Field L). Six additional fields were recruited to collect crumb rubber bulk samples only (Fields E-J). Air sampling occurred during July 2009 on crumb rubber fields with polyethylene fibers that were both new (<2 years) and old (>3 years). Algorithms were developed to identify chemicals possibly related to turf. Of the 60 VOCs tested in air, 4 VOCs appear to be associated with turf. Of 22 PAHs, 6 were found in the air on the turf at 2 fold greater concentrations than in background locations on at least two fields. Of the five targeted SVOCs, benzothiazole and butylated hydroxytoluene were the only chemicals detected in the personal and area air samples from outdoor turf fields ranging from <80-1200 ng/m$^3$ and <80-130 ng/m$^3$, respectively. Nitrosamine air levels were below reporting levels. PM$_{10}$ air concentrations were greater in background locations than on the turf at all fields with the exception of Field B. However, the PM$_{10}$ air concentration on turf at Field B, 5.89 ug/m$^3$, was within the range of other PM$_{10}$ background concentrations. All of the composite samples of turf fibers and crumb rubber were below the level EPA considers as presenting a "soil-lead hazard" in play areas (400ppm).

The airborne concentrations of VOCs, targeted SVOCs (e.g. benzothiazole) and miscellaneous SVOCs were highest at the indoor field. These data were collected from only one indoor facility. Higher concentrations of these chemicals at the indoor field likely reflects the lack of air movement relative to outdoor fields. In addition, the air in the indoor field was not influenced by outdoor factors that may degrade and off-gas chemicals, such as sunlight, rain, and other weather conditions. Furthermore, potential point sources were identified in the facility, (electric carts, portable chargers, and maintenance supplies) and the indoor facility did not have its exhaust system operating on the day samples were collected. More research is needed to better understand chemical exposures in indoor facilities.
2.0 Introduction

2.1 Purpose

Crumb rubber fields have been installed or are being proposed in many towns throughout Connecticut, and elsewhere in the United States. Crumb rubber consists of recycled, chipped/pulverized, used automobile tires. The tire crumbs are roughly the size of grains of course sand and generally are spread two to three inches thick over the field surface and packed between ribbons of green plastic used to simulate grass. Crumb rubber granules may release a variety of chemicals typical in rubber, including polycyclic aromatic hydrocarbons (PAHs) and volatile organic chemicals (VOCs). In addition, crumb rubber includes some amount of dusts and small particles, which may be further increased by mechanical abrasion and wear that comes with use of the fields [1]. Health questions continue to arise because exposures and risks to playing on these fields have not been fully characterized [2, 3, 4].

The primary purpose of this project was to characterize the concentrations of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), rubber-related chemicals (e.g. benzothiazole), and particulate matter less than 10 micron concentrations (PM$_{10}$) and its constituents in ambient air at selected crumb rubber fields in Connecticut under conditions of active field use. Air monitoring data is needed to characterize exposure patterns of targeted compounds in the breathing zone of children using artificial turf fields. In addition, there is insufficient data on how relevant variables, such as weather conditions, age of field, nature of sporting activities and type of infill, affect exposure to chemical constituents and particulate matter.

In Connecticut, we know of at least 85 crumb rubber fields already in use, and another 30 that have been proposed or are being constructed. Air data collected at selected crumb rubber fields are needed to begin the characterization of potential exposures that could be used in a companion risk assessment of the data generated from this work.

Data from the Connecticut Agricultural Experiment Station (CAES) laboratory head space analyses on manufacturers’ crumb rubber infill were used to guide aspects of the design of this field investigation [5]. We also established collaborative relationships with those doing similar research in New Jersey, New York State, New York City and U.S. EPA to learn of parallel activities and results as this project proceeded [6, 7]. For example, a recent study conducted in New York found that rubber dust was not found in the respirable range, and therefore, PM$_{10}$ was selected for this study [6].

2.2 Field Investigation Objectives

This exposure characterization had the following objectives.

1. Collect personal measurements in the breathing zone of the target population - young children who play on crumb rubber athletic fields.
2. Characterize the concentrations of VOCs, SVOCs, and particulate matter (PM) (and constituents on PM) in air at selected crumb rubber fields in Connecticut under conditions involving active field use in warm weather.
3. Assess airborne concentrations of the targeted chemicals and particulates in areas surrounding and away from the crumb rubber fields. The collection of background samples is a key component as exposure to airborne rubber particles and component gases is not unique to turf fields.

2.3 Sampling Plan

Industrial hygienists from the Section of Occupational and Environmental Medicine at the University of Connecticut Health Center (OEM UCHC) conducted the field sampling and managed the analytical components of this exposure investigation. OEM UCHC provides research, educational programs and training, industrial hygiene consulting, prevention guidance, risk communication and clinical care for occupational and environmental illnesses and problems. Specifically, OEM UCHC personnel performed the collection of air samples, contracted with laboratories for analyses, provided quality control /quality assurance, and reviewed and compiled the data. OEM UCHC sub-contracted laboratory analyses to three AIHA accredited laboratories: Wisconsin Occupational Health Laboratory (WOHL), the Wisconsin State Laboratory of Hygiene (WSLH) and the ESIS Environmental Health Laboratory (EHL) in Cromwell, Connecticut. WOHL is a full service industrial hygiene chemistry laboratory that is part of the Wisconsin State Laboratory of Hygiene (WSLH) at the University of Wisconsin-Madison. WSLH analyzed air samples for VOCs, SVOCs and PM$_{10}$. WOHL analyzed bulk crumb rubber head space for VOCs and targeted SVOCs (e.g. benzothiazole), and air samples for nitrosamines and targeted SVOCs. Additional bulk
samples were analyzed for lead by the ESIS Environmental Health Laboratory (EHL). The EHL has been accredited by the American Industrial Hygiene Association (AIHA) for both industrial hygiene and environmental lead. This report summarizes the data collected by OEM UCHC.

This project employed a cross-sectional environmental sampling strategy of synthetic crumb rubber turf fields to capture a range of chemical exposures during the summer season when ambient air temperatures are above 75-80°F. Three general types of sites were targeted: outdoor crumb rubber fields, indoor facilities with crumb rubber turf, and an outdoor grass field in a suburban area. Sampling goals were to collect air samples on old and new turf fields during active field use and to collect air samples at an upwind site of each field. A special focus of the design included personal air sampling of many of the chemicals reported in previous studies (e.g. VOCs and benzothiazole), and other chemicals of potential concern, such as a nitrosamine. The sampling strategy also included the collection of area air samples for chemicals at different heights on the turf to assess a vertical profile of release. These air samples were collected in areas on the turf field near active play and areas on the turf away from active play. Because crumb rubber includes some amount of dusts and small particles, particulate matter air monitoring was incorporated into the stationary sampling plan (using sampling at a single height only). Bulk samples of turf grass and crumb rubber were also collected, and meteorological data (e.g. air direction, wind speed and ambient air temperature) were recorded.

**Bulk Samples:** Composite bulk samples of green artificial turf fibers and composite bulk samples of crumb rubber were collected from 5 locations on each study field. These samples were analyzed for lead by EHL in Connecticut. Additional bulk samples of crumb rubber were collected at eleven fields. These samples were analyzed for targeted SVOCs, VOCs and other chemicals in a 340 milliliter large volume sample headspace unit (LVSH) by WOHL. CAES collected and analyzed samples of crumb rubber material supplied by several manufacturers [5]. Their crumb rubber samples included material from only two of our outdoor fields (A and D). These two crumb rubber fields were manufactured by two different companies. The results are difficult to compare between the two laboratories (WOHL and CAES) because they used different analytical methods.

**Personal Sampling:** Study team members from the Connecticut Department of Public Health (CT DPH), Connecticut Department of Environmental Protection (CT DEP), and OEM-UCHC simulated a soccer game for the collection of the personal airborne chemicals. Active play among 3-4 players consisted of running and kicking the ball on the turf field, one on one soccer drills and “keep away” soccer games. Duration of play was two hours with one break. Personal air samples were collected at waist height, approximately 3-feet, with sampling equipment worn by 3 players during active play on the field. Personal measurements for nitrosamine, benzothiazole, and VOC were collected from players at each field. Two personal samples were collected for each of the types of measurements. Evacuated 1.4 liter SUMMA canisters were worn by players at hip height to collect VOC samples. Personal sampling pumps fit with absorptive media were worn by players at hip height to collect samples for benzothiazole, nitrosamine, 4-Tert (octyl) phenol, 2-mercaptobenzothiazole, Butylated hydroxyanisole (BHA) and Butylated hydroxytoluene (BHT).

**Area Sampling:**
Area samples were collected for 2 hours to measure VOCs, SVOCs, benzothiazole, and ambient PM$_{10}$ concentrations during active play. Samplers were located at various heights on the field in the immediate vicinity of the simulated soccer game and in an off-turf upwind area to represent background locations. Additional background samples were collected in one suburban community location (non-turf grass field) to help put the field-related results into a larger exposure context. VOCs were measured with 6-liter SUMMA canisters according to EPA Method TO-15 [8]. SVOCs in ambient air were measured with PS-1 Samplers according to EPA Method TO-13A [9]. An additional day of sampling for 6 hours was conducted with the PS-1 Samplers on one field without active play. Specific chemicals (e.g. benzothiazole and nitrosamines) were separately measured using sampling pumps and sorptive media to trap those chemicals according to NIOSH methods [10, 11]. PM$_{10}$ concentrations were measured using Harvard Impactors (Air Diagnostics and Engineering, Inc., Harrison, ME) [12, 13]. OEM-UCHC collected all samples and shipped sampling media to WOHL for analysis. Table 1 provides a general description of the targeted analytes, air sampling and analytical methods for each set of analytes. Appendix A provides a sampling map.
3.0 Methods and Results

3.1 Field Recruitment
CT DEP recruited six fields: 4 outdoor turf fields (Fields A-D), 1 indoor turf field (Field K) and 1 outdoor suburban grass area (Field L). Six additional fields were recruited to collect crumb rubber bulk samples only (Fields E-J). As shown in Table 2, air sampling occurred during July 2009 on crumb rubber fields with polyethylene fibers that were both new (<2 years) and old (>3 years). Fields B, C, and J contained silica sand in the crumb rubber. Sampling dates were chosen to coordinate several factors: sunny and no wind days, rental sampling equipment costs/availability, field accessibility due to school summer programs, and staff availability. Table 2 provides the total number of air samples collected at each field.

Fields A-B and K were in located in rural areas and fields C, D and L were in suburban communities with nearby roads with high traffic volume. Field D was also near an interstate highway. Field K, the indoor turf facility, had four exhaust fans at each end of the building. These fans were not operating during sampling. There was an equipment room located inside the facility containing small electric motorized carts (these carts were driven out of the facility minutes before the sampling began). In addition, the room had a portable charger, an ice machine, maintenance supplies (e.g. cans of paints) and other gym equipment.

3.2 Meteorological Sampling
Meteorological conditions for each sampling day were collected by a subcontactor (Air Quality Research and Logistics, LLC) with a Davis Vantage Pro 2 weather station by Air Quality Research and Logistics, Inc. Meteorological parameters included: wind speed, wind direction and air temperature at different heights (near ground level and 3 feet above the ground). Thermometers were enclosed in naturally aspirated radiation shields (Davis Part. No. 7714). Measurement of continuous (15 minute average) ambient air temperature, wind direction and speed were collected. Table 3 provides a summary of the meteorological conditions at each field. Appendix B provides a report by Air Quality Research and Logistics, Inc. On July 28, 2009, meteorological data was not collected during the 6 hour sampling at Field D. Temperature and wind direction data were obtained from Weather Underground (www.wunderground.com).

<table>
<thead>
<tr>
<th>Table 1. Target Analytes, Air Sampling Equipment and Analytical Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Compounds</strong></td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Volatile Organic Compounds (VOCs)</td>
</tr>
<tr>
<td>General Semi-Volatile Organic Compounds (SVOCs) scan</td>
</tr>
<tr>
<td>Targeted SVOCs Benzothiazole 2-mercaptobenzothiazole 4-Tert (octyl)phenol Butylated hydroxyanisole Butylated hydroxytoluene</td>
</tr>
<tr>
<td>Nitrosamines</td>
</tr>
<tr>
<td>Particulate Matter (PM₁₀)</td>
</tr>
</tbody>
</table>
Table 2. Total number of air samples collected at each field

<table>
<thead>
<tr>
<th>Compounds/Methods</th>
<th>Location</th>
<th>N</th>
<th>Fields</th>
<th>Sampling Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>VOCs EPA TO-15</td>
<td>Personal</td>
<td>10</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>On Turf Area</td>
<td>10</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Background Area</td>
<td>6</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SVOCs scan EPA TO-13A</td>
<td>On Turf Area</td>
<td>6</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Background Area</td>
<td>6</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Targeted SVOCs NIOSH 2550 (modified)</td>
<td>Personal</td>
<td>10</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>On Turf Area</td>
<td>23</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Background Area</td>
<td>12</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Field Blanks</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Field Spikes</td>
<td>6</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Nitrosamines NIOSH 2522</td>
<td>Personal</td>
<td>10</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>On Turf Area</td>
<td>12</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Background Area</td>
<td>11</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Field Blanks</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PM$_{10}$ CFR Title 40 Part 50</td>
<td>On Turf Area</td>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Background Area</td>
<td>7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Field Blanks</td>
<td>6</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 3. Description of sampling fields and weather conditions during sampling day.

<table>
<thead>
<tr>
<th>Field ID</th>
<th>Surface Age (location)</th>
<th>Sampling Date</th>
<th>Sampling Time of Day</th>
<th>Ambient Temperature On Surface (°Fahrenheit)</th>
<th>Wind Speed (mph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2 years (outdoor)</td>
<td>7/27/09</td>
<td>12:15-2:15pm</td>
<td>79-89</td>
<td>76-83</td>
</tr>
<tr>
<td>B</td>
<td>2 years (outdoor)</td>
<td>7/15/09</td>
<td>11:30-1:30pm</td>
<td>83-89</td>
<td>77-80</td>
</tr>
<tr>
<td>C</td>
<td>5 years (outdoor)</td>
<td>7/20/09</td>
<td>11:30-1:45pm</td>
<td>85-88</td>
<td>81-82</td>
</tr>
<tr>
<td>D</td>
<td>2 years (outdoor)</td>
<td>7/14/09 7/28/09</td>
<td>12:35-2:40pm 9:30-3:30pm</td>
<td>80-88</td>
<td>76-86 68-87*</td>
</tr>
<tr>
<td>K</td>
<td>3 years (indoor)</td>
<td>7/22/09</td>
<td>3:50-5:50pm</td>
<td>77-79</td>
<td>78-80</td>
</tr>
<tr>
<td>L</td>
<td>Grass (outdoor)</td>
<td>7/12/09</td>
<td>11:48-1:48pm</td>
<td>NA a</td>
<td>78-80 b</td>
</tr>
</tbody>
</table>

* Temperature not measured directly. Information collected from Weather Underground.

aNA=Not available. Temperature information was not collected 3 inches above the surface.
3.3 Bulk Samples

*Crumb Rubber Bulk Sampling Methods for Head Space Analysis:* Crumb rubber bulk samples were collected from 11 different fields in June 2009. Table 3 provides the turf surface age for fields A-D, K. The turf surface age of the other six fields were: E (3 yrs), F (9 yrs), G (4 yrs), H (6 yrs), I (1 yr), and J (1 yr). Bulk samples were collected from 5 locations on each field (see Figure 1). At each location, crumb rubber was placed in a pre-cleaned glass jar, covered with foil and placed in a brown paper bag. Five samples per field were collected and shipped to WOHL (n=55).

![Figure 1. Sampling locations for bulk samples.](image)

**3.3.1 VOC Crumb Rubber Head Space Analysis:** WOHL stored the samples in a refrigerator at 4°C. Bulk samples were analyzed for VOCs by WOHL method WG086.2, a method based on OSHA PV2120 for the analysis of volatile organic compounds (VOCs) in air. The samples were analyzed in a 340 milliliter large volume sample headspace unit (LVSH) as follows: The cleaned LVSH was heated to 70°C overnight and then brought to room temperature in a clean room. A 0.5 gram sample was placed in the LVSH and heated in an oven at 70°C for at least 1 hour. Immediately after the LVSH was removed from the oven, a 100 ml sample volume from the LVHS was cryofocused and injected in a gas chromatograph equipped with a mass selective detector and a RTX-624 capillary column. The following precautions were taken for the bulk crumb rubber VOC analysis: 1) bulk crumb rubber samples were stored in teflon lined screw capped jars and were opened only when removing sample for analysis; 2) the 340mL LVSH were baked at 70°C overnight; and 3) one of the LVSH units was analyzed empty with each analytical run as a method blank, and any VOCs detected above reporting limit noted in the analytical report.

VOC identification was conducted by the National Institute of Standards and Technology Library (NIST) search. Laboratory blanks during analyses were below reporting limits for most compounds. Carbon disulfide, silyls, and siloxane-containing VOCs are common contaminants of the analytical system. Therefore, trace amounts of these VOCs reported may not be components of the samples. Trace levels of carbon disulfide were detected in laboratory blanks. All siloxane-containing VOCs were below reporting limits (<20ppb) in laboratory blanks. Because some of the VOC compounds detected in bulk crumb rubber off gassing experiments are commonly used laboratory solvents, a laboratory background VOC sample was also collected in the walk-in cooler/sample storage area and analyzed. The following VOC compounds were reported in the laboratory background sample: 2-methyl-butane (31ppb), acetone (830ppb), benzene (18ppb), methylene chloride (1030ppb), methyl alcohol (790ppb), and pentane (52ppb).
The head space methodology used by WOHL differed from CAES in several areas. WOHL used smaller amount of crumb rubber (0.5 vs. 1 gram), a larger volume head space unit, and different analytical parameters (e.g. cryogenically concentrates head space injection vs. direct injection technique). Appendix C provides a description of the analytical method used by WOHL.

**Results:** Table 4 provides a list of VOCs identified in crumb rubber samples from the 11 different turf fields. The most commonly found VOCs (range of concentrations in parts per billion-ppbV) include: acetonitrile (60-300ppbV), methylene chloride (20-430ppbV), methyl alcohol (33-270ppbV), and methyl isobutyl ketone (21-150ppbV). Bulk crumb rubber from the newer fields (A, B and D) contained more than ten VOCs. Crumb rubber from other fields contained less than 5 VOCs. Carbon disulfide concentrations were found in the majority of field samples with estimates ranging from 41-141 ppb, and are considered a contaminant of the analytical system and not a turf related VOC. VOCs also found in the laboratory background sample are noted below with the asterisks “c”. Appendix C provides the WOHL analytical laboratory reports of the data.

### Table 4. VOCs identified in bulk crumb rubber head space at 11 fields.

<table>
<thead>
<tr>
<th>Volatile Organic Compounds (VOCs)</th>
<th>Fields A-D, K</th>
<th>Fields E-J</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,1,2-Trichloro-1,2,2-trifluoroethane</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>2-methyl-Butane&lt;sup&gt;c&lt;/sup&gt;</td>
<td>A, B, C</td>
<td></td>
</tr>
<tr>
<td>3-methyl-Pentane</td>
<td>A&lt;sup&gt;a&lt;/sup&gt;, B, D&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Acetone&lt;sup&gt;c&lt;/sup&gt;</td>
<td>A&lt;sup&gt;a&lt;/sup&gt;, B&lt;sup&gt;a&lt;/sup&gt;, D</td>
<td>I&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Acetonitrile</td>
<td>A, B, C, D</td>
<td>E</td>
</tr>
<tr>
<td>Benzene&lt;sup&gt;c&lt;/sup&gt;</td>
<td>A, D</td>
<td></td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Cyclopentane, methyl-</td>
<td>A, B, D</td>
<td></td>
</tr>
<tr>
<td>Ethanol</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Ethyl Benzene</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>Hexane</td>
<td>B, C, D</td>
<td></td>
</tr>
<tr>
<td>Isopropyl Alcohol</td>
<td>A, B</td>
<td></td>
</tr>
<tr>
<td>Methyl Alcohol&lt;sup&gt;c&lt;/sup&gt;</td>
<td>A, B, C, D, K</td>
<td>E</td>
</tr>
<tr>
<td>Methylene Chloride&lt;sup&gt;c&lt;/sup&gt;</td>
<td>A, B, C, D</td>
<td>E, F, G, H, I</td>
</tr>
<tr>
<td>Methyl Isobutyl Ketone</td>
<td>A, B, D</td>
<td>E, G, H, I</td>
</tr>
<tr>
<td>Pentane&lt;sup&gt;c&lt;/sup&gt;</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Styrene</td>
<td>A, B, D</td>
<td></td>
</tr>
<tr>
<td>Toluene</td>
<td>A, B, D</td>
<td></td>
</tr>
</tbody>
</table>

Reporting limit is <10 or 20 ppbV depending on the chemical.

<sup>a</sup>Indicates that the area summed includes an unresolved compound.

<sup>b</sup>Indicates that there is some question as to identity.

<sup>c</sup>Compound was also detected in the laboratory background sample.
3.3.2 Targeted SVOCs Bulk Crumb Rubber Head Space Analysis: In the crumb rubber bulk samples, five targeted SVOCs were analyzed: benzoathiazole, 2-mercaptobenzothiazole, butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), and 4-tert-(octyl)-phenol). Four chemicals, 2-mercaptobenzothiazole, BHA, BHT, and 4-tert-(octyl)-phenol) were added to the list of targeted SVOCs as a result of the findings reported by CAES in 2009. For targeted SVOCs, a Supelco Adsorbent Tube Injector System (ATIS) was utilized to thermally extract the bulk rubber infill samples. The off-gassed SVOCs were loaded onto sampling media and analyzed according to the various analytical methods used in the study. For benzothiazole/4-tert-(octyl)-phenol, the method is based upon National Institute for Occupational Safety and Health (NIOSH) Method Number 2550 (Modified). In summary, SVOCs off gassed from bulk infill material collected on XAD filter air sampling devices were desorbed separately with 10 minutes of sonication performed 3 times with 3mL of methanol each. The combined methanol fractions were evaporated to approximately 0.5mL with nitrogen, and brought to a final volume of 1.0mL with methanol. Extracts were analyzed by reversed phase high-performance liquid chromatography employing a 0.1% formic acid:methanol linear gradient program. Detection was achieved by triple quadrupole mass spectrometry using multiple reaction monitoring (MRM).

SVOCs Bulk Crumb Rubber Results: Table 5 provides a list of SVOCs identified in crumb rubber samples from the 11 different turf field fields. Appendix D provides WOHL laboratory analytical reports.

Table 5. Identification of targeted SVOCs in bulk crumb rubber head space samples collected at 11 fields.

<table>
<thead>
<tr>
<th>Semi-Volatile Organic Compounds (SVOCs)</th>
<th>Study Turf Fields A-K</th>
<th>Additional Turf Fields E -J</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzothiazole</td>
<td>A, B, C, D and K</td>
<td>E, G, J</td>
</tr>
<tr>
<td>2-mercaptobenzothiazole</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>4-tert-(octyl)-phenol</td>
<td>A, B, C, D and K</td>
<td>E, F, G, H, I, J</td>
</tr>
<tr>
<td>Butylated hydroxyanisole (BHA)</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Butylated hydroxytoluene (BHT)</td>
<td>A, K</td>
<td>G</td>
</tr>
<tr>
<td>Nitrosamine</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>
3.3.3 Lead  

**Bulk Sampling Method:** Composite bulk samples of green artificial turf fibers and composite bulk samples of crumb rubber were collected from 5 locations on each field (Figure 1) at study fields only. The bulk samples were placed in zip lock bags. Because lead was detected in the composite bulk sample from Field D, four additional crumb rubber composite bulk samples (two at 20 paces and two at 40 paces) and one additional composite fiber bulk sample were collected from Field D. The bulk samples were analyzed for environmental lead by the ESIS Environmental Health Laboratory (EHL) in Cromwell, Connecticut. The analytical method used by the laboratory was Modified EPA-SW-846-3050/ICP, Modified OSHA ID 125. The sampling and analytical methods are similar to the methods used by New York City Department of Parks and Recreation during their study of 103 crumb rubber fields [14].

**Results:** Table 6 shows that all of the composite samples were below the level EPA considers as presenting a “soil-lead hazard” in play areas (400ppm). This definition, however, applies to residential buildings and to soil rather than other surfaces [15]. Appendix E provides the EHL analytical laboratory reports.

**Table 6. Concentrations of microgram lead/gram material (µg/g) in fibers and crumb rubber at study field fields.**

<table>
<thead>
<tr>
<th>Field</th>
<th>Fiber Concentration (µg/g)</th>
<th>Crumb Rubber Concentration (µg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&lt;60.1</td>
<td>&lt;71.4</td>
</tr>
<tr>
<td>B</td>
<td>&lt;59.0</td>
<td>&lt;68.9</td>
</tr>
<tr>
<td>C</td>
<td>&lt;60.2</td>
<td>&lt;70.4</td>
</tr>
<tr>
<td>D</td>
<td>&lt;59.0</td>
<td>271 (20 paces)</td>
</tr>
<tr>
<td></td>
<td>&lt;76.5</td>
<td>&lt;70.6 (20 paces)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;78.5 (20 paces)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;72.6 (40 paces)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;78.7 (40 paces)</td>
</tr>
<tr>
<td>K</td>
<td>&lt;60.8</td>
<td>&lt;72.1</td>
</tr>
</tbody>
</table>

Limit of Detection: 7.5 µg/sample  
Environmental Protection Agency (EPA) lead level for soil in children’s play areas: 400 ppm (µg/g)
3.4 Air Samples
3.4.1 Volatile Organic Compounds (VOCs)

**Personal Sampling:** Personal air samples for VOCs were collected using evacuated 1.4 L silica-lined SUMMA Canisters with FSL QT MicroValve (Entech Instruments, California). Two study team members each wore a canister at waist-height during each sampling session. Each canister was placed inside a cotton “tool belt” and secured to a coated mesh waist belt with plastic ties. Study team members played soccer on the turf field with 2 other members for 120 minutes. One water/food break (5-10 minutes) was taken by the team members during the play period. At the beginning of each sampling event staff checked each canister’s gauge and confirmed that the pressure was at the level noted in the laboratory’s SOP. At the end of each sampling event, staff confirmed that the pressure gauge had reached “0”. The majority of samples collected air for at least 60 minutes or greater. Two samples collected air for less than 25 minutes (collected at indoor field, Field K). Samples were sent to the WSLH laboratory (Madison, WI) by overnight mail on the day they were collected. Ten samples were collected, two from each turf field field (Fields A, B, C, D, and K). All of the 1.4L cans were pressure checked upon return to the lab and prior to analysis. No data were flagged to indicate problems.

Newly purchased items, such as apron belt, coated mesh belt, and plastic twist ties were used to hold the sampling equipment in place during personal sampling. Because several VOCs, such as acrolein, were present in personal samples and not in any area samples, a request was made to WOHL to analyze these extra items to determine if they released any VOC emissions. Therefore, seven months after sampling, a cloth apron, plastic twist tie, sampling pump, segment of the coated mesh waist belt and the belt buckle were analyzed for VOCs in the head space unit. This sampling was done because these items were in close contact to the sampling inlet of the 1.4L canisters that team members wore.

**Area Sampling:** Area air samples for VOCs were collected using evacuated 6 liter (L) silica-lined SUMMA Canisters with Nupro Valve (Entech Instruments, California). Canisters were placed at 6 inches and at 3 feet above the turf in an area away from active play of study team members (AFAP) during each sampling session. Another canister was placed upwind of the turf field on grass at 3 feet above the ground. At Field L (grass field), the canister was placed at 3 feet. At the beginning of each sampling event staff checked each canister’s gauge and confirmed that the pressure was at the level noted in the laboratory’s SOP. At the end of each sampling event, staff confirmed that the pressure gauge had reached “0”. The majority of samples collected air for at least 60 minutes or greater. One sample collected air for less than 20 minutes (collected at outdoor background, Field K). Samples were sent to the WSLH (Madison, WI) by overnight mail on the day they were collected. In total, sixteen samples were collected from the various fields. Samples were collected from the following fields: A (n=3), B (n=3), C (n=3), D (n=3), K (n=3) and L (n=1). The lab confirmed if the canister valve was closed and tight upon arrival. One 6 L canister valve was open upon arrival, and the sample was not analyzed (collected at Field A, 6 inches above the turf).

**Sample Preparation and Analysis:** All canisters (1.4L and 6L) were calibrated with a mass flow controller to collect air samples for up to 120 minutes by the ESS Organics WSHL. A modified version of Compendium EPA Method TO-15 by GC/MS was used to measure ambient-level concentrations for 60 VOC analytes. Briefly, this method incorporates a multi-stage concentration process using an Entech 7100A Preconcentrator. This removes carbon dioxide, nitrogen, and water with a series of traps. The sample (500ml) is injected on a glass bead trap at a temperature of -150°C. The trap is then heated to 10°C and purged gently with helium to transfer the VOCs and the carbon dioxide to a second trap. The second trap, which contains Tenax(tm), is then cooled to 10°C, allowing the carbon dioxide to pass through the trap while retaining the VOCs. The second trap is heated and back-flushed with helium, sending the sample to the focusing trap, which is cooled to -160°C. The focusing trap is then rapidly heated to 60°C and the sample is injected onto the Rxi-lm s (Restek U.S., 110 Benner Circle, Bellefonte, PA 16823), 60m capillary column and finally the mass spec detector. VOC concentrations were reported in ppbV and microgram per cubic meter (μg/m^3).

Each analytical run included one method blank per batch of samples. If an analyte in the method blank was greater than its limit of detection (LOD), the result for that analyte was flagged to indicate blank contamination. One set of samples contained acetone in the blank sample, and concentrations were corrected (samples collected at Field B). Duplicate analysis was performed on one sample per analytical batch. Duplicate analyses were always within 25% for each compound. Daily quality control checks were
performed using a second source standard. Analytes in the quality control/QC check standard were always within 30% of the corresponding calibration standards.

Results: The EPA Method TO-15 is designed to scan for 60 VOCs, and the results provide a list of VOCs that are detected at least once on field or background locations. WSHL analytical laboratory reports for all 60 VOCs (in ppbV) in air per field are summarized in Appendix F. Tables 7-10 summarize the VOC concentrations in μg/m³ at Fields A-D, all outdoor turf fields. Table 11 shows the VOC concentrations from Field K (an indoor field), and Table 12 presents data for Field L (the non-turf grass background suburban site). Table 13 provides an additional list of VOCs in the personal, on-turf, and background samples that were tentatively identified through the use of the National Institute of Standards and Technology (NIST) library. VOC concentrations are shown in bold for each VOC analyte if concentrations were two times higher than the background concentration. Total Volatile Organic Compound (TVOC) value is the sum of the all the concentrations that were detectable, and is not an approximate concentration based on toluene response. The airborne VOC concentrations reported at Field C should be reviewed with caution (Table 9). During the first ten minutes of sampling at Field C, a pesticide mixture was applied to the grass field adjacent to the synthetic turf field. Study coordinator asked the applicator to stop the application. Unfortunately, air sampling had already begun in the background location near the grass field when the application occurred. Three different pesticides (Merit 75 WSP Insecticide, Drive 75 DF Herbicide, and Cross Check Insecticide) were applied to the perimeter of the field with a Perma Green Ride-on Spreader.

Special Sampling Equipment Head Space Results: WOHL’s VOC head space analyses of the plastic ties, cloth apron bag, mesh waist belt and buckle are summarized in Appendix G. The cloth apron contained detectable levels of acetaldehyde, propanal, hexanal, nonanal, and octanal and trace levels of acrolein. The mesh belt contained acetaldehyde, 2-butenal, pentanal, hexanal, heptanal, and nonanal and trace levels of acrolein. A peak with NIST mass spectral library match for acrolein was detected in the cloth apron and mesh belt sample. These peaks were below the reporting limit of 20ppb and additional mass spectral peaks were present, including possible co-eluting compounds. Detectable levels of nonanal, decanal, and octanal were found in the plastic ties.
Table 7. Volatile Organic Compound (VOC) Concentrations in $\mu$g/m$^3$ at Field A  
(personal and on-turf concentrations 2X higher than background are in bold)

<table>
<thead>
<tr>
<th>Compound Name</th>
<th>Personal</th>
<th>Personal</th>
<th>On Turf 3</th>
<th>Background</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AFAP 3 ft</td>
<td>3 ft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,1,2,2-Tetrachloroethane</td>
<td>&lt;0.68</td>
<td>&lt;0.68</td>
<td>&lt;0.68</td>
<td>1.02</td>
</tr>
<tr>
<td>1,2,4-Trichlorobenzene</td>
<td>&lt;0.74</td>
<td>&lt;0.74</td>
<td>&lt;0.74</td>
<td>0.89</td>
</tr>
<tr>
<td>Acetone</td>
<td>52.17</td>
<td>33.20</td>
<td>12.33</td>
<td>12.33</td>
</tr>
<tr>
<td>Acrolein</td>
<td>1.95</td>
<td>1.40</td>
<td>&lt;1.15</td>
<td>&lt;1.15</td>
</tr>
<tr>
<td>Benzene</td>
<td>&lt;0.32</td>
<td>&lt;0.32</td>
<td>&lt;0.32</td>
<td>0.41</td>
</tr>
<tr>
<td>Bromoform</td>
<td>&lt;1.02</td>
<td>2.35</td>
<td>&lt;1.02</td>
<td>1.02</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>&lt;0.62</td>
<td>&lt;0.62</td>
<td>&lt;0.62</td>
<td>0.93</td>
</tr>
<tr>
<td>Chloromethane</td>
<td>1.57</td>
<td>1.55</td>
<td>1.45</td>
<td>1.33</td>
</tr>
<tr>
<td>Dichlorodifluoromethane</td>
<td>2.42</td>
<td>2.47</td>
<td>2.28</td>
<td>2.23</td>
</tr>
<tr>
<td>Ethyl Acetate</td>
<td>1.37</td>
<td>1.76</td>
<td>&lt;0.36</td>
<td>0.61</td>
</tr>
<tr>
<td>Halocarbon 11</td>
<td>1.85</td>
<td>1.79</td>
<td>1.74</td>
<td>1.96</td>
</tr>
<tr>
<td>Hexane</td>
<td>24.61</td>
<td>8.79</td>
<td>&lt;0.35</td>
<td>3.30</td>
</tr>
<tr>
<td>Methyl Ethyl Ketone</td>
<td>2.94</td>
<td>2.53</td>
<td>1.35</td>
<td>1.74</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>&lt;0.34</td>
<td>&lt;0.34</td>
<td>&lt;0.34</td>
<td>0.69</td>
</tr>
<tr>
<td>Propene</td>
<td>&lt;0.17</td>
<td>0.38</td>
<td>&lt;0.17</td>
<td>&lt;0.17</td>
</tr>
<tr>
<td>Toluene</td>
<td>1.58</td>
<td>1.92</td>
<td>&lt;0.38</td>
<td>0.75</td>
</tr>
<tr>
<td>Vinyl Acetate</td>
<td>1.23</td>
<td>1.13</td>
<td>&lt;0.35</td>
<td>1.02</td>
</tr>
<tr>
<td>Total VOCs</td>
<td>91.69</td>
<td>59.27</td>
<td>19.15</td>
<td>29.21</td>
</tr>
</tbody>
</table>

A tentative ID match for four compounds was made using the NIST Library in personal samples. No tentative ID matches were found in other areas. See Table 13.

AFAP= away from active play of study team members.

Total VOCs is the sum of all the concentrations that were detectable (does not include values less than reporting limit).
### Table 8. Volatile Organic Compound (VOC) Concentrations in μg/m³ at Field B.  
(personal and on-turf concentrations 2X higher than background are in bold)

<table>
<thead>
<tr>
<th>VOC Concentration (μg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Compound Name</strong></td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>1,2,4-Trimethyl Benzene</td>
</tr>
<tr>
<td>1,2-Dichloropropane</td>
</tr>
<tr>
<td>1,3,5-Trimethyl Benzene</td>
</tr>
<tr>
<td>1-Ethyl-4-Methyl Benzene</td>
</tr>
<tr>
<td>Acetone*</td>
</tr>
<tr>
<td>Acrolein</td>
</tr>
<tr>
<td>Benzene</td>
</tr>
<tr>
<td>Carbon Disulfide</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
</tr>
<tr>
<td>Chlorobenzene</td>
</tr>
<tr>
<td>Chloromethane</td>
</tr>
<tr>
<td>Cyclohexane</td>
</tr>
<tr>
<td>Dichlorodifluoromethane</td>
</tr>
<tr>
<td>Ethyl Acetate</td>
</tr>
<tr>
<td>Ethylbenzene</td>
</tr>
<tr>
<td>Halocarbon 11</td>
</tr>
<tr>
<td>Heptane</td>
</tr>
<tr>
<td>Hexane</td>
</tr>
<tr>
<td>M/P-Xylene</td>
</tr>
<tr>
<td>Methyl Ethyl Ketone</td>
</tr>
<tr>
<td>Methyl Isobutyl Ketone</td>
</tr>
<tr>
<td>Methylene Chloride</td>
</tr>
<tr>
<td>O-Xylene</td>
</tr>
<tr>
<td>Propene</td>
</tr>
<tr>
<td>Styrene</td>
</tr>
<tr>
<td>Tetrachloroethylene</td>
</tr>
<tr>
<td>Tetrahydrofuran</td>
</tr>
<tr>
<td>Toluene</td>
</tr>
<tr>
<td>Trichloroethylene</td>
</tr>
<tr>
<td><strong>Total VOCs</strong></td>
</tr>
</tbody>
</table>

A tentative ID match for 16 compounds was made using the NIST Library in personal samples. See Table 12. There was one tentative ID match in a background sample. See Table 13.  
AFAP= away from active play of study team members.  
*Acetone was detected in lab blank (1.5ppb) and all concentrations were corrected.  
Total VOCs is the sum of all the concentrations that were detectable (does not include values less than reporting limit).
Table 9. Volatile Organic Compound (VOC) Concentrations in $\mu g/m^3$ at Field C.  
(personal and on-turf concentrations 2X higher than background are in bold)

<table>
<thead>
<tr>
<th>Compound Name</th>
<th>Personal</th>
<th>Personal</th>
<th>On Turf 6 inch AFAP</th>
<th>On Turf 3 ft AFAP</th>
<th>Background 3 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,1,2,2-Tetrachloroethane</td>
<td>&lt;0.68</td>
<td>&lt;0.68</td>
<td>&lt;0.68</td>
<td>&lt;0.68</td>
<td>1.09</td>
</tr>
<tr>
<td>1,1,2-Trichlorotrifluorethane</td>
<td>&lt;0.78</td>
<td>&lt;0.78</td>
<td>&lt;0.78</td>
<td>0.76</td>
<td>1.99</td>
</tr>
<tr>
<td>1,1-Dichloroethane</td>
<td>&lt;0.40</td>
<td>&lt;0.40</td>
<td>&lt;0.40</td>
<td>&lt;0.40</td>
<td>0.80</td>
</tr>
<tr>
<td>1,1-Dichloroethene</td>
<td>&lt;0.40</td>
<td>&lt;0.40</td>
<td>&lt;0.40</td>
<td>&lt;0.40</td>
<td>0.63</td>
</tr>
<tr>
<td>1,2-Dibromoethane</td>
<td>&lt;0.80</td>
<td>&lt;0.80</td>
<td>&lt;0.80</td>
<td>&lt;0.80</td>
<td>1.84</td>
</tr>
<tr>
<td>1,3- Butadiene</td>
<td>&lt;0.22</td>
<td>&lt;0.22</td>
<td>&lt;0.22</td>
<td>&lt;0.22</td>
<td>0.38</td>
</tr>
<tr>
<td>1,2-Dichlorobenzene</td>
<td>&lt;0.60</td>
<td>&lt;0.60</td>
<td>&lt;0.60</td>
<td>&lt;0.60</td>
<td>1.37</td>
</tr>
<tr>
<td>1,3-Dichlorobenzene</td>
<td>&lt;0.60</td>
<td>&lt;0.60</td>
<td>&lt;0.60</td>
<td>&lt;0.60</td>
<td>1.13</td>
</tr>
<tr>
<td>1,4-Dichlobenzene</td>
<td>&lt;0.60</td>
<td>&lt;0.60</td>
<td>&lt;0.60</td>
<td>&lt;0.60</td>
<td>1.37</td>
</tr>
<tr>
<td>Acetone</td>
<td>30.83</td>
<td>26.08</td>
<td>23.71</td>
<td>10.67</td>
<td>11.14</td>
</tr>
<tr>
<td>Benzene</td>
<td>0.61</td>
<td>0.57</td>
<td>0.54</td>
<td>0.54</td>
<td>0.92</td>
</tr>
<tr>
<td>Bromoform</td>
<td>1.94</td>
<td>&lt;1.02</td>
<td>&lt;1.02</td>
<td>&lt;1.02</td>
<td>1.74</td>
</tr>
<tr>
<td>Bromomethane</td>
<td>&lt;0.38</td>
<td>&lt;0.38</td>
<td>&lt;0.38</td>
<td>&lt;0.38</td>
<td>0.69</td>
</tr>
<tr>
<td>Carbon Disulfide</td>
<td>&lt;0.31</td>
<td>0.50</td>
<td>&lt;0.31</td>
<td>&lt;0.31</td>
<td>0.62</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>0.68</td>
<td>&lt;0.62</td>
<td>0.87</td>
<td>0.93</td>
<td>1.43</td>
</tr>
<tr>
<td>Chlorobenzene</td>
<td>&lt;0.49</td>
<td>&lt;0.49</td>
<td>&lt;0.49</td>
<td>&lt;0.49</td>
<td>1.10</td>
</tr>
<tr>
<td>Chloroethane</td>
<td>&lt;0.26</td>
<td>&lt;0.26</td>
<td>&lt;0.26</td>
<td>&lt;0.26</td>
<td>0.55</td>
</tr>
<tr>
<td>Chloromethane</td>
<td>0.70</td>
<td>0.63</td>
<td>1.00</td>
<td>1.06</td>
<td>1.02</td>
</tr>
<tr>
<td>Cis-1,3-Dichloropropene</td>
<td>&lt;0.45</td>
<td>&lt;0.45</td>
<td>&lt;0.45</td>
<td>&lt;0.45</td>
<td>0.99</td>
</tr>
<tr>
<td>Cyclohexane</td>
<td>0.62</td>
<td>&lt;0.34</td>
<td>&lt;0.34</td>
<td>&lt;0.34</td>
<td>&lt;0.34</td>
</tr>
<tr>
<td>Dibromochloromethane</td>
<td>&lt;0.84</td>
<td>&lt;0.84</td>
<td>&lt;0.84</td>
<td>&lt;0.84</td>
<td>1.85</td>
</tr>
<tr>
<td>Dichlorodifluoromethane</td>
<td>1.43</td>
<td>1.19</td>
<td>2.23</td>
<td>2.42</td>
<td>2.33</td>
</tr>
<tr>
<td>Ethyl Acetate</td>
<td>&lt;0.36</td>
<td>0.61</td>
<td>&lt;0.36</td>
<td>&lt;0.36</td>
<td>&lt;0.36</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>1.21</td>
</tr>
<tr>
<td>Halocarbon 11</td>
<td>1.01</td>
<td>0.84</td>
<td>1.51</td>
<td>1.62</td>
<td>2.46</td>
</tr>
<tr>
<td>Heptane</td>
<td>0.49</td>
<td>&lt;0.41</td>
<td>&lt;0.41</td>
<td>&lt;0.41</td>
<td>&lt;0.41</td>
</tr>
<tr>
<td>Hexane</td>
<td>3.48</td>
<td>0.63</td>
<td>0.87</td>
<td>0.49</td>
<td>1.02</td>
</tr>
<tr>
<td>Methyl Ethyl Ketone</td>
<td>2.06</td>
<td>1.83</td>
<td>1.62</td>
<td>2.03</td>
<td>1.53</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>1.20</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>0.76</td>
</tr>
<tr>
<td>M/P-Xylene</td>
<td>1.56</td>
<td>&lt;0.66</td>
<td>&lt;0.66</td>
<td>&lt;0.66</td>
<td>1.78</td>
</tr>
<tr>
<td>n-Xylene</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>0.91</td>
</tr>
<tr>
<td>Propene</td>
<td>0.34</td>
<td>0.24</td>
<td>0.17</td>
<td>0.17</td>
<td>&lt;0.17</td>
</tr>
<tr>
<td>Styrene</td>
<td>&lt;0.42</td>
<td>&lt;0.42</td>
<td>&lt;0.42</td>
<td>&lt;0.42</td>
<td>0.94</td>
</tr>
<tr>
<td>Tetrachloroethylene</td>
<td>&lt;0.67</td>
<td>&lt;0.67</td>
<td>&lt;0.67</td>
<td>&lt;0.67</td>
<td>1.27</td>
</tr>
<tr>
<td>Toluene</td>
<td>4.89</td>
<td>1.77</td>
<td>1.13</td>
<td>1.13</td>
<td>1.54</td>
</tr>
<tr>
<td>Trans-1,2-Dichloroethylene</td>
<td>&lt;0.39</td>
<td>&lt;0.39</td>
<td>&lt;0.39</td>
<td>&lt;0.39</td>
<td>0.82</td>
</tr>
<tr>
<td>Vinyl Chloride</td>
<td>&lt;0.25</td>
<td>&lt;0.25</td>
<td>&lt;0.25</td>
<td>&lt;0.25</td>
<td>0.48</td>
</tr>
<tr>
<td>Total VOCs</td>
<td>51.84</td>
<td>34.89</td>
<td>33.48</td>
<td>21.66</td>
<td>48.43</td>
</tr>
</tbody>
</table>

A tentative ID match for 5 compounds was made using the NIST Library in personal samples. No tentative ID matches for compounds were found in other areas. See Table 13.
AFAP= away from active play of study team members.
*Total VOCs is the sum of all the concentrations that were detectable (does not include values less than reporting limit).
Table 10. Volatile Organic Compound (VOC) Concentrations in μg/m³ at Field D.
(personal and on-turf concentrations 2X higher than background are in bold)

<table>
<thead>
<tr>
<th>Compound Name</th>
<th>Personal</th>
<th>Personal</th>
<th>On Turf 6 inch AFAP</th>
<th>On Turf 3 ft AFAP</th>
<th>Background 3 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,2,4-Trimethyl Benzene</td>
<td>1.37</td>
<td>&lt;0.49</td>
<td>&lt;0.49</td>
<td>&lt;0.49</td>
<td>&lt;0.49</td>
</tr>
<tr>
<td>Acetone</td>
<td>28.45</td>
<td>23.71</td>
<td>5.69</td>
<td>6.64</td>
<td>7.35</td>
</tr>
<tr>
<td>Bromoform</td>
<td>1.02</td>
<td>13.29</td>
<td>1.02</td>
<td>1.02</td>
<td>1.02</td>
</tr>
<tr>
<td>Chloromethane</td>
<td>0.98</td>
<td>1.06</td>
<td>1.10</td>
<td>1.08</td>
<td>1.06</td>
</tr>
<tr>
<td>Dichlorodifluoromethane</td>
<td>2.23</td>
<td>2.33</td>
<td>2.42</td>
<td>2.47</td>
<td>2.47</td>
</tr>
<tr>
<td>Ethyl Acetate</td>
<td>1.15</td>
<td>1.22</td>
<td>&lt;0.36</td>
<td>&lt;0.36</td>
<td>&lt;0.36</td>
</tr>
<tr>
<td>Halocarbon 11</td>
<td>1.40</td>
<td>1.40</td>
<td>1.40</td>
<td>1.46</td>
<td>1.46</td>
</tr>
<tr>
<td>Heptane</td>
<td>0.65</td>
<td>0.70</td>
<td>&lt;0.41</td>
<td>&lt;0.41</td>
<td>&lt;0.41</td>
</tr>
<tr>
<td>Hexane</td>
<td>0.77</td>
<td>0.77</td>
<td>&lt;0.35</td>
<td>&lt;0.35</td>
<td>&lt;0.35</td>
</tr>
<tr>
<td>Methyl Ethyl Ketone</td>
<td>1.59</td>
<td>1.44</td>
<td>1.09</td>
<td>1.12</td>
<td>1.06</td>
</tr>
<tr>
<td>Methyl Isobutyl Ketone</td>
<td>2.66</td>
<td>2.29</td>
<td>&lt;2.04</td>
<td>&lt;2.04</td>
<td>&lt;2.04</td>
</tr>
<tr>
<td>Propene</td>
<td>0.48</td>
<td>0.50</td>
<td>&lt;0.17</td>
<td>&lt;0.17</td>
<td>&lt;0.17</td>
</tr>
<tr>
<td>Toluene</td>
<td>1.39</td>
<td>1.47</td>
<td>0.71</td>
<td>&lt;0.38</td>
<td>&lt;0.38</td>
</tr>
<tr>
<td>Total VOCs*</td>
<td>44.14</td>
<td>50.18</td>
<td>13.43</td>
<td>13.79</td>
<td>15.47</td>
</tr>
</tbody>
</table>

A tentative ID match for 6 compounds was made using the NIST Library in personal samples. There were tentative ID matches 3 feet above the turf and in the background area. See Table 13.

AFAP= away from active play of study team members.

*Total VOCs is the sum of all the concentrations that were detectable (does not include values less than reporting limit).
Table 11. Volatile Organic Compound (VOC) Concentrations in μg/m³ at Field K. (personal and on-turf concentrations 2X higher than background are in bold)

<table>
<thead>
<tr>
<th>Compound Name</th>
<th>Personal</th>
<th>Personal</th>
<th>On Turf 6 inch AFAP</th>
<th>On Turf 3 ft AFAP</th>
<th>Background 3 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,1,2-Trichlorotrifluoroethane</td>
<td>0.54</td>
<td>0.54</td>
<td>0.54</td>
<td>0.54</td>
<td>1.53</td>
</tr>
<tr>
<td>1,1,2-Trichloroethane</td>
<td>0.54</td>
<td>0.54</td>
<td>0.54</td>
<td>0.54</td>
<td>0.76</td>
</tr>
<tr>
<td>1,2-Dichloropropane</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>0.45</td>
<td>0.69</td>
</tr>
<tr>
<td>1,2,4-Trimethyl Benzene</td>
<td>1.28</td>
<td>2.11</td>
<td>0.49</td>
<td>0.49</td>
<td>&lt;0.49</td>
</tr>
<tr>
<td>1,2-Dichloroethane</td>
<td>1.04</td>
<td>&lt;0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>0.68</td>
</tr>
<tr>
<td>1,3,5-Trimethyl Benzene</td>
<td>&lt;0.49</td>
<td>1.18</td>
<td>0.49</td>
<td>0.49</td>
<td>&lt;0.49</td>
</tr>
<tr>
<td>1-Ethyl-4-Methyl Benzene</td>
<td>&lt;0.49</td>
<td>1.37</td>
<td>0.49</td>
<td>0.49</td>
<td>&lt;0.49</td>
</tr>
<tr>
<td>Acetone</td>
<td>92.48</td>
<td>&lt;1.19</td>
<td>17.01</td>
<td>12.33</td>
<td>9.25</td>
</tr>
<tr>
<td>Acrolein</td>
<td>3.66</td>
<td>3.89</td>
<td>&lt;1.15</td>
<td>1.15</td>
<td>&lt;1.15</td>
</tr>
<tr>
<td>Benzene</td>
<td>1.15</td>
<td>1.18</td>
<td>&lt;0.32</td>
<td>&lt;0.32</td>
<td>0.64</td>
</tr>
<tr>
<td>Bromodichloromethane</td>
<td>0.62</td>
<td>&lt;0.62</td>
<td>&lt;0.66</td>
<td>0.66</td>
<td>&lt;0.66</td>
</tr>
<tr>
<td>Bromoform</td>
<td>34.75</td>
<td>&lt;1.02</td>
<td>&lt;1.02</td>
<td>&lt;1.02</td>
<td>&lt;1.02</td>
</tr>
<tr>
<td>Carbon Disulfide</td>
<td>0.87</td>
<td>0.84</td>
<td>0.90</td>
<td>0.90</td>
<td>&lt;0.31</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>&lt;0.62</td>
<td>&lt;0.62</td>
<td>&lt;0.62</td>
<td>&lt;0.62</td>
<td>1.30</td>
</tr>
<tr>
<td>Chloroform</td>
<td>&lt;0.48</td>
<td>&lt;0.48</td>
<td>&lt;0.48</td>
<td>0.48</td>
<td>0.68</td>
</tr>
<tr>
<td>Chloromethane</td>
<td>1.57</td>
<td>1.45</td>
<td>1.17</td>
<td>1.23</td>
<td>1.21</td>
</tr>
<tr>
<td>Cyclohexane</td>
<td>10.30</td>
<td>7.21</td>
<td>0.82</td>
<td>0.82</td>
<td>&lt;0.34</td>
</tr>
<tr>
<td>Dichlorodifluoromethane</td>
<td>3.02</td>
<td>2.87</td>
<td>2.77</td>
<td>2.87</td>
<td>2.72</td>
</tr>
<tr>
<td>Ethyl Acetate</td>
<td>10.07</td>
<td>11.87</td>
<td>&lt;0.36</td>
<td>&lt;0.36</td>
<td>&lt;0.36</td>
</tr>
<tr>
<td>Ethylbenzene</td>
<td>4.77</td>
<td>4.77</td>
<td>1.00</td>
<td>1.04</td>
<td>&lt;0.43</td>
</tr>
<tr>
<td>Halocarbon 11</td>
<td>2.07</td>
<td>1.96</td>
<td>1.90</td>
<td>2.02</td>
<td>2.41</td>
</tr>
<tr>
<td>Heptane</td>
<td>10.22</td>
<td>7.36</td>
<td>0.98</td>
<td>0.98</td>
<td>0.53</td>
</tr>
<tr>
<td>Hexane</td>
<td>11.25</td>
<td>10.90</td>
<td>7.38</td>
<td>7.38</td>
<td>9.4</td>
</tr>
<tr>
<td>M/P-Xylene</td>
<td>12.13</td>
<td>11.70</td>
<td>2.17</td>
<td>2.17</td>
<td>&lt;0.87</td>
</tr>
<tr>
<td>Methyl Ethyl Ketone</td>
<td>44.15</td>
<td>44.15</td>
<td>2.09</td>
<td>2.00</td>
<td>1.83</td>
</tr>
<tr>
<td>Methyl Isobutyl Ketone</td>
<td>20.44</td>
<td>22.08</td>
<td>35.98</td>
<td>35.98</td>
<td>&lt;0.29</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>10.30</td>
<td>9.96</td>
<td>1.10</td>
<td>1.17</td>
<td>1.10</td>
</tr>
<tr>
<td>O-Xylene</td>
<td>3.42</td>
<td>4.03</td>
<td>0.87</td>
<td>0.91</td>
<td>&lt;0.43</td>
</tr>
<tr>
<td>Propene</td>
<td>0.76</td>
<td>0.72</td>
<td>&lt;0.17</td>
<td>&lt;0.17</td>
<td>&lt;0.17</td>
</tr>
<tr>
<td>Styrene</td>
<td>1.45</td>
<td>3.53</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
<td>&lt;0.43</td>
</tr>
<tr>
<td>Tetrachloroethylene</td>
<td>1.34</td>
<td>1.14</td>
<td>&lt;0.67</td>
<td>&lt;0.67</td>
<td>0.94</td>
</tr>
<tr>
<td>Tetrahydrofuran</td>
<td>3.53</td>
<td>3.24</td>
<td>&lt;1.42</td>
<td>&lt;1.42</td>
<td>&lt;1.47</td>
</tr>
<tr>
<td>Toluene</td>
<td>135.4</td>
<td>127.88</td>
<td>2.78</td>
<td>2.82</td>
<td>1.09</td>
</tr>
<tr>
<td>Trichloroethylene</td>
<td>2.23</td>
<td>2.13</td>
<td>&lt;0.53</td>
<td>&lt;0.53</td>
<td>&lt;0.53</td>
</tr>
<tr>
<td>Vinyl Acetate</td>
<td>&lt;0.35</td>
<td>2.95</td>
<td>&lt;0.35</td>
<td>&lt;0.35</td>
<td>&lt;0.35</td>
</tr>
<tr>
<td>Total VOCs</td>
<td>424.27</td>
<td>292.47</td>
<td>78.92</td>
<td>71.80</td>
<td>36.76</td>
</tr>
</tbody>
</table>

A tentative ID match for 10 compounds was made using the NIST Library in personal samples. There were tentative ID matches for 5 compounds on turf and no matches were found in the background area. See Table 13.

*Concentration is an estimate. The value is above the upper calibration range.
AFAP = away from active play of study team members.
Total VOCs is the sum of all the concentrations that were detectable (does not include values less than reporting limit).
### Table 12. Volatile Organic Compounds (VOC) Concentrations in μg/m³ at Field L.

<table>
<thead>
<tr>
<th>Compound Name</th>
<th>VOC Concentration (μg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 ft</td>
</tr>
<tr>
<td>Acetone</td>
<td>7.11</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>0.75</td>
</tr>
<tr>
<td>Chloromethane</td>
<td>1.19</td>
</tr>
<tr>
<td>Dichlorodifluoromethane</td>
<td>2.28</td>
</tr>
<tr>
<td>Halocarbon 11</td>
<td>1.46</td>
</tr>
<tr>
<td>Hexane</td>
<td>7.38</td>
</tr>
<tr>
<td>Methyl Ethyl Ketone</td>
<td>1.41</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>0.48</td>
</tr>
<tr>
<td>Propene</td>
<td>0.48</td>
</tr>
<tr>
<td>Toluene</td>
<td>0.90</td>
</tr>
<tr>
<td>Total VOCs</td>
<td>23.44</td>
</tr>
</tbody>
</table>

No tentative ID matches for additional compounds were found using the NIST Library.

*Total VOCs is the sum of all the concentrations that were detectable (does not include values less than reporting limit).

### Table 13. Tentative identification of VOCs in personal, on-turf and background areas matched with the NIST Library at all fields (A-D, K-L).

<table>
<thead>
<tr>
<th>Chemicals</th>
<th>Fields Personal</th>
<th>Fields On-Turf</th>
<th>Fields (height of sample)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Bromo-propane</td>
<td>B, K</td>
<td></td>
<td>K (3')</td>
</tr>
<tr>
<td>1-Chloro-1,1-Difluoroethane</td>
<td>K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,1-Difluorethane</td>
<td>B</td>
<td>B (6&quot; and 3')</td>
<td>B (3')</td>
</tr>
<tr>
<td>1,2-diethylbenzene</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-Methyl Butane</td>
<td>B, K</td>
<td>D, K (3')</td>
<td></td>
</tr>
<tr>
<td>2-Methyl Pentane</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-Methyl Hexane</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-Methyl Pentane</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,3-Pentadiene</td>
<td>A, K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1R-Alpha-Pinene</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acetaldehyde</td>
<td>A, B, C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acetonitrile</td>
<td>B, K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beta-Pinene</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Butane</td>
<td></td>
<td>K (6&quot; and 3')</td>
<td></td>
</tr>
<tr>
<td>D-Limonen</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethanol</td>
<td>K</td>
<td></td>
<td>K (6&quot;)</td>
</tr>
<tr>
<td>Ethyl Alcohol</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluorobenzene</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hexanal</td>
<td>B, K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isobutane</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isobutene</td>
<td>K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isopropyl Alcohol</td>
<td>A, B, C, D, K</td>
<td></td>
<td>K (6&quot; and 3')</td>
</tr>
<tr>
<td>Methyl-Cyclopentane</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonanal</td>
<td>C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Octamethyl – Cyclotetrasiloxane</td>
<td>D</td>
<td>D (3')</td>
<td></td>
</tr>
<tr>
<td>Octanal</td>
<td>A, B, C</td>
<td></td>
<td>K (6&quot; and 3')</td>
</tr>
<tr>
<td>Pentane</td>
<td>B, C, K</td>
<td></td>
<td>K (6&quot; and 3')</td>
</tr>
</tbody>
</table>
3.4.2 Semi-Volatile Organic Compounds (SVOCs)

An SVOC is any organic compound having a vapor pressure of 1 mmHg or less at standard conditions (293 K and 760 mmHg). Three categories of SVOCs were included in this investigation: 1) polyaromatic hydrocarbons (PAHs), 2) miscellaneous SVOCs associated with air pollution such as alkanoid acids (sources include road dust), hopanes/steranes (sources include diesel and gasoline vehicles), and other general compounds such as branched/n-alkanes \[16\] and 3) five targeted rubber-related SVOCs: benzothiazole, 2-mercaptobenzothiazole, 4-tert-(octyl-phenol, butylated hydroxanisole (BHA), and butylated hydroxytoluene (BHT).

**PAHs and Miscellaneous SVOCs Area Sampling:** PAHs and miscellaneous SVOCs associated with air pollution were collected with Polyurethane Foam Samplers (PS-1, Anderson Instruments, Inc., GA) according to EPA Method TO-13A. Air samples were collected for two hours at flow rates ranging from 207-237 liters per minute (lpm). At Field D, additional air sampling was conducted for 6 hours at flow rates ranging from 209-226 lpm. Samplers were placed on the turf near the middle of each field and in a location upwind and off the turf field (background). All of the samples were collected at a height of approximately 4 feet. The same sampler was used for each designated location (background or on-turf) at all fields. Several extension cords (100-150ft) were used to supply power to samplers from buildings near the sampling fields. The motor of each sampler was exhausted downwind and away from sampling equipment with a 15 foot flexible duct.

Sampler magnehelic gauges were calibrated for each sampling event using a calibrated critical orifice as a transfer standard. The orifices were connected to a slack tube manometer in the UCHC office in Farmington, CT. Manometer and magnehelic gauge readings were recorded, and flow rates were compared to the WOHL calibrations measurements recorded in the WOHL laboratory. Measurements were within ±10% of one another. Calibration flow verifications were performed after use to ensure that the calculated magnehelic set point was accurate. Prior to each sampling event, sampling heads and samplers were cleaned with hexane.

Sampling heads were loaded with cylindrical glass PUF (polyurethane foam)/XAD-2 cartridge (PUF Plug Part #20038, Supelco, Bellefonte, PA) and filter (Whatman Quartz Microfiber Filters, 102 mm, NJ) in UCHC office. After loading, each head was placed in a ziplock bag, then placed in a travel bag, and transported to the field. In the field, samplers were turned on for five minutes. Leak checks were conducted on site prior to sampling. Sampling heads were placed in the PS-1 samplers and magnehelic gauge measurements were recorded on site at the beginning and end of sampling. Magnehelic gauge measurements were the same at the beginning and end of sampling at all fields. Sampling heads were transported to UCHC on ice. Media was processed out of the sampling heads and placed in glass jars at UCHC. All samples were shipped to WOHL/WSLH on ice on the same day as sampling.

During 2 hour sampling at Field D on July 14, 2009, the PS-1 Sampler was turned on for approximately ten minutes without the valve open (sample 217-background). Site coordinator corrected the problem, checked for air leaks, re-tightened seals, and re-checked for air leaks. During the 6-hour sampling session on July 28 at Field D, power was lost for approximately ten minutes (sample 221-background). The site coordinator reported the power problem, and facilities corrected it.

A total of 12 field samples were collected. The first set of samples collected from Field L (community) broke during shipment to WOHL/WSLH. Shipping procedures were modified to place the glass cartridges in foam and extra wrapping. Unfortunately, glass PUF/XAD cartridges broke during transportation of the media to UCHC and insufficient sampling media was available to collect samples from Fields B and C (upwind background location only). It was not possible to reschedule these sampling events to collect more data. Ten field samples were analyzed.

**Sample Preparation and Analysis:** Samples were prepared and analyzed according to EPA Method TO-13 by WSLH. All samples had all internal standards spiked pre-extraction. A rotovap was used in place of a K-D concentrator. Other parameters include: inlet temp 300 C, flow 1.0 ml/min, and average velocity 37cm/sec. Initial oven temperature 65C hold for 10 min, ramp up at 10 C/min until 300 C, then hold at 300 C for 26.50 minutes. Although laboratory spike recoveries of benzothiazole were acceptable on the PUF/XAD media, low levels of benzothiazole were observed in the high volume field samples in comparison to the personal sampler benzothiazole method. Since collection efficiency is unknown for benzothiazole on high volume sampler media, the high volume sampler results were determined to be non-reportable.
If an analyte in the method blank was greater than its reporting limit, the result for that analyte was flagged to indicate blank contamination. Concentrations were corrected for any blank contamination. Extraction of most chemicals was complete ranging from 75 to 125% as specified by the EPA Method TO-13A. Final concentrations were adjusted by extraction recoveries for analytes below 75% (Appendix H). Concentrations with recoveries exceeding 125% are not adjusted.

**Results:** Tables 1-6 in Appendix I provide the SVOC concentrations for Fields A-D and K. Final SVOC concentrations are reported as nanogram per cubic meter (ng/m³). Analytes not detected are reported as nondetectable (ND). Target analytes positively detected but too far below the reporting limit are reported as DNQ. Values for analyte concentrations confirmed but measured below the reporting limit are reported with the footnote “a”. Values for analyte concentrations corrected by extraction recoveries are reported with the footnote “b”.

**SVOCs Six Hour vs. Two Hour Sampling Method:** Our sampling strategy included a 2 hour sampling time because it represents a typical activity period for athletes using turf fields. At Field D, an extra day of sampling was conducted for 6 hours using EPA Method TO-13A to increase the sensitivity (Tables 3 and 4 in Appendix I). The results suggest that the 2 hour sampling time period allowed for the collection of useful data. During both the 2 and 6 hour sampling periods, similar patterns were observed—nearly half of the SVOCs were either not detected or they were found in greater concentrations on turf than in background locations. Although additional PAHs were detected on turf during the 6 hour sampling (e.g. benz(a)anthracene, benzo(b)fluoranthene, benzo(e)pyrene, benzo(GHI)perylene, benzo(k)fluoroanthene), their concentrations on turf were similar to background concentrations. Eight miscellaneous SVOCs were not detected during the 2 hour sampling but were reported with two fold greater concentrations on the turf than in background during the 6 hour sampling period (e.g. decycloclohexane, dodecane, dotriacontane, octacosane, pristine, tetracontane, triacontane, tritriacontane).
Polyaromatic Hydrocarbons
The EPA Method TO-13A includes qualitative and quantitative analyses for certain categories of compounds, such as PAHs. The concentrations of PAHs are provided in Tables 14-16. Because PAHs may be found in crumb rubber made from tires, the following 22 were targeted:

Acenaphthene
Acenaphthylene
Anthracene
Benz(a)anthracene
Benzo(a)pyrene
Benzo(e)pyrene
Benzo(GHI)perylene
Benzo(b)fluoranthene
Chrysene
Coronene
Dibenz(a,h)anthracene
Dibenz(a,h)anthracene

Table 14. PAH concentrations in ng/m³ at Fields A-C (ng/m³).
(on-turf concentrations 2X higher than background are in bold for field A only)

<table>
<thead>
<tr>
<th>PAHs</th>
<th>Field A On Turf</th>
<th>Field A Background</th>
<th>Field B On Turf</th>
<th>Field C On Turf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acenaphthene</td>
<td>2.14</td>
<td>2.95</td>
<td>2.74 b</td>
<td>3.46 b</td>
</tr>
<tr>
<td>Benz(a)anthracene</td>
<td>ND</td>
<td>&lt;0.36</td>
<td>ND</td>
<td>0.11 a</td>
</tr>
<tr>
<td>Benzo(a)pyrene</td>
<td>ND</td>
<td>&lt;0.20</td>
<td>ND</td>
<td>0.16 a</td>
</tr>
<tr>
<td>Benzo(e)pyrene</td>
<td>ND</td>
<td>&lt;0.21</td>
<td>ND</td>
<td>0.12 a</td>
</tr>
<tr>
<td>Benzo(GHI)fluoranthene</td>
<td>ND</td>
<td>&lt;0.35</td>
<td>ND</td>
<td>0.08 d</td>
</tr>
<tr>
<td>Benzo(k)fluoranthene</td>
<td>0.14 a</td>
<td>ND</td>
<td>0.05 a</td>
<td>0.07 a</td>
</tr>
<tr>
<td>Chrysene</td>
<td>ND</td>
<td>&lt;0.32</td>
<td>ND</td>
<td>0.04 a</td>
</tr>
<tr>
<td>Fluoranthene</td>
<td>1.68</td>
<td>1.474</td>
<td>2.83</td>
<td>1.70</td>
</tr>
<tr>
<td>Fluorene</td>
<td>2.21 b</td>
<td>2.87 b</td>
<td>4.10 b</td>
<td>2.62 b</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>5.99</td>
<td>7.72</td>
<td>6.17</td>
<td>12.51</td>
</tr>
<tr>
<td>Phenanthrene</td>
<td>5.07</td>
<td>6.35</td>
<td>10.46</td>
<td>7.27</td>
</tr>
<tr>
<td>Pyrene</td>
<td>1.70</td>
<td>1.01</td>
<td>2.66</td>
<td>0.97</td>
</tr>
<tr>
<td>1-Methylnaphthalene</td>
<td>3.96 b</td>
<td>6.34 b</td>
<td>3.72 b</td>
<td>5.67 b</td>
</tr>
<tr>
<td>2,6-Dimethylnaphthalene</td>
<td>2.83</td>
<td>4.47</td>
<td>ND</td>
<td>&lt;0.91</td>
</tr>
</tbody>
</table>

Abbreviations: ND = analytes not detected. DNQ = analytes positively detected but too far below the reporting limit.

a Values for analyte concentrations confirmed but measured below the reporting limit.
b Values for analyte concentrations corrected by extraction recoveries. See Appendix F.
### Table 15. PAH concentrations in ng/m³ at Field D (2 and 6 hour sampling).

(On-turf concentrations 2X higher than background are in bold)

<table>
<thead>
<tr>
<th>PAHs</th>
<th>Field D On Turf (2 hour)</th>
<th>Field D Background (2 hour)</th>
<th>Field D On Turf (6 hour)</th>
<th>Field D Background (6 hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acenaphthene</td>
<td>3.38 (b)</td>
<td>2.95 (b)</td>
<td>2.79 (b)</td>
<td>2.47 (b)</td>
</tr>
<tr>
<td>Acenaphthylene</td>
<td>6.60 (d)</td>
<td>ND &lt; 3.74</td>
<td>ND &lt; 1.25</td>
<td>0.77</td>
</tr>
<tr>
<td>Anthracene</td>
<td>ND &lt; 0.22</td>
<td>ND &lt; 0.22</td>
<td>ND &lt; 0.07</td>
<td>0.02 (a)</td>
</tr>
<tr>
<td>Benz(a)anthracene</td>
<td>ND &lt; 0.42</td>
<td>ND &lt; 0.42</td>
<td>0.04 (a)</td>
<td>0.03</td>
</tr>
<tr>
<td>Benzo(a)pyrene</td>
<td>ND &lt; 0.23</td>
<td>ND &lt; 0.23</td>
<td>0.07 (a)</td>
<td>0.05 (a)</td>
</tr>
<tr>
<td>Benzo(b)fluoranthene</td>
<td>ND &lt; 0.75</td>
<td>ND &lt; 0.76</td>
<td>0.07 (a)</td>
<td>0.07 (a)</td>
</tr>
<tr>
<td>Benzo(e)pyrene</td>
<td>ND &lt; 0.24</td>
<td>ND &lt; 0.25</td>
<td>0.07 (a)</td>
<td>0.06 (a)</td>
</tr>
<tr>
<td>Benzo(GHI)fluoranthene</td>
<td>DNQ</td>
<td>ND &lt; 0.41</td>
<td>0.02 (a)</td>
<td>ND &lt; 0.13</td>
</tr>
<tr>
<td>Benzo(GHI)perylene</td>
<td>ND &lt; 0.67</td>
<td>ND &lt; 0.69</td>
<td>0.04 (a)</td>
<td>0.06 (a)</td>
</tr>
<tr>
<td>Benzo(k)fluoranthene</td>
<td>ND &lt; 0.37</td>
<td>ND &lt; 0.38</td>
<td>0.05 (a)</td>
<td>0.04 (a)</td>
</tr>
<tr>
<td>Chrysene</td>
<td>0.30</td>
<td>0.07 (b)</td>
<td>0.12</td>
<td>0.08 (a)</td>
</tr>
<tr>
<td>Fluoranthene</td>
<td>6.76</td>
<td>1.19</td>
<td>2.26</td>
<td>3.96</td>
</tr>
<tr>
<td>Fluorene</td>
<td>3.65 (b)</td>
<td>3.59 (b)</td>
<td>2.93 (b)</td>
<td>2.43 (b)</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>6.32</td>
<td>4.51</td>
<td>14.57</td>
<td>16.94</td>
</tr>
<tr>
<td>Phenanthrene</td>
<td>14.34</td>
<td>6.11</td>
<td>11.48</td>
<td>13.05</td>
</tr>
<tr>
<td>Pyrene</td>
<td>6.92</td>
<td>0.47</td>
<td>2.42</td>
<td>3.16</td>
</tr>
<tr>
<td>1-Methylnaphthalene</td>
<td>9.31 (b)</td>
<td>4.08 (b)</td>
<td>8.31 (b)</td>
<td>6.91 (b)</td>
</tr>
<tr>
<td>2-Methylnaphthalene</td>
<td>4.237 (b)</td>
<td>2.16 (b)</td>
<td>3.76 (b)</td>
<td>3.31 (b)</td>
</tr>
<tr>
<td>2,6-Dimethylnaphthalene</td>
<td>ND &lt; 0.95</td>
<td>ND &lt; 0.97</td>
<td>7.65</td>
<td>6.13</td>
</tr>
</tbody>
</table>

Abbreviations: ND = analytes not detected. DNQ = analytes positively detected but too far below the reporting limit. 

\(a\) Values for analyte concentrations confirmed but measured below the reporting limit.

\(b\) Values for analyte concentrations corrected by extraction recoveries. See Appendix F.

### Table 16. PAH concentrations in ng/m³ at Field K.

(On-turf concentrations 2X higher than background are in bold)

<table>
<thead>
<tr>
<th>PAHs</th>
<th>Field K On Turf</th>
<th>Field K Background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acenaphthene</td>
<td>17.37 (b)</td>
<td>3.99 (a)</td>
</tr>
<tr>
<td>Acenaphthylene</td>
<td>6.79</td>
<td>ND &lt; 3.20</td>
</tr>
<tr>
<td>Chrysene</td>
<td>ND &lt; 0.26</td>
<td>0.04 (a)</td>
</tr>
<tr>
<td>Fluoranthene</td>
<td>5.55</td>
<td>0.58</td>
</tr>
<tr>
<td>Fluorene</td>
<td>53.70 (b)</td>
<td>3.42 (b)</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>112.99</td>
<td>7.05</td>
</tr>
<tr>
<td>Phenanthrene</td>
<td>32.26</td>
<td>7.56</td>
</tr>
<tr>
<td>Pyrene</td>
<td>11.84</td>
<td>0.37</td>
</tr>
<tr>
<td>1-Methylnaphthalene</td>
<td>114.20 (b)</td>
<td>6.16 (b)</td>
</tr>
<tr>
<td>2,6-Dimethylnaphthalene</td>
<td>28.70</td>
<td>10.37</td>
</tr>
<tr>
<td>2-Methylnaphthalene</td>
<td>63.38 (b)</td>
<td>2.72 (b)</td>
</tr>
</tbody>
</table>

Abbreviations: ND = analytes not detected.

\(a\) Values for analyte concentrations confirmed but measured below the reporting limit.

\(b\) Values for analyte concentrations corrected by extraction recoveries. See Appendix F.

*Not in calibration standard mix but is quantitated.
3.4.2.3 Targeted Rubber-Related SVOCs

Air Sampling: Personal and area air samples were collected for the following five rubber-related SVOCs: benzothiazole, 2-mercaptobenzothiazole, 4-tert-(octyl-phenol, butylated hydroxanisole (BHA), and butylated hydroxytoluene (BHT). Air samples for these compounds were collected using sampling pumps fit with XAD-2 adsorbent media and 37mm, 2 micron PTFE pre filters. The pumps were pre and post calibrated for approximately 2 liters per minute (LPM). The samples were collected for two hours.

At Fields A-D and K, the personal samples were collected by placing the pumps at waist-height on two study team members involved in active play. Two area samples were collected at 6 inches and 3 feet above the ground at the following locations: on the field near active play (NAP), on the field away from active play (AFAP), and at the upwind background location. At Field L, an area sample was collected at 3 feet. At Field D during the six hour sampling event, two on field air samples were collected (6 inches and 3 feet). The two sampling pumps failed during the six hour sampling event. The data were considered unreliable and are not reported. A field blank was submitted for each field. Field spike samples were also submitted for Fields A, B, D (6 hr), and K. A total of 58 samples were collected including 7 field blanks and 6 field spikes.

Sample Analysis: All samples were analyzed by WOHL using NIOSH Method 2550 (modified). Bulk material or samples collected on XAD-2 (vapor) and/or PTFE pre-filter (particulate) filter air sampling devices were desorbed with 10 minutes of sonication performed with methanol. Desorption volumes were 2mL methanol for the particulate portion and 1mL methanol for vapor portion of each sample. Extracts were analyzed by reversed phase high-performance liquid chromatography employing a 0.1% formic acid:methanol linear gradient program. Detection was achieved by triple quadrupole mass spectrometry using multiple reaction monitoring (MRM). Quality control samples also included laboratory reagent blanks, laboratory method blanks, and laboratory control spikes. Calibration check standards were also analyzed after every 10 samples analyzed.

Results: Concentrations are reported in ng/m³. Benzothiazole and 2-mercaptopbenzothiazole recoveries were incomplete (below 75%). The field spike recovery for benzathiozole (vapor phase) was also incomplete (mean recovery = 72%). Therefore, results reported were corrected for incomplete recoveries. 4-tert-(octyl-phenol, Butylated hydroxanisole (BHA), and Butylated hydroxytoluene (BHT) recoveries were also adjusted when spike recoveries observed were below 75%. In cases where background signal was observed in reagent and/or method blanks, the reporting limit was raised to account for this. The reporting limit chosen for each analyte also represents the lowest calibration standard that resulted in acceptable back calculated recovery (within +/- 25% of theoretical value). Appendix I provides the WOHL analytical laboratory reports.

Tables 17-22 in Appendix I provide the results of the targeted rubber-related SVOCs.
### Table 17. Targeted Rubber-Related SVOC concentrations in ng/m³ at Field A.
(On turf concentrations higher than two times background are in bold)

<table>
<thead>
<tr>
<th>SVOCs</th>
<th>P1</th>
<th>P2</th>
<th>6” on field</th>
<th>3’ on field</th>
<th>6” on field</th>
<th>3’ on field</th>
<th>6” background</th>
<th>3’ background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzothiazole</td>
<td>&lt;81</td>
<td>130</td>
<td>160</td>
<td>240</td>
<td>230</td>
<td>&lt;81</td>
<td>&lt;84</td>
<td>&lt;82</td>
</tr>
<tr>
<td>2-mercapto benzothiazole</td>
<td>&lt;81</td>
<td>&lt;81</td>
<td>&lt;83</td>
<td>&lt;84</td>
<td>&lt;82</td>
<td>&lt;81</td>
<td>&lt;84</td>
<td>&lt;82</td>
</tr>
<tr>
<td>4-tert-octyl</td>
<td>&lt;40</td>
<td>&lt;40</td>
<td>&lt;41</td>
<td>&lt;42</td>
<td>22</td>
<td>&lt;41</td>
<td>&lt;42</td>
<td>26</td>
</tr>
<tr>
<td>BHA</td>
<td>&lt;40</td>
<td>&lt;40</td>
<td>&lt;41</td>
<td>&lt;42</td>
<td>&lt;41</td>
<td>&lt;42</td>
<td>&lt;41</td>
<td>&lt;41</td>
</tr>
<tr>
<td>BHT</td>
<td>&lt;81</td>
<td>&lt;81</td>
<td>&lt;83</td>
<td>&lt;84</td>
<td>86</td>
<td>&lt;81</td>
<td>150</td>
<td>&lt;82</td>
</tr>
</tbody>
</table>

Abbreviations: NAP = near active play; AFAP = away from active play

### Table 18. Targeted Rubber-Related SVOC concentrations in ng/m³ at Field B.
(On turf concentrations higher than two times background are in bold)

<table>
<thead>
<tr>
<th>SVOCs</th>
<th>P1</th>
<th>P2</th>
<th>6” on field</th>
<th>3’ on field</th>
<th>6” on field</th>
<th>3’ on field</th>
<th>6” background</th>
<th>3’ background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzothiazole</td>
<td>&lt;80</td>
<td>&lt;83</td>
<td>210</td>
<td>210</td>
<td>180</td>
<td>&lt;85</td>
<td>&lt;85</td>
<td>&lt;84</td>
</tr>
<tr>
<td>2-mercapto benzothiazole</td>
<td>&lt;80</td>
<td>&lt;83</td>
<td>&lt;80</td>
<td>&lt;85</td>
<td>&lt;85</td>
<td>&lt;85</td>
<td>&lt;85</td>
<td>&lt;84</td>
</tr>
<tr>
<td>4-tert-octyl</td>
<td>&lt;40</td>
<td>&lt;41</td>
<td>&lt;40</td>
<td>&lt;43</td>
<td>&lt;42</td>
<td>&lt;42</td>
<td>&lt;43</td>
<td>&lt;42</td>
</tr>
<tr>
<td>BHA</td>
<td>&lt;40</td>
<td>&lt;41</td>
<td>&lt;40</td>
<td>&lt;43</td>
<td>&lt;42</td>
<td>&lt;42</td>
<td>&lt;43</td>
<td>&lt;42</td>
</tr>
<tr>
<td>BHT</td>
<td>&lt;80</td>
<td>&lt;83</td>
<td>&lt;80</td>
<td>&lt;85</td>
<td>&lt;85</td>
<td>&lt;85</td>
<td>&lt;85</td>
<td>&lt;84</td>
</tr>
</tbody>
</table>

Abbreviations: NAP = near active play; AFAP = away from active play

### Table 19. Targeted Rubber-Related SVOC concentrations in ng/m³ at Field C.
(On turf concentrations higher than two times background are in bold)

<table>
<thead>
<tr>
<th>SVOCs</th>
<th>P1</th>
<th>P2</th>
<th>6” on field</th>
<th>3’ on field</th>
<th>6” on field</th>
<th>3’ on field</th>
<th>6” background</th>
<th>3’ background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzothiazole</td>
<td>&lt;82</td>
<td>&lt;81</td>
<td>220</td>
<td>&lt;74</td>
<td>220</td>
<td>&lt;82</td>
<td>&lt;81</td>
<td>&lt;80</td>
</tr>
<tr>
<td>2-mercapto benzothiazole</td>
<td>&lt;82</td>
<td>&lt;81</td>
<td>&lt;73</td>
<td>&lt;74</td>
<td>&lt;82</td>
<td>&lt;82</td>
<td>&lt;81</td>
<td>&lt;80</td>
</tr>
<tr>
<td>4-tert-octyl</td>
<td>&lt;41</td>
<td>&lt;41</td>
<td>&lt;36</td>
<td>&lt;37</td>
<td>&lt;41</td>
<td>&lt;41</td>
<td>&lt;40</td>
<td>&lt;40</td>
</tr>
<tr>
<td>BHA</td>
<td>&lt;41</td>
<td>&lt;41</td>
<td>&lt;36</td>
<td>&lt;37</td>
<td>&lt;41</td>
<td>&lt;41</td>
<td>&lt;40</td>
<td>&lt;40</td>
</tr>
<tr>
<td>BHT</td>
<td>&lt;82</td>
<td>&lt;81</td>
<td>&lt;73</td>
<td>&lt;74</td>
<td>&lt;82</td>
<td>&lt;82</td>
<td>&lt;81</td>
<td>&lt;80</td>
</tr>
</tbody>
</table>

Abbreviations: NAP = near active play; AFAP = away from active play
Table 20. Targeted Rubber-Related SVOC concentrations in ng/m³ at Field D.
(on turf concentrations higher than two times background are in bold)

<table>
<thead>
<tr>
<th>SVOCs</th>
<th>P1</th>
<th>P2</th>
<th>6” on field NAP</th>
<th>3’ on field NAP</th>
<th>6” on field AFAP</th>
<th>3’ on field AFAP</th>
<th>6” background</th>
<th>3’ back ground</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzothiazole</td>
<td>240</td>
<td>&lt;82</td>
<td>610</td>
<td>210</td>
<td>1200</td>
<td>280</td>
<td>700</td>
<td>&lt;77</td>
</tr>
<tr>
<td>2-mercapto</td>
<td>&lt;81</td>
<td>&lt;82</td>
<td>&lt;78</td>
<td>&lt;80</td>
<td>&lt;82</td>
<td>&lt;84</td>
<td>&lt;79</td>
<td>&lt;77</td>
</tr>
<tr>
<td>benzothiazole</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-tert-octyl</td>
<td>&lt;40</td>
<td>&lt;41</td>
<td>&lt;39</td>
<td>&lt;40</td>
<td>&lt;41</td>
<td>&lt;42</td>
<td>&lt;40</td>
<td>&lt;38</td>
</tr>
<tr>
<td>BHA</td>
<td>&lt;40</td>
<td>&lt;41</td>
<td>&lt;39</td>
<td>&lt;40</td>
<td>&lt;41</td>
<td>&lt;42</td>
<td>&lt;40</td>
<td>&lt;38</td>
</tr>
<tr>
<td>BHT</td>
<td>&lt;81</td>
<td>97</td>
<td>160</td>
<td>130</td>
<td>&lt;82</td>
<td>&lt;84</td>
<td>&lt;79</td>
<td>&lt;77</td>
</tr>
</tbody>
</table>

Abbreviations: NAP=near active play; AFAP=away from active play

Table 21. Targeted Rubber-Related SVOC concentrations in ng/m³ at Field K.
(on turf concentrations higher than two times background are in bold)

<table>
<thead>
<tr>
<th>SVOCs</th>
<th>P1</th>
<th>P2</th>
<th>6” on field NAP</th>
<th>3’ on field NAP</th>
<th>6” on field AFAP</th>
<th>3’ on field AFAP</th>
<th>6” background</th>
<th>3’ back ground</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzothiazole</td>
<td>11000</td>
<td>13000</td>
<td>14000</td>
<td>12000</td>
<td>11000</td>
<td>12000</td>
<td>&lt;82</td>
<td>&lt;82</td>
</tr>
<tr>
<td>2-mercapto</td>
<td>&lt;82</td>
<td>&lt;86</td>
<td>&lt;81</td>
<td>&lt;83</td>
<td>&lt;82</td>
<td>&lt;82</td>
<td>&lt;82</td>
<td>&lt;82</td>
</tr>
<tr>
<td>benzothiazole</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-tert-octyl</td>
<td>&lt;41</td>
<td>&lt;43</td>
<td>&lt;41</td>
<td>&lt;42</td>
<td>&lt;41</td>
<td>&lt;41</td>
<td>&lt;41</td>
<td>&lt;41</td>
</tr>
<tr>
<td>BHA</td>
<td>&lt;41</td>
<td>&lt;43</td>
<td>&lt;41</td>
<td>&lt;42</td>
<td>&lt;41</td>
<td>&lt;41</td>
<td>&lt;41</td>
<td>&lt;41</td>
</tr>
<tr>
<td>BHT</td>
<td>1300</td>
<td>1800</td>
<td>2100</td>
<td>3900</td>
<td>2100</td>
<td>1900</td>
<td>88</td>
<td>&lt;82</td>
</tr>
</tbody>
</table>

Abbreviations: NAP=near active play; AFAP=away from active play

Table 22. SVOC concentrations in ng/m³ at Field L.

<table>
<thead>
<tr>
<th>SVOCs</th>
<th>3’ on grass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzothiazole</td>
<td>&lt;83</td>
</tr>
<tr>
<td>2-mercapto</td>
<td>&lt;83</td>
</tr>
<tr>
<td>benzothiazole</td>
<td>&lt;83</td>
</tr>
<tr>
<td>4-tert-octyl</td>
<td>&lt;42</td>
</tr>
<tr>
<td>BHA</td>
<td>&lt;42</td>
</tr>
<tr>
<td>BHT</td>
<td>280</td>
</tr>
</tbody>
</table>
3.4.3 Nitrosamines

Air Sampling: Personal and air samples for Nitrosamine were collected using sampling pumps fit with Thermosorb/N™ tubes. The pumps were pre and post calibrated at approximately 2 liters per minute. The samples were collected for two hours.

At fields A-D and K, the personal samples were collected by placing the pumps at waist-height on two study team members involved in active play. Two area samples were collected on the fields away from active (AFAP) at 6 inches and 3 feet above the ground, and two area samples were collected at the upwind background location at 6 inches and 3 feet above the ground. At Field L, one area sample was collected at 3 feet. At Field D during the six hour sampling event, two on field area samples (6 inches and 3 feet) were collected. A field blank was collected at each field. A total of 40 samples were collected including 7 field blanks. Upon arrival to WOHL, one field sample had a cracked inlet.

Analysis: All samples were analyzed by WOHL using NIOSH 2522 for the following nitrosamines: N-nitrosodimethylamine (NDMA), N-nitrosomorpholine (NMOR), N-nitrosopyrrolidine (NPYR), N-nitrosodiethylamine (NDEA), N-nitrosopiperdine (NPIP), N-nitrosodipropylamine (NDPA), and N-nitrosodibutylamine (NDBA). Nitrosamines were not found in the field blanks.

Results: Table 23 provides the results of the nitrosamine sampling. Concentrations are reported in µg/m³. All concentrations were below the reporting limits. Appendix J provides the WOHL analytical laboratory reports for nitrosamine sampling.
Table 23. Nitrosamine concentrations in µg/m³ at each field (A-D, K-L)

<table>
<thead>
<tr>
<th>Field</th>
<th>Location</th>
<th>Nitrosamine µg/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6” on field AFAP</td>
<td>&lt;0.41</td>
</tr>
<tr>
<td>A</td>
<td>3’ on field AFAP</td>
<td>&lt;0.32</td>
</tr>
<tr>
<td>A</td>
<td>6” background</td>
<td>&lt;0.42</td>
</tr>
<tr>
<td>A</td>
<td>3’ background</td>
<td>&lt;0.41</td>
</tr>
<tr>
<td>A</td>
<td>Personal</td>
<td>&lt;0.42</td>
</tr>
<tr>
<td>A</td>
<td>Personal</td>
<td>&lt;0.41</td>
</tr>
<tr>
<td>B</td>
<td>6” on field AFAP</td>
<td>&lt;0.34</td>
</tr>
<tr>
<td>B</td>
<td>3’ on field AFAP</td>
<td>&lt;0.41</td>
</tr>
<tr>
<td>B</td>
<td>6” background</td>
<td>&lt;0.35</td>
</tr>
<tr>
<td>B</td>
<td>3’ background</td>
<td>&lt;0.43</td>
</tr>
<tr>
<td>B</td>
<td>Personal</td>
<td>&lt;0.39</td>
</tr>
<tr>
<td>B</td>
<td>Personal</td>
<td>&lt;0.41</td>
</tr>
<tr>
<td>C</td>
<td>6” on field AFAP</td>
<td>&lt;0.41</td>
</tr>
<tr>
<td>C</td>
<td>3’ on field AFAP</td>
<td>&lt;0.34</td>
</tr>
<tr>
<td>C</td>
<td>6” background</td>
<td>&lt;0.39</td>
</tr>
<tr>
<td>C</td>
<td>3’ background</td>
<td>&lt;0.32</td>
</tr>
<tr>
<td>C</td>
<td>Personal</td>
<td>&lt;0.38</td>
</tr>
<tr>
<td>C</td>
<td>Personal</td>
<td>&lt;0.38</td>
</tr>
<tr>
<td>D</td>
<td>6” on field AFAP</td>
<td>&lt;0.42</td>
</tr>
<tr>
<td>D</td>
<td>3’ on field AFAP</td>
<td>&lt;0.42</td>
</tr>
<tr>
<td>D</td>
<td>6” background</td>
<td>&lt;0.38</td>
</tr>
<tr>
<td>D</td>
<td>3’ background</td>
<td>&lt;0.35</td>
</tr>
<tr>
<td>D</td>
<td>Personal</td>
<td>&lt;0.39</td>
</tr>
<tr>
<td>D</td>
<td>Personal</td>
<td>&lt;0.40</td>
</tr>
<tr>
<td>D-6hr</td>
<td>6” on field AFAP</td>
<td>&lt;0.14</td>
</tr>
<tr>
<td>D-6hr</td>
<td>3’ on field AFAP</td>
<td>&lt;0.14</td>
</tr>
<tr>
<td>K</td>
<td>6’’ on field AFAP</td>
<td>&lt;0.40</td>
</tr>
<tr>
<td>K</td>
<td>3’ on field AFAP</td>
<td>&lt;0.39</td>
</tr>
<tr>
<td>K</td>
<td>6” background</td>
<td>&lt;0.31</td>
</tr>
<tr>
<td>K</td>
<td>3’ background</td>
<td>&lt;0.34</td>
</tr>
<tr>
<td>K</td>
<td>Personal</td>
<td>&lt;0.39</td>
</tr>
<tr>
<td>K</td>
<td>Personal</td>
<td>&lt;0.41</td>
</tr>
<tr>
<td>L</td>
<td>3’</td>
<td>&lt;0.25*</td>
</tr>
</tbody>
</table>

Abbreviations: AFAP=away from active play.

* The sampler had a cracked inlet upon arrival to WOHL.
3.4.3 Air Particulate Matter (PM$_{10}$)

**Air Sampling:** Area Air samples for particulate matter (PM$_{10}$) were collected using the Harvard Impactor (MS&T Area Sampler, Air Diagnostics and Engineering, Harrison, ME, USA). Samples were collected onto 37 mm Teflon filters (2.0 um) at a flow rate of 20 Liters/minute (Pump Model SP-280, Air Diagnostics and Engineering Inc., Harrison, ME; S/N 30637 and 30565). Two samples were collected at 3 feet above the ground per field: on turf near the middle of the field and upwind off-turf (background). Field blanks were collected and analyzed at every sampled field. Extension cords were connected to electrical outlets in external buildings to provide power to the sampling pumps. The airflow rate was measured with a rotameter (AALBORG, Orangeburg, NY, S/N 227-202-4) before and after sampling with a representative sample medium according to HSPH Type Impactor SOP Protocol (6-26-00-Air Diagnostics and Engineering, Harrison, ME, USA). Flow rates after sampling were within ± 5% of the initial flow rate at each sampling field.

Twelve field samples and six field blanks were collected (two field samples and one blank per field). Filters were shipped to the WOHL laboratory on the same day as sampling on ice and frozen upon receipt until weight analysis.

**Analysis:** Samples were weighed according to CFR Title 40 Part 50 (Appendix L) before and after sampling to determine PM$_{10}$ concentration. Tare (before sampling) and post sampling weights were measured three times on a Mettler Toledo Model MX5 Balance (weighs to 0.001mg). These measurements were averaged, and the difference between the average tare and post sampling concentrations were used to calculate PM$_{10}$ concentration as micrograms per cubic meter of air (μg/m$^3$). Final PM$_{10}$ concentrations for field samples were corrected by field blanks (samples at fields C and K were corrected).

**Results:** Table 24 provides the PM$_{10}$ concentrations for all fields. PM$_{10}$ concentrations were greater in background locations than on the turf at all fields with the exception of Field B. However, the concentration on turf at Field B, 5.89 μg/m$^3$, was within the range of background concentrations (4.96-17.79 μg/m$^3$). The protocol for sampling at Field A was not followed properly and, therefore, data is not available.

<table>
<thead>
<tr>
<th>Field ID</th>
<th>Location Type</th>
<th>Pm$_{10}$ Concentration (μg/m$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Outdoor</td>
<td>---$^a$</td>
</tr>
<tr>
<td>B</td>
<td>Outdoor</td>
<td>5.89</td>
</tr>
<tr>
<td>C</td>
<td>Outdoor</td>
<td>16.54$^b$</td>
</tr>
<tr>
<td>D</td>
<td>Outdoor</td>
<td>4.52</td>
</tr>
<tr>
<td>L</td>
<td>Outdoor</td>
<td>NA$^c$</td>
</tr>
<tr>
<td></td>
<td>(non-turf site)</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>Indoor</td>
<td>7.22</td>
</tr>
</tbody>
</table>

$^a$ Sampling protocol was not followed during sampling.

$^b$ Pesticide application occurred adjacent to field during sampling day (~10 minutes)

$^c$ NA is non applicable because sampling occurred in an suburban grass field (non-turf).

**Air Particulate Matter (PM$_{10}$) Characterization**

Following gravimetric analysis, samples were stored at room temperature until particulate characterization analyses. Six samples were selected for Microscopic Particle Identification and characterization by Polarized Light Microscopy (WP001.20 Analysis), Scanning Electron Microscopy, and Energy Dispersive X-Ray (EDXA) analyses. These samples were collected from Fields B, D, K (on turf) and L (suburban grass). Appendix K provides the WOHL analytical laboratory reports for PM$_{10}$. Other samples were not analyzed as planned because rubber fragments were not easily detected and identification of particles were inconclusive.
4.0 Summary Findings
This report identifies and measures chemicals across several synthetic crumb rubber turf fields and
background locations. The measurements collected from background locations are necessary to better
understand the data because many of these chemicals are present in ambient air as a result of air pollution.

The following algorithm was used to identify a possible turf-related VOC, targeted SVOC or nitrosamine:
Chemicals found in: A) either 6” or 3’ samples; or B) in both personal and either 6” or 3’ samples, greater
than two times the background concentration measured near the field, were considered to have originated
from the turf. The attribution of a chemical to the turf was considered stronger if the chemical was also
found in at least one field’s crumb rubber head space.

For PAHs and general SVOC’s the following algorithm was used to identify a possible turf related chemical:
Chemicals found in turf air samples but: A) not in background air samples or B) at twice the field’s
background concentration, were considered to have originated from the turf. Attribution of a chemical to an
origin in the turf was considered stronger if this finding held on at least two fields.

4.1 Crumb Rubber Infill Bulk VOCs
The most commonly found VOCs (range of concentrations in parts per billion-ppbV) detected in crumb
rubber infill include: acetonitrile (60-300ppbV), methylene chloride (dichloromethane) (20-430ppbV), methyl
alcohol (33-270ppbV), and methyl isobutyl ketone (21-150ppbV). Bulk crumb rubber from the newer fields
(A, B and D) contained more than ten VOCs. Crumb rubber from other fields contained less than 5 VOCs.

Bulk crumb rubber can act as a sink for organic compounds in the environment. Some VOCs, such as
methylene chloride, methyl alcohol and acetone, were also found in a laboratory blank where the crumb
rubber field samples were processed for the head space analysis. Presence of a VOC in the head space of
the bulk crumb rubber infill as well as in air samples at two times greater than background levels is
considered more suggestive that crumb rubber infill is the source of the VOC.

4.2 Air VOCs-Possibly Turf-Related
Of the 60 VOCs tested, 4 VOCs appear to be associated with turf. The concentration of methyl isobutyl
ketone (35.98 μg/m³) was the highest VOC detected in area samples collected on the turf (Field K).
Acetone was the second highest VOC found in area samples on the turf, and it was also found in the air of
the background location at lower concentration. Inter-player variability of total VOC air concentrations was
notable on fields B (28.99 vs. 240.51 μg/m³) and K (292.47 vs. 424.27 μg/m³). The highest air
concentrations on the turf for most VOCs were found at Field K.

Table 25 summarizes one possible algorithm for determining which VOCs may be related to crumb rubber
emissions. Chemicals meeting these criteria are bolded, and most frequently found in Field K, the indoor
facility, and not in the outdoor fields. Chemicals found in personal samples (at two times greater
concentrations than background) but not in 6” or 3’ or any bulk crumb rubber head space sample are
unlikely to be turf related.

The belts and aprons that held the personal samplers in place during simulated soccer play emit a number
of chemicals. Trace levels of acrolein were detected seven months later in mesh belt and cloth apron.
Other sources of VOCs, such as sweat or the players’ use of personal care products (e.g. sunscreen,
deoarant, etc.) may be contributing to the VOC levels found in the personal results; however, it is difficult
to determine this. In the future, personal samples should also be collected on grass (non-turf) field in order
to better interpret the data.
Table 25. VOC exposure assessment- screening algorithm for chemicals’ relationship to crumb rubber emissions.

<table>
<thead>
<tr>
<th>Screen for each field</th>
<th>Chemical Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Either 6” or 3’ two times &gt; background for this field Chemical in this field’s crumb rubber head space</td>
<td>Toluene D</td>
</tr>
<tr>
<td>Either 6” or 3’ two times &gt; background for this field Chemical not in field’s crumb rubber head space but in at least one other field’s crumb rubber head space</td>
<td>Acetone[^c] C, Ethyl Benzene K, Methyl Isobutyl Ketone K, Toluene K</td>
</tr>
<tr>
<td>Either 6” or 3’ two times &gt; background for this field Chemical is not in any field’s crumb rubber head space</td>
<td>Carbon Disulfide K, Cyclohexane B, K, M/P-Xylene K, O-Xylene K</td>
</tr>
<tr>
<td>Personal two times &gt; background for this field Chemical is two times background in 6” or 3’ sample Chemical is in this field’s crumb rubber head space</td>
<td>Toluene D</td>
</tr>
<tr>
<td>Personal two times &gt; background for this field Chemical is two times background in 6” or 3’ sample Chemical is not in field’s crumb rubber head space</td>
<td>Acetone[^c] C, Ethyl Benzene K, Methyl Isobutyl Ketone K, Toluene K</td>
</tr>
<tr>
<td>Personal two times &gt; background for this field Chemical is two times background in 6” or 3’ sample Chemical is not in any field’s crumb rubber head space</td>
<td>Carbon Disulfide K, Cyclohexane B, K, M/P-Xylene K, O-Xylene K</td>
</tr>
<tr>
<td>Personal two times &gt; background for this field Chemical is not two times &gt; background in 6” or 3’ sample Chemical is in this field’s crumb rubber head space</td>
<td>Acetone[^c] A, B, Hexane B, C, Methylene Chloride B, Methyl Isobutyl Ketone A, B, Toluene (Acetonitrile)^[^a] B, (Isopropyl Alcohol)^[^a] A, B</td>
</tr>
<tr>
<td>Personal two times &gt; background for this field Chemical is not two times &gt; background in 6” or 3’ sample Chemical not in field’s crumb rubber head space but in at least one other field’s crumb rubber head space</td>
<td>Acetone[^c] D, Benzene[^c] B, Ethyl Benzene B, Hexane A, Toluene B, C, (Acetonitrile)^[^a] K, (Isopropyl Alcohol)^[^a] C, D, K</td>
</tr>
</tbody>
</table>

[^a] tentative identification with NIST Library
[^c] Compound was detected in the background sample of the laboratory used to analyze the bulk crumb rubber head space.
Air VOCs-Background
Twenty VOCs of 60 were found in upwind background locations (Table 26). Five of these VOCs (chloromethane, dichlorodifluoromethane, halocarbon 11, hexane and methyl ethyl ketone) were found in the upwind background locations at all five fields. Air concentrations of acetone, carbon tetrachloride and toluene were found at four background sites, whereas benzene and methylene chloride were detected at three sites.

Table 26. VOC Concentrations in upwind background locations at all fields.

<table>
<thead>
<tr>
<th>VOCs</th>
<th>Fields</th>
<th>Range of VOC Concentrations μg/m³</th>
<th>(parts per billion ppbV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,1,-2-Trichlorotrifluoroethane</td>
<td>K</td>
<td>1.53</td>
<td>(0.20)</td>
</tr>
<tr>
<td>1,1,2-Trichloroethane</td>
<td>K</td>
<td>0.76</td>
<td>(0.14)</td>
</tr>
<tr>
<td>1,2-Dichloropropane</td>
<td>K</td>
<td>0.69</td>
<td>(0.15)</td>
</tr>
<tr>
<td>1,2-Dichloroethane</td>
<td>K</td>
<td>0.68</td>
<td>(0.17)</td>
</tr>
<tr>
<td>1,1,2,2-Tetrachloroethane</td>
<td>A</td>
<td>1.02</td>
<td>(0.15)</td>
</tr>
<tr>
<td>Acetone</td>
<td>A, B, D, L</td>
<td>7.11-12.33</td>
<td>(3.0-5.2)</td>
</tr>
<tr>
<td>Benzene</td>
<td>A, D, L</td>
<td>0.41-0.64</td>
<td>(0.13-0.20)</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>A, B, K, L</td>
<td>0.75-1.30</td>
<td>(0.14-0.21)</td>
</tr>
<tr>
<td>Chloroform</td>
<td>K</td>
<td>0.68</td>
<td>(0.14)</td>
</tr>
<tr>
<td>Chloromethane</td>
<td>A, B, D, K, L</td>
<td>1.06-1.33</td>
<td>(0.52-0.65)</td>
</tr>
<tr>
<td>Dichlorodifluoromethane</td>
<td>A, B, D, K, L</td>
<td>2.23-2.47</td>
<td>(0.45-0.5)</td>
</tr>
<tr>
<td>Ethyl Acetate</td>
<td>A</td>
<td>0.61</td>
<td>(0.17)</td>
</tr>
<tr>
<td>Halocarbon 11</td>
<td>A, B, D, K, L</td>
<td>0.53-1.96</td>
<td>(0.13-0.35)</td>
</tr>
<tr>
<td>Heptane</td>
<td>K</td>
<td>0.53</td>
<td>(0.13)</td>
</tr>
<tr>
<td>Hexane</td>
<td>A, B, D, K, L</td>
<td>0.88-9.40</td>
<td>(0.25-2.6)</td>
</tr>
<tr>
<td>Methyl Ethyl Ketone</td>
<td>A, B, D, K, L</td>
<td>1.06-1.74</td>
<td>(0.36-0.62)</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>A, K, L</td>
<td>0.48-1.83</td>
<td>(0.14-0.32)</td>
</tr>
<tr>
<td>Propene</td>
<td>L</td>
<td>0.48</td>
<td>(0.28)</td>
</tr>
<tr>
<td>Toluene</td>
<td>A, B, K, L</td>
<td>0.75-0.1.09</td>
<td>(0.2-0.29)</td>
</tr>
<tr>
<td>Vinyl Acetate</td>
<td>A</td>
<td>1.02</td>
<td>(0.29)</td>
</tr>
</tbody>
</table>
4.3 Air PAHs and SVOCs—Possibly Turf Related

The EPA Method TO-13A was followed to collect and analyze ten air samples for 115 SVOCs. Table 27 provides the range of concentrations of PAHs across all the fields on outdoor turf, indoor turf and upwind background locations.

Table 28 summarizes one possible algorithm for determining which miscellaneous SVOCs may be related to crumb rubber emissions. The criteria used to determine if a chemical is potentially turf-related includes: Chemicals found in turf air samples but: A) not in background air samples or B) at twice the field’s background concentration, were considered to have originated from the turf. Attribution of a chemical to an origin in the turf was considered stronger if this finding held on at least two fields.

At Field K, several compounds were ten fold higher on turf than background including five PAHS (1-methylnaphthalene, 2-methylnaphthalene, fluorene, naphthalene, and pyrene) and 7 general SVOCs (dotriacontane, heptacosane, hexacosane, octanoic acid, pentacosane, tetracosane, and tetradecane).

Table 27. Range Concentrations of PAHs in ng/m\(^3\) On Outdoor Turf and Upwind Background Locations.

<table>
<thead>
<tr>
<th>PAH</th>
<th>Outdoor On Turf Range ng/m(^3) (n=5(^*))</th>
<th>Indoor On Turf Concentration ng/m(^3) (n=1)</th>
<th>Background Range ng/m(^3) (n=4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Methylnaphthalene</td>
<td>3.72-9.31</td>
<td>ND</td>
<td>4.08-6.91</td>
</tr>
<tr>
<td>2,6 Dimethylnaphthalene</td>
<td>ND-7.65</td>
<td>28.70</td>
<td>ND-10.37</td>
</tr>
<tr>
<td>2-Methylnaphthalene</td>
<td>1.88-4.24</td>
<td>63.38</td>
<td>ND-3.31</td>
</tr>
<tr>
<td>Acenaphthene</td>
<td>2.14-3.45</td>
<td>17.37</td>
<td>ND-0.399</td>
</tr>
<tr>
<td>Acenaphthylene</td>
<td>ND-6.59</td>
<td>6.78</td>
<td>ND-0.77</td>
</tr>
<tr>
<td>Anthracene</td>
<td>ND-ND</td>
<td>ND</td>
<td>ND-0.02</td>
</tr>
<tr>
<td>Benz(a)anthracene</td>
<td>ND-ND</td>
<td>ND</td>
<td>ND-0.03</td>
</tr>
<tr>
<td>Benzo(a)pyrene</td>
<td>ND-0.19</td>
<td>ND</td>
<td>ND-0.05</td>
</tr>
<tr>
<td>Benzo(b)fluoranthene</td>
<td>ND-0.21</td>
<td>ND</td>
<td>ND-0.07</td>
</tr>
<tr>
<td>Benzo(e)pyrene</td>
<td>ND-0.26</td>
<td>ND</td>
<td>ND-0.06</td>
</tr>
<tr>
<td>Benzo(GHI)fluoranthene</td>
<td>ND-0.08</td>
<td>ND</td>
<td>ND-ND</td>
</tr>
<tr>
<td>Benzo(GHI)perylene</td>
<td>ND-0.14</td>
<td>ND</td>
<td>ND-0.06</td>
</tr>
<tr>
<td>Benzo(k)fluoranthene</td>
<td>ND-0.08</td>
<td>ND</td>
<td>ND-0.04</td>
</tr>
<tr>
<td>Chrysene</td>
<td>ND-0.34</td>
<td>ND</td>
<td>ND-0.04</td>
</tr>
<tr>
<td>Fluoranthene</td>
<td>1.68-6.76</td>
<td>5.55</td>
<td>0.58-3.96</td>
</tr>
<tr>
<td>Fluorene</td>
<td>2.21-4.09</td>
<td>53.70</td>
<td>2.43-3.59</td>
</tr>
<tr>
<td>Indeno(1,2,3-cd)pyrene</td>
<td>ND-0.05</td>
<td>8.00</td>
<td>ND-0.05</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>5.99-14.57</td>
<td>113.00</td>
<td>4.50-16.94</td>
</tr>
<tr>
<td>Phenanthrene</td>
<td>5.07-14.34</td>
<td>32.26</td>
<td>6.11-13.05</td>
</tr>
<tr>
<td>Pyrene</td>
<td>0.97-6.92</td>
<td>11.84</td>
<td>0.37-3.16</td>
</tr>
</tbody>
</table>

ND=nondetectable; see appendix for reporting limits.

*Four fields were sampled, and one field (D) was sampled twice.
Table 28. SVOC exposure assessment- screening algorithm for chemicals’ relationship to crumb rubber emissions.

<table>
<thead>
<tr>
<th>Screen for each field</th>
<th>Chemical</th>
<th>Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAHs detected on the turf field and not detected in background, and found on at least 2 fields</td>
<td>Acenaphthylene</td>
<td>D and K</td>
</tr>
<tr>
<td>PAHs detected on the turf field at more than two times the concentration of background levels, and found on at least 2 fields</td>
<td>1-Methylnaphthalene</td>
<td>D and K</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2- Methylnaphthalene</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fluorantheine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phenanthrene</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pyrene</td>
</tr>
<tr>
<td>Miscellaneous SVOCs detected on the turf field at more than two times the concentration of background levels, and found on at least 2 fields</td>
<td>Eicosane</td>
<td>D and K</td>
</tr>
<tr>
<td></td>
<td>Eicosanic acid</td>
<td>D and K</td>
</tr>
<tr>
<td></td>
<td>Heneicosane</td>
<td>D and K</td>
</tr>
<tr>
<td></td>
<td>Hexadecanoic acid</td>
<td>D and K</td>
</tr>
<tr>
<td></td>
<td>Octadecanoic acid</td>
<td>A and D</td>
</tr>
<tr>
<td></td>
<td>Phytane</td>
<td>D and K</td>
</tr>
<tr>
<td></td>
<td>Tetradecanoic acid</td>
<td>D and K</td>
</tr>
<tr>
<td></td>
<td>Tetratriacontane</td>
<td>A and K</td>
</tr>
<tr>
<td></td>
<td>Tricosane</td>
<td>D and K</td>
</tr>
</tbody>
</table>
4.4 Targeted SVOCs—Possibly Turf-Related

Of the five targeted SVOCs in air, Benzothiazole and BHT were the only chemicals detected above background (Table 29). Concentrations of benzothiazole were higher on the turf at six inches away from active play than in background locations at all fields. Most concentrations of benzothiazole and BHT were an order of magnitude lower among the outdoor turf fields than the indoor field, ranging from <80-1200 ng/m³ and <80-130 ng/m³, respectively. Indoor concentrations of benzothiazole and BHT on the turf range from 11000-14,000 and 1240-3900 ng/m³, respectively. The indoor field contained the highest concentration of benzothiazole in the crumb rubber. 4-tert-(octyl)-phenol was detected in the crumb rubber head space in all fields (A-K), however, it was only found in two air samples (on turf level was less than background). BHT was detected in air at 3 feet at the grass background Site L (280 ng/m³).

Table 29. Field locations where air concentrations are greater than relative background concentration for each field.

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Personal</th>
<th>6” NAP</th>
<th>3’ NAP</th>
<th>6” AFAP</th>
<th>3’ AFAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzothiazole</td>
<td>A*, D*, K</td>
<td>A, B, K</td>
<td>B, D, K</td>
<td>A, B, C, D, K</td>
<td>D, K</td>
</tr>
<tr>
<td>2-mercaptobenzothiazole</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>4-tert-octyl</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>BHA</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>BHT</td>
<td>D*, K</td>
<td>K</td>
<td>D, K</td>
<td>K</td>
<td>K</td>
</tr>
</tbody>
</table>

Abbreviations: NAP=near active play; AFAP=away from active play
* one of two personal samples exceeded background
# one of two personal samples exceeded 6” background but not 3’ background

Table 30 summarizes one possible algorithm for determining which targeted SVOC may be related to crumb rubber emissions. Chemicals found in: A) either 6” or 3’ samples; or B) in both personal and either 6” or 3’ samples, greater than the background concentration measured near the field, were considered to have originated from the turf. The attribution of a chemical to the turf was considered stronger if the chemical was also found in at least one field’s crumb rubber head space. Chemicals meeting these criteria are bolded. Benzothiazole and BHT met this criteria.

Table 30. Targeted SVOCs exposure assessment—screening algorithm for chemicals’ relationship related to crumb rubber emissions.

<table>
<thead>
<tr>
<th>Screen for each field</th>
<th>Chemical</th>
<th>Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Either 6” or 3’ two times &gt; background for this field</td>
<td>Benzothiazole</td>
<td>A, B, C, D, K</td>
</tr>
<tr>
<td>Chemical in this field’s crumb rubber head space</td>
<td>BHT</td>
<td>K</td>
</tr>
<tr>
<td>Either 6” or 3’ two times &gt; background for this field</td>
<td>BHT</td>
<td>D</td>
</tr>
<tr>
<td>Chemical not in field’s crumb rubber head space but in at least another field’s crumb rubber head space</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal two times &gt; 3’ background for this field</td>
<td>Benzothiazole</td>
<td>A, D, K</td>
</tr>
<tr>
<td>Chemical is in 6” or 3’ sample two times background</td>
<td>BHT</td>
<td>K</td>
</tr>
<tr>
<td>Chemical is in this field’s crumb rubber head space</td>
<td>BHT</td>
<td>D</td>
</tr>
<tr>
<td>Personal two times &gt; 3’ background for this field</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical is in 6” or 3’ sample two times background</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical not in field’s crumb rubber head space but in at least another field’s crumb rubber head space</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Nitrosamine
All samples were below the reporting limit including the crumb rubber infill.

Particulate Matter (PM₁₀)
PM₁₀ concentrations measured on the turf are typical levels found in background locations. Rubber fragments were not easily detected and analyses of particles were inconclusive.

Lead
All of the composite samples of artificial turf fibers and crumb rubber were below the level EPA considers as presenting a "soil-lead hazard" in play areas (400ppm). This definition, however, applies to residential buildings and to soil rather than other surfaces.
5.0 Limitations

The primary objective of this project was to characterize human exposure via inhalation to a targeted group of chemicals that are associated with crumb rubber synthetic turf. Other routes of exposures, such as ingestion and contact, were not within the scope of this study. Some chemicals of potential concern, such as natural rubber latex, were not included as part of the targeted chemicals in our study but should be included in future studies. There are several limitations to this project. This project has a potential for selection bias because participation was voluntary and self-selected. The sample size was small (4 outdoor fields and 1 indoor field), however, goals of the project were met in recruiting outdoor turf fields, an indoor facility and a suburban grass field.

During the summer of 2009, temperature conditions for the sampling events were on average lower than normal. The 30-year monthly average maximum temperature for the month of July is 84.9 °F, and during July 2009, the average was 79.9 °F. Most notably, wind conditions were low, and little cloud overcast occurred on most sampling days.

Personal sampling occurred at waist height, and not in the normal breathing zone of the study team players. The placement of 1.4 L SUMMAs and personal sampling pumps at this height is not a conventional industrial hygiene personal sampling method. This method was chosen to better represent a child’s height. Some VOCs (e.g. acrolein) were found in personal samples and not on the turf or in the background areas. Players wore the SUMMAs close to their bodies, and they were up against the sampling belts and plastic ties that players wore to hold all the sampling equipment. The belts were purchased new, and may have had some coatings on them. SUMMAs are a very sensitive air sampling method, and may have collected VOCs associated with personal care products and sampling belts worn by the team players. Players were asked not to wear products to limit any contamination. Because of the intense heat and sun exposure, some players wore sun protection and all players sweated. WOHL conducted a follow-up experiment to determine if the new belts and plastic ties were capable of releasing compounds. WOHL detected trace levels of several compounds in the 7 month old belt, apron and tie. Any future personal sampling must address these kinds of issues, and “control” team members playing on the grass (non turf setting) should be included in the sampling strategy. There are many factors to consider for “control” team members, including the type of player clothing, personal product use, personal characteristics (sweat and exhaled breath), laundering practices, and behavior.

Field coordination for this project was challenging at times. For example, it is unfortunate that background samples were not collected at two fields with the PS-1 Samplers as a result of media breakage issues during transportation. In addition, one of the fields (C) was contaminated by a pesticide application which may explain the larger number of VOCs found in comparison to the other outdoor fields. The indoor field had multiple uncharacterized potential point sources.

Sampling for two hours was a limitation. Although the 6-hour sampling at Field D allowed for greater sensitivity, similar patterns were observed with both strategies. Benzothiazole is not a targeted SVOC for the TO-13A Method, and more validation studies are needed to better understand how to collect air samples with the PS-1 Samplers and analyze them for benzothiazole. NIOSH Method 2550 (modified) was adequate to capture concentrations of benzothiazole at the three levels, and other targeted SVOCs.

The lab was not able to identify rubber particles on the Teflon filters from several fields, and therefore, SEM analysis was not completed for all field samples. U.S. EPA’s study used polycarbonate filters with the same air sampling method and reported similar difficulties. More research is needed to better characterize particulate matter containing crumb-rubber.

The airborne concentrations of VOCs, Targeted SVOCs (e.g. benzothiazole) and SVOCs were highest in the indoor field. These data were collected from only one indoor facility. The crumb rubber of the indoor facility was manufactured by the same company as Field B, and installed one year earlier. The air in the indoor field was not influenced by outdoor factors that may degrade and off gas chemicals, such as sunlight, high temperatures, rain, and other weather conditions. Furthermore, potential point sources were identified in the facility, (electric carts, portable chargers, and maintenance supplies), and the indoor facility did not have its exhaust system operating on the day samples were collected. The use of the exhaust
system in this facility varies according to need. More research is needed to better understand chemical exposures in indoor facilities.

6.0 Connecticut Academy of Science and Engineering Review (CASE): CASE performed a peer review of this final report in June 2010. The scope of the technical review for this report included an examination of the appropriateness of the methods used to sample targeted compounds and the laboratory analytical methods. Based on CASE comments, this report was revised to: 1) clarify laboratory quality control and assurance laboratory procedures for VOCs by WSLH and WOHL, 2) strengthen the criteria of the algorithm used to identify a turf-related compound to take into account variability among concentrations (e.g. turf-related compound was reported as twice a field’s background concentration), 3) move tables presenting concentrations of miscellaneous SVOCs commonly found in the environment to appendices and 4) include a description of the similarities and source locations of the bulk crumb rubber samples collected from UCHC and CAES. CASE also highlighted that the SVOC air contaminants found above the field are consistent between fields, and are also consistent with air contaminants reported in other similar studies. Issues raised by the CASE review are addressed below and incorporated into the report.

Design of Experiment: Analysis of crumb rubber for latex antigen was beyond the scope of the current investigation. This should be included in future studies.

Explain why PM10 was measured and not PM2.5: During our planning for this study, several states and US EPA were finishing reports related to synthetic turf. We discussed their findings, and used data that best represents inhalation exposure while playing on a turf field. In US EPA’s scoping study, two kinds of PM10 integrated air samples were collected (one for particle mass and metals analysis and another for scanning electron microscopy analysis). NYCity did not reveal meaningful differences in concentrations between the results for the samples collected upwind and those on the field. In addition, they did not find rubber dust in the respirable range. Because of these findings, we decided to use the PM10 range.

Concern with VOC Results: Precautions used by the laboratories to prevent VOC contamination were added in the UCHC final report as recommended by CASE. The OEM UCHC sub-contracted laboratory analyses to three AIHA accredited laboratories: Wisconsin Occupational Health Laboratory (WOHL), the Wisconsin State Laboratory of Hygiene (WSLH) and the ESIS Environmental Health Laboratory (EHL) in Cromwell, Connecticut. WOHL is a full service industrial hygiene chemistry laboratory that is part of the Wisconsin State Laboratory of Hygiene (WSLH) at the University of Wisconsin-Madison. WSLH analyzed air samples for VOCs, SVOCs and PM10. WOHL analyzed bulk crumb rubber head space for VOCs and targeted SVOCs (e.g. benzothiazole), and air samples for nitrosamines and targeted SVOCs. Additional bulk samples were analyzed for lead by the ESIS Environmental Health Laboratory (EHL).

The following precautions were taken for the personal and area VOC analysis by WSLH: WSLH followed the quality control and assurance protocols defined in the EPA TO-15 Method. Each analytical run included one method blank per batch of samples. If an analyte in the method blank was greater than its limit of detection (LOD), the result for that analyte was flagged to indicate blank contamination. As indicated in the report, one set up samples contained acetone in the blank sample (1.5 ppb), and concentrations were corrected. Duplicate analysis was performed on one sample per analytical batch. Duplicate analyses were always within 25% for each compound. Daily quality control checks were performed using a second source standard. Analytes in the quality control/QC check standard were always within 30% of the corresponding calibration standards.

The following precautions were taken for the bulk crumb rubber VOC analysis by WOHL and added to the final report: 1) bulk crumb rubber samples were stored in teflon lined screw capped jars and were opened only when removing sample for analysis; 2) the 340mL LVSH were baked at 70°C overnight; and 3) one of the LVSH units was analyzed empty with each analytical run as a method blank, and any VOCs detected above reporting limit noted in the analytical report. In addition, a laboratory background VOC air sample was collected in the storage cooler of the bulk crumb rubber samples. As indicated in the report, six VOCs were found and reported in this sample. These six VOCs were flagged as a footnote in tables presenting results.

Criteria used to determine concentrations greater than background: CASE recommended that qualifiers be included for the VOC and SVOC data for concentrations greater than background. UCHC agrees with CASE and modified the report. The criteria for identifying a possibly turf-related chemical of concern was changed: all concentrations greater than two times background were indicated in tables and bolded.
Semivolatile Organic Compound (SVOC) Results: CASE recommended leaving out the miscellaneous SVOCs since it appears that few, if any, of these pertain to crumb rubber or artificial turf. UCHC agrees with CASE, and moved the data into an appendix.

Off-Gas Findings: DPH risk assessment discusses the consistency of the SVOC concentrations across fields. The UCHC final report provides the data for the risk assessment.

Reference Lead Levels: CASE identified other reference levels for lead (e.g. Consumer Product Safety Commission standard for children’s products). UCHC is referencing the EPA lead in soil standard (400ug/g) in the final report because it is the most comparable standard for athletic playing fields.

Analytical Results- CAES versus WOHL: CASE recommended including more information to describe the similarities and differences between CAES and WOHL samples. In the final report, UCHC included a description of the similarities and source locations of the bulk crumb rubber samples collected from UCHC and CAES. CAES collected and analyzed samples of crumb rubber material supplied by several manufacturers [5]. Their crumb rubber samples included material from only two of UCHC outdoor fields (A and D). These two crumb rubber fields were manufactured by two different companies. The results are difficult to compare between the two laboratories (WOHL and CAES) because they used different analytical methods.
REFERENCES


7.0 Appendices (available upon request)

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Appendix B Meteorological Report
Appendix C Crumb Rubber Head Space VOC WOHL Reports
Appendix D Crumb Rubber Head Space Target SVOCs WOHL Reports
Appendix E Crumb Rubber Bulk Samples Lead EHL Reports
Appendix F Air VOC WOHL Reports
Appendix G Special Items Head Space WOHL Reports
Appendix H Air PAHs and Miscellaneous SVOCs EPA Method TO-13A WOHL Reports
Appendix I Air Targeted SVOCs NIOSH 2550 WOHL Reports
Appendix J Air Nitrosamine WOHL Reports
Appendix K Air PM$_{10}$ WOHL Reports
FINAL REPORT

Artificial Turf Study

Leachate and Stormwater Characteristics

Connecticut Department of Environmental Protection

July 2010
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APPENDICES

Appendix A: Stormwater Sampling and Analysis Documentation
Appendix B: Stormwater Treatment Measures, UNH Fact Sheets
1. PROJECT OVERVIEW

In December 2008, four Connecticut State agencies, the University of Connecticut Health Center, The Connecticut Agricultural Experiment Station, the Connecticut Department of Environmental Protection and the Connecticut Department of Public Health, agreed to jointly develop and implement a study to evaluate the health and environmental impacts associated with artificial turf fields. The overall objectives of the study were to:

1. Identify comprehensively substances, including organic compounds and elements, which derive from the crumb rubber infill used on synthetic turf fields, as well as currently available alternative infill products, through off-gassing and leaching pathways;
2. Establish the level of chemical variability for infill at individual synthetic turf fields and between different synthetic fields in Connecticut;
3. Measure levels of off-gassed compounds and airborne particulate matter in the normal breathing zone of children during a "simulated worse-case scenario" at athletic field(s) in Connecticut (inhalation risk);
4. Measure levels of leached compounds in storm water runoff collected in actual field conditions (environmental risk); and
5. Utilize collected data to make environmental and public health risk assessments regarding outdoor artificial turf fields.

The Department of Environmental Protection ("DEP") was specifically tasked with: (1) collecting stormwater runoff samples from the four artificial turf fields selected for the study; (2) analyzing the stormwater samples for levels of compounds leached from the artificial turf materials; (3) scientifically evaluating the laboratory analysis results; and (4) developing an environmental risk assessment for the artificial turf fields.

This report is not intended to be a comprehensive investigation of the environmental risks associated with artificial turf fields, but a basic assessment of water quality data collected from a limited number of fields during a three-month period. It should be understood, that the ultimate conclusions in the report are based on eight stormwater sampling events, essentially a “snapshot”, of an ongoing chemical and physical process.

2. SITE SELECTION

The four artificial turf fields selected for DEP’s stormwater sampling plan were the same fields sampled in the summer of 2009 by the University of Connecticut Health Center for airborne contaminants. Specific field selection criteria included: crumb rubber infill, owner permission, installation date, different manufacturers and site location. The owners of the selected four fields provided engineered drainage plans to DEP. DEP staff reviewed the drainage plans and established sampling points that only collected stormwater draining from the artificial turf field.

3. ARTIFICIAL TURF FIELD SYSTEMS

The artificial turf fields selected were installed by different engineering, synthetic turf and construction companies, but are similar in general design. The fields are composed of a top layer
of polyethylene or polypropylene grass fibers, with a crumb rubber (sometimes intermixed with sand) infill layer, and underlain by crushed stone/gravel with a piped drainage system (see Figures 1 and 2 below).

Figure 1.

Figure 2. (source: www.suncountrysystems.com/.../syntheticgrass.jpg)

The critical field component for this study is the infill layer, which includes crumb rubber materials produced from recycled tires. The infill layer can be composed of entirely styrene-butadiene rubber (SBR) granules, produced by ambient and/or cryogenic grinding process, or intermixed with quartz crystals (sand). The assumption for this study, and the sampling plan, is that precipitation lands on the surface of the artificial turf field, flows downward through the infill and rock/gravel layers, collects in the subsurface drain pipes and then ultimately discharges from the field. The artificial turf drainage pipes often discharge to existing subsurface drainage
system at catch basin and/or manhole connections. The subsurface drainage pipes utilized under the fields can be solid or perforated.

4. SAMPLING PROTOCOLS

DEP staff reviewed EPA protocols and previous artificial turf leaching studies and established the following stormwater sampling plan:

1. Sampling Plan
   a. One sampling station was established at each of the four artificial turf fields;
   b. The sampling stations were located at a point where runoff was only from the artificial turf field;
   c. The size of the drainage area (in square feet) to each sampling station was calculated;
   d. Grab samples were collected and delivered to the laboratory by qualified individuals during the fall of 2009; and
   e. Samples were analyzed by an EPA certified laboratory.

2. Storm Event Criteria
   a. Samples were collected from discharges resulting from a storm event that was greater than 0.1 inch in magnitude and that occurred approximately 72 hours after any previous storm event of 0.1 inch or greater;
   b. Grab samples were collected during the first 30 minutes of a storm event discharge, or as close thereto as possible, and were completed as soon as possible;
   c. The following information was collected for the storm events monitored:
      i. The date, temperature, time of the start of the discharge, time of sampling, and magnitude (in inches) of the storm event sampled; and
      ii. The duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event.

3. Sampling Procedures
   a. Grab sample collection, chain of custody and laboratory delivery were performed in accordance with the EPA NPDES Stormwater Sampling Guidance Document (EPA 833-B-92-001, 7/92); [http://www.epa.gov/npdes/pubs/owm0093.pdf](http://www.epa.gov/npdes/pubs/owm0093.pdf)
   b. Laboratory analysis of grab samples included the following:
      i. Acute Toxicity 48 hour LC50 *Daphnia pulex* & 48 hour and 96 hour LC50 *Pimephales promelas* (EPA 821-R-02-012).
      ii. EPA Method 130.1, Hardness, Total (mg/L as CaCO$_3$)
      iii. EPA Method 150.2, pH
      iv. EPA Method 200.7, (Antimony, Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium, Thallium, Vanadium and Zinc)
      v. EPA Method 624, Volatile Organic Compounds
      vi. EPA Method 625, Semivolatile Organic Compounds (TIC’s for Benzothiazole, Butylated hydroxyanisole (BHA), n-hexadecane and 4-(t-octyl) phenol.)
5. FIELD SAMPLING METHODS

In September of 2009, the stormwater sampling plan was implemented at the four artificial turf fields: Field A, Field B and Field D all constructed in 2007; and Field C constructed in 2005. Stormwater samples were successfully collected from Fields A, C and D. Field B was visited during five precipitation events and no discharge from the established sampling station was observed. A total of eight stormwater samples were collected from Fields A, C and D between 9/11/09 and 12/3/09. Based on DEP staff observations, Fields B and C did not appear to regularly discharge runoff during or after precipitation events, while Fields A and D discharged during and after every precipitation event monitored. For the one sample collected from Field C, DEP staff was fortunate to experience an extremely hard (downpour) rain event that exceeded the infiltration rate of the perforated underdrain system. DEP staff reviewed the engineered drainage plans and determined that Fields B and C utilized perforated drainage pipes causing the stormwater to normally infiltrate into the soil beneath the fields. Fields A and D utilized solid drainage pipes, which discharge the stormwater to local drainage systems at the sites, similar to an impervious surface.

For each precipitation event, stormwater collected at the fields was sampled for total metals, hardness, pH, volatile organic compounds, semi-volatile organic compounds (including rubber Tentatively Identified Compounds found by The Connecticut Agricultural Experiment Station in a 2007 study), pesticides/ polychlorinated biphenyls (PCBs) and acute aquatic toxicity (48 hours for *Daphnia pulex* (Dp)and 96 hours for *Pimephales promelas* (Pp)). Stormwater samples were analyzed at the Connecticut Department of Public Health Laboratory, Environmental Chemistry Division, Inorganic Chemistry Section, 10 Clinton Street Hartford, CT 06106 for pH, Hardness and Total Metals; at Phoenix Environmental Laboratories, Inc. 587 East Middle Turnpike, Manchester, CT 06040 for volatile organic compounds, semi-volatile organic compounds, pesticides, PCBs; and at GZA GeoEnvironmental, Inc., 120 Mountain Avenue, Bloomfield, CT 06002 for acute toxicity. A summary of the tests performed on the samples collected are shown in Table A below.

Table A

<table>
<thead>
<tr>
<th>Location</th>
<th>Date</th>
<th>pH</th>
<th>Hardness</th>
<th>Metals</th>
<th>Volatiles</th>
<th>Semivolatiles</th>
<th>Pesticides and PCBs</th>
<th>Aquatic Toxicity LC50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field C</td>
<td>9/11/09</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Field A</td>
<td>9/27/09</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Field A</td>
<td>10/7/09</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Field A</td>
<td>10/18/09</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Field D</td>
<td>10/18/09</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Field D</td>
<td>10/28/09</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Field D</td>
<td>11/20/09</td>
<td>√</td>
<td>√</td>
<td>√</td>
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6. DEP STORMWATER SAMPLING RESULTS

a) Method 624/Method 625 and Tentatively Identified Compounds (TICs):

No standard volatile or semi-volatile organic compounds were detected in any sample using the EPA 624 and 625 analytical methods. All samples were analyzed for non-standard semi-volatile organic compounds, including the following rubber compounds benzothiazole, butylated hydroxyanisole (BHA), n-hexadecane and 4-((t-octyl) phenol. The semi-volatile analysis detected the analytical peaks of twenty-two compounds, of which nine were tentatively identified (see Table B below). The concentrations of these compounds ranged from 1 ug/l to 150 ug/l. The grey columns in Table B correspond to the three stormwater samples determined to be acutely toxic. Table C details the aquatic toxicity information found for the other tentatively identified compounds listed in Table B.

b) Pesticides and PCBs (Method 608)

Pesticides

Pesticides were detected in the samples of stormwater collected on September 11, 2009 from Field C and on October 28, 2009 from Field D. DEET and heptachlor were detected at estimated concentrations of 6.9 ug/l and 0.18 ug/l, respectively. It is assumed that these substances were not derived from the artificial turf, but were a result of pesticide applications at the site.

PCBs

No PCBs were detected during the stormwater sampling events.

c) pH, Hardness and Metals:

The results from the pH, hardness and metals analysis conducted on the stormwater runoff from the fields are presented in the table below.

pH

The pH of the stormwater samples ranged from 6.6 to 8.0. The pH of stormwater in Connecticut is generally considered to be between 5.6 and 6.0. Based on this fact, the pH of the stormwater samples are more alkaline than expected. It is possible that the crushed stone used as a sub-base in the fields affected the pH of the stormwater as it drained through the field.

The pH alone does not exhibit toxic effects unless it falls below 5 or is higher than 10. However, metals are often more soluble and toxic at lower pH’s. The observed neutral pH in the stormwater may have reduced the concentrations and toxicity of the metals leaching from the fields.
<table>
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<tr>
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<th>Parameter: Tentatively identified Compounds</th>
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<th>Field A C</th>
<th>Field A E</th>
<th>Field D F</th>
<th>Field D G</th>
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</table>
Hardness

The hardness of the stormwater samples ranged from 8 to 59 mg/L. Hardness in the range of 0 to 60 mg/L is generally termed “soft”. Hardness can also influence the toxicity of metals; the greater the hardness, the less toxic the metals. It is not expected that the observed hardness had much effect on metal concentrations in the stormwater.

Metals

The metal parameters which had results reported above the detection limit are listed in Table C below. Silver, molybdenum, thallium and beryllium were analyzed but were below the detection limit for every sample. In Table C, the values bolded and underlined exceed Connecticut’s acute aquatic life criteria. Metal concentrations in excess of the acute aquatic life criteria for more than one hour could cause mortality to the more sensitive organisms in the receiving surface waters. The values bolded meet or exceed Connecticut’s chronic aquatic life criteria. Average metal concentrations which exceed the chronic life criteria for more than 4 continuous days are expected to impact the ability of organisms to survive, reproduce or grow. EPA recommends that neither of these criteria be exceeded more than once in three years (EPA TSD EPA/505/2-90-001). The samples highlighted in grey also exhibited acute toxicity. Since stormwater is an intermittent discharge, the acute criteria for aquatic toxicity are more applicable. A review of the data indicates that only zinc consistently violates the acute criteria.

**TABLE D**

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<th>Location</th>
<th>Sample #</th>
<th>Sample date</th>
<th>pH</th>
<th>Hardness</th>
<th>Conductivity</th>
<th>Cu  ug/l</th>
<th>Zn  ug/l</th>
<th>Ba  ug/l</th>
<th>Fe  ug/l</th>
<th>Al  ug/l</th>
<th>V   ug/l</th>
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<th>Chronic</th>
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</table>
d) Aquatic Toxicity

The toxicity tests conducted on the stormwater measured both an LC50 value (the concentration of stormwater that is lethal to 50% of the test organisms) and an NOAEL (No Observable Acute Effect Level, the concentration of stormwater where no acute toxicity is observed). Toxicity tests conducted on the samples of stormwater collected indicate that 3 out of 8 sampling events were acutely toxic. Acute toxicity is observed when there is less than 90% survival of the test organisms in the undiluted effluent. The frequency of occurrence for acute toxicity was at least one sample per field. Where both *Pimephales promelas* (Pp) and *Daphnia pulex* (Dp) toxicity tests were conducted, the fathead minnow (*Pimephales promelas*) seemed to be slightly more sensitive to the contaminants in the stormwater discharge. Due to laboratory issues, the test duration for the fish, *Pimephales promelas*, for the October 18, 2009 Field A and Field D samples was limited to only 48 hours. If the test duration was extended to 96 hours, both samples could have had an LC50 value less than the 100% reported. The results for the aquatic toxicity testing conducted are shown in Table E below.

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<th>Location:</th>
<th>Sample #</th>
<th>Sample date</th>
<th>Dp % Surv 100%</th>
<th>Dp LC50</th>
<th>Dp NOAEL</th>
<th>Pp % Surv in 100%</th>
<th>Pp LC50</th>
<th>Pp NOAEL</th>
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7. CAES LABORATORY HEADSPACE AND LEACHING RESULTS

The CAES performed both headspace (off-gassing) and SPLP (Standard Precipitation Leaching Procedure) evaluations on seventeen samples of crumb rubber materials used as infill for artificial turf fields. These studies indicated the primary contaminants likely to be found in the stormwater coming from these sites. Organic compounds were identified by head space analysis, with results shown in Table F below. The other organic compounds detected from the crumb rubber infill, but not quantified in the analysis, included hexadecane, fluoranthene, phenanthrene and pyrene.
TABLE F. (Table 2. From CAES 2009) Concentration (ng /ml) of Volatile Compounds in Headspace Over Crumb Rubber Samples Analyzed at CAES (average of two analyses per sample)

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<th>benzothiazole</th>
<th>butylated hydroxytoluene</th>
<th>naphthalene</th>
<th>butylated hydroxyanisole</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1001</td>
<td>0.13</td>
<td>0.19</td>
<td>0.28</td>
<td>3.98</td>
<td>n.d.</td>
<td>0.42</td>
<td>0.50</td>
</tr>
<tr>
<td>A1002</td>
<td>0.11</td>
<td>0.15</td>
<td>0.31</td>
<td>5.59</td>
<td>n.d.</td>
<td>0.31</td>
<td>0.61</td>
</tr>
<tr>
<td>A1003</td>
<td>0.03</td>
<td>0.07</td>
<td>0.19</td>
<td>8.67</td>
<td>n.d.</td>
<td>0.10</td>
<td>0.68</td>
</tr>
<tr>
<td>A1004</td>
<td>0.04</td>
<td>0.07</td>
<td>0.31</td>
<td>6.52</td>
<td>0.15</td>
<td>0.16</td>
<td>0.69</td>
</tr>
<tr>
<td>A1005</td>
<td>0.08</td>
<td>0.09</td>
<td>0.23</td>
<td>2.35</td>
<td>0.09</td>
<td>0.23</td>
<td>0.46</td>
</tr>
<tr>
<td>A1006</td>
<td>0.08</td>
<td>0.14</td>
<td>0.31</td>
<td>4.89</td>
<td>0.12</td>
<td>0.23</td>
<td>0.75</td>
</tr>
<tr>
<td>A1007</td>
<td>0.13</td>
<td>0.20</td>
<td>0.52</td>
<td>3.50</td>
<td>n.d.</td>
<td>0.23</td>
<td>0.69</td>
</tr>
<tr>
<td>A1008</td>
<td>0.06</td>
<td>0.10</td>
<td>0.18</td>
<td>1.93</td>
<td>n.d.</td>
<td>0.22</td>
<td>0.43</td>
</tr>
<tr>
<td>A1009</td>
<td>0.03</td>
<td>0.06</td>
<td>0.13</td>
<td>2.89</td>
<td>0.13</td>
<td>0.08</td>
<td>0.50</td>
</tr>
<tr>
<td>A1010</td>
<td>0.07</td>
<td>0.11</td>
<td>0.22</td>
<td>4.91</td>
<td>0.13</td>
<td>0.20</td>
<td>0.64</td>
</tr>
<tr>
<td>A1011</td>
<td>0.04</td>
<td>0.06</td>
<td>0.30</td>
<td>3.94</td>
<td>0.16</td>
<td>0.11</td>
<td>0.62</td>
</tr>
<tr>
<td>A1012</td>
<td>0.08</td>
<td>0.14</td>
<td>0.46</td>
<td>2.70</td>
<td>0.13</td>
<td>0.28</td>
<td>0.64</td>
</tr>
<tr>
<td>A1013</td>
<td>0.09</td>
<td>0.12</td>
<td>0.45</td>
<td>4.45</td>
<td>n.d.</td>
<td>0.30</td>
<td>0.65</td>
</tr>
<tr>
<td>A1014</td>
<td>0.10</td>
<td>0.15</td>
<td>0.49</td>
<td>4.25</td>
<td>n.d.</td>
<td>0.31</td>
<td>0.65</td>
</tr>
<tr>
<td>B1002</td>
<td>n.d.</td>
<td>n.d.</td>
<td>0.43</td>
<td>1.21</td>
<td>0.67</td>
<td>0.09</td>
<td>0.36</td>
</tr>
<tr>
<td>B1009</td>
<td>n.d.</td>
<td>n.d.</td>
<td>0.07</td>
<td>1.29</td>
<td>0.48</td>
<td>0.06</td>
<td>0.35</td>
</tr>
<tr>
<td>B1010</td>
<td>n.d.</td>
<td>n.d.</td>
<td>0.06</td>
<td>1.03</td>
<td>0.40</td>
<td>0.05</td>
<td>0.34</td>
</tr>
</tbody>
</table>

CAES also performed simulated weathering experiments on the crumb rubber samples to determine trends in organic compound emissions over time. The weathering test results show that, except for 4-(t-octyl)-phenol, all other detected volatile compounds significantly decreased in concentration after only 20 days of outdoor exposure. By the end of the eight week study, benzothiazole, butylated hydroxyanisole and 4-(t-octyl)-phenol were detected at the highest concentrations. The results are shown in Table G. below.

TABLE G: (Table 9 from CAES, 2009) Concentrations (ng /ml) of Volatile Compounds in Headspace Over Crumb Rubber Samples Aged at CAES (average of two analyses per sample)

<table>
<thead>
<tr>
<th>Sample ID (week)</th>
<th>benzothiazole</th>
<th>1-methyl naphthalene</th>
<th>2-methyl naphthalene</th>
<th>naphthalene</th>
<th>4-(t-octyl)-phenol</th>
<th>butylated hydroxyanisole</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0</td>
<td>3.75</td>
<td>0.12</td>
<td>0.24</td>
<td>0.40</td>
<td>0.35</td>
<td>0.77</td>
</tr>
<tr>
<td>T1</td>
<td>1.95</td>
<td>0.05</td>
<td>0.09</td>
<td>0.12</td>
<td>0.28</td>
<td>0.45</td>
</tr>
<tr>
<td>T2</td>
<td>0.97</td>
<td>0.04</td>
<td>0.06</td>
<td>0.06</td>
<td>0.31</td>
<td>0.40</td>
</tr>
<tr>
<td>T3</td>
<td>1.56</td>
<td>0.04</td>
<td>0.07</td>
<td>0.08</td>
<td>0.31</td>
<td>0.44</td>
</tr>
<tr>
<td>T4</td>
<td>1.77</td>
<td>0.04</td>
<td>0.08</td>
<td>0.08</td>
<td>0.30</td>
<td>0.43</td>
</tr>
<tr>
<td>T5</td>
<td>1.59</td>
<td>0.05</td>
<td>0.07</td>
<td>0.10</td>
<td>0.30</td>
<td>0.48</td>
</tr>
<tr>
<td>T6</td>
<td>1.20</td>
<td>0.04</td>
<td>0.06</td>
<td>0.05</td>
<td>0.25</td>
<td>0.36</td>
</tr>
<tr>
<td>T7</td>
<td>0.99</td>
<td>0.04</td>
<td>0.06</td>
<td>0.04</td>
<td>0.24</td>
<td>0.33</td>
</tr>
<tr>
<td>T8</td>
<td>1.17</td>
<td>0.05</td>
<td>0.05</td>
<td>0.06</td>
<td>0.23</td>
<td>0.41</td>
</tr>
</tbody>
</table>

CAES also performed an SPLP test on the same seventeen samples of the crumb rubber infill material. The resulting leachate was then analyzed for metals and organic compounds. Based on communications with CAES, the leachate contained the same organic compounds that were identified in the head space analyses, however, only benzothiazole concentrations were estimated for the test. A summary of compounds detected and their concentrations are listed in Table H below. Based on these results, the predominant contaminant leaching from artificial turf fields is
zinc, followed by barium, manganese and lead. It should be noted some metals associated with
tires and rubber products were not analyzed in this experiment, such as iron and vanadium.

In Table H, the values which exceed Connecticut’s acute aquatic life criteria are highlighted in
yellow. The summary shows that zinc is present in the leachate at concentrations about 500
times greater than the toxicity criteria. The leachate study indicates that there is a high potential
for the artificial turf to leach acutely toxic levels of metals especially copper and zinc. Certain
samples of crumb rubber also leached acutely toxic levels of cadmium, barium, manganese and
lead.

TABLE H

<table>
<thead>
<tr>
<th>ug/l</th>
<th>Benzothiazole</th>
<th>Cr</th>
<th>Mn</th>
<th>Ni</th>
<th>Cu</th>
<th>Zn</th>
<th>As</th>
<th>Cd</th>
<th>Ba</th>
<th>Pb</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>average</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.153</td>
<td>6.24</td>
<td>263.16</td>
<td>19.88</td>
<td>22.31</td>
<td>34170.5</td>
<td>3.35</td>
<td>1.60</td>
<td>313.88</td>
<td>11.57</td>
</tr>
<tr>
<td></td>
<td>0.209</td>
<td>11.28</td>
<td>348.45</td>
<td>27.48</td>
<td>20.41</td>
<td>50269.8</td>
<td>1.50</td>
<td>0.50</td>
<td>463.62</td>
<td>7.77</td>
</tr>
<tr>
<td>Max</td>
<td>0.268</td>
<td>31.47</td>
<td>1443.19</td>
<td>57.15</td>
<td>143.32</td>
<td>71535.5</td>
<td>27.94</td>
<td>17.01</td>
<td>502.91</td>
<td>69.90</td>
</tr>
<tr>
<td>Acute</td>
<td>21333.000</td>
<td>323</td>
<td>616</td>
<td>260.5</td>
<td>14.3</td>
<td>65</td>
<td>340</td>
<td>2.02</td>
<td>2000</td>
<td>30</td>
</tr>
<tr>
<td>Chronic</td>
<td>3200.000</td>
<td>42</td>
<td>28.9</td>
<td>4.8</td>
<td>65</td>
<td>150</td>
<td>1.35</td>
<td>220</td>
<td>1.2</td>
<td></td>
</tr>
</tbody>
</table>

8. DISCUSSION

a) Potential Contaminants

The analyses performed on the stormwater samples were focused on compounds previously
documented to leach from crumb rubber material derived from recycled tires, primarily volatile
organic compounds, semi-volatile organic compounds and metals. The stormwater samples were
also assessed for whole effluent toxicity. Other potential parameters of concern in the
stormwater were identified from the results of the CAES off-gassing and leaching laboratory
studies performed on the crumb rubber material.

b) Organic compounds

The stormwater generated at the artificial turf sites did not include many readily identifiable,
volatile or semi-volatile organic compounds, as evidenced by no detections using EPA Methods
625 and 624. Additional semi-volatile compound investigations were performed on the
stormwater samples, resulting in nine tentatively identified compounds and thirteen unidentified
chromatograph peaks. Benzothiazole, which CAES also detected in their leaching analysis, was
identified in the September 27 and October 7, 2009 samples from Field A at concentrations of 1
and 4.9 ug/l, respectively. Of the compounds that were tentatively identified such as
benzothiazole, pentanoic acid, and thiopenes, none of these compounds are considered
particularly toxic to aquatic organisms at the estimated concentrations.
Although it is not possible to determine the potential impact of the unidentified semi-volatile compounds, it is important to note, that the six highest concentrations of the unidentified semi-volatile compounds detected (150 ug/l, 28 ug/l, 14 ug/l, 12 ug/l, 10 ug/l and 9.5 ug/l) did not correspond to the three acutely toxic samples of stormwater determined in the study.

The results from the CAES laboratory headspace, leaching and simulated weathering tests suggest that benzothiazole, 4-(t-octyl)-phenol, 1-methyl naphthalene, 2-methyl naphthalene, naphthalene, butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) are the likely semi-volatile compounds to be found in the stormwater discharge from artificial turf fields. The test results also suggest that Benzothiazole, 4-(t-octyl)-phenol and butylated hydroxytoluene (BHT) would be the most persistent SVOCs in the crumb rubber as the artificial turf fields aged.

Comparing the VOCs and SVOCs results to EPA’s Maximum Contaminant Levels for drinking water (MCLs) and DEP’s Remediation Standards Regulations, Section 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies (June 1996), no exceedences of groundwater standards have been identified.

Based on our results, no VOCs or SVOCs have been identified as risks to surface and groundwater resources.

c) Metals

The laboratory leaching analyses performed by CAES as part of the State of Connecticut Artificial Turf Study detected the following metals: arsenic (As), barium (Ba), cadmium (Cd), chromium (Cr), lead (Pb), manganese (Mn), nickel (Ni), and zinc (Zn). Zinc was present in concentrations orders of magnitude greater than the other metals. CAES’s leaching analyses indicated that both copper (Cu) and zinc (Zn) concentrations exceeded acute aquatic toxicity criteria for 80% of the tests, with limited (<20%) exceedences of acute criteria for cadmium (Cd), manganese (Mn) and lead (Pb).

The stormwater analysis results show that the artificial turf fields in our study leached significantly less contaminants, specifically zinc and copper, than predicted by the CAES leaching test results. The lower metal concentrations observed in the stormwater could be a result of alkaline pHs, the weathering (2-4 years since installation) of the crumb rubber infill, or the conservative approach inherent in the SPLP methodology.

The stormwater analysis results showed that zinc was the only metal to exceed the acute aquatic toxicity criteria (65 ug/l), with one exceedence at each of the three study fields. The overall mean concentration of zinc in the stormwater samples analyzed was 84 ug/l, with a maximum of 260 ug/l and a minimum of 10 ug/l. The stormwater analysis results showed that aluminum, barium, copper and zinc all exceeded chronic aquatic toxicity criteria at least once during the sampling. Since chronic toxicity criteria apply to four days of continuous discharge, these exceedences are not of significant concern for these intermittent discharges.

No metal concentrations exceeded EPA’s and DEP’s drinking water standards. However, the concentration of zinc in three stormwater samples did exceed the surface water protection
criteria of 123 ug/l established in the Appendix D to Sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies Surface-water Protection Criteria for Substances in Ground Water (June 1996). Since the mean concentration of zinc in the stormwater samples (84 ug/l) is below the surface water protection criteria, the discharge from the artificial turf fields to groundwater is intermittent, and zinc is immobilized in soils by adsorption, absorption and precipitation, the potential for impacts to surface waters being recharged by this groundwater is minimal.

Based on our results, zinc has been identified as a potential risk to surface waters. No other metals have been identified as a risk to groundwater or surface waters.

9. ENVIRONMENTAL RISK ASSESSMENT

a) Potential Risk to Surface Waters

The only potential risk to surface waters identified in the stormwater collected from the artificial turf fields is zinc, since it was the only chemical parameter that was detected above the acute aquatic life criteria of 65 ug/l. Acute toxicity is assumed to occur when the zinc concentration in-stream exceeds 65ug/l for one hour in any three year period. In three of the eight stormwater samples analyzed, zinc concentrations were detected at 130, 150 and 260 ug/l, well above the acute aquatic life criteria. It is important to note, that the three stormwater samples with acutely toxic levels of zinc were also determined to exhibit aquatic toxicity (<90% survivorship) for both species *Pimephales promelas* and *Daphnia pulex* in the whole effluent toxicity testing.

Other than the acute aquatic toxicity criteria, there are no specific zinc standards or permit limits that are applicable to artificial turf fields. For industrial sites that discharge to surface waters, DEP has set a stormwater general permit guideline (Section 5 (c) (1) (F) (i) of the General Permit) for total zinc of 200 ug/l. This industrial stormwater total zinc guideline assumes a default 5:1 dilution factor for the receiving surface water at the 7Q10 flow. The 7Q10 is the lowest flow expected to occur for seven continuous days at a frequency of every 10 years. The 7Q10 flow is the critical low flow used when evaluating toxicity and toxic impacts (CT WQS 2002). Based on the results of our study, the stormwater discharges from artificial turf fields would not be expected to regularly exceed this zinc limit.

However, the estimated 7Q10 flows for the receiving watercourse from Fields A, C and D did not meet the 5:1 dilution factor for stormwater discharges from artificial turf football fields (57,600 square feet), assuming a one inch rain storm over one hour with direct discharge to the watercourse over an hour. It is important to note, that this a conservative approach, which assumes the watercourse receives no other stormwater runoff from its representative watershed. For the three receiving streams in the study, the highest dilution factor at the DEP estimated 7Q10 flow was equivalent to a 0.14:1 ratio. Given this dilution ratio of the receiving streams in the study, there is a potential for acute toxicity due to zinc loading.

Since zinc concentrations in stormwater from artificial turf fields may pose a risk to surface waters, especially to smaller watercourses, it is important to note that these fields are not the only sources of stormwater runoff in any given watershed. During the sampling at Fields A, C and D,
DEP staff observed stormwater runoff, generated by acres of parking lots, roadways and buildings, entering the same drainage systems that collected runoff from the artificial turf fields. Based on these observations, it appears that stormwater runoff from the artificial turf fields is combined with the runoff from the adjacent impervious surfaces prior to ultimate discharge at the site.

This is an interesting phenomenon, since the levels of zinc in urban runoff are comparable to the concentrations detected in the discharge from artificial turf fields. It has been well established that urban runoff contains many contaminants such as nutrients, suspended solids, hydrocarbons and heavy metals, including zinc. The average concentration of zinc in urban stormwater runoff has been estimated at 129 ug/l in recent studies (Smullen 1998). EPA’s Nationwide Urban Runoff Program (NURP) has collected runoff data and determined that for urban sites the median concentrations of total zinc ranged from 179 -226 ug/l. The National Stormwater Quality Database (NSQD, version 1.1), dated February 16, 2004, compiled zinc concentration data in runoff from various land uses across the United States, which is shown in Table L below.

<table>
<thead>
<tr>
<th>Land Uses</th>
<th>Zinc Total (ug/l) Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall (All Uses)</td>
<td>117</td>
</tr>
<tr>
<td>Residential</td>
<td>73</td>
</tr>
<tr>
<td>Mixed Residential</td>
<td>99.5</td>
</tr>
<tr>
<td>Commercial</td>
<td>150</td>
</tr>
<tr>
<td>Mixed Commercial</td>
<td>135</td>
</tr>
<tr>
<td>Industrial</td>
<td>210</td>
</tr>
<tr>
<td>Mixed Industrial</td>
<td>160</td>
</tr>
<tr>
<td>Institutional</td>
<td>305</td>
</tr>
<tr>
<td>Freeways</td>
<td>200</td>
</tr>
<tr>
<td>Mixed Freeways</td>
<td>90</td>
</tr>
<tr>
<td>Open Space</td>
<td>40</td>
</tr>
<tr>
<td>Mixed Open Space</td>
<td>88</td>
</tr>
<tr>
<td><strong>CT Artificial Turf Stormwater</strong></td>
<td><strong>84 (mean)</strong></td>
</tr>
</tbody>
</table>

Since zinc concentrations in the runoff from artificial turf fields are consistent with those associated with urban runoff, it would be a logical step to apply the same best management practices (BMPs) to mitigate the toxicity effects to surface waters. The 2005 Stormwater Management Manual for Western Washington specifically recommends the following BMPs to remove dissolved zinc (and other metals) from stormwater runoff: stormwater treatment wetlands, wet ponds, infiltration structures, compost filters, sand filters and biofiltration structures. The 2004 Connecticut Stormwater Quality Manual suggest the same measures since these treatment practices incorporate biological removal mechanisms that are more effective in removing pollutants than systems that strictly rely on gravity or physical separation of particles in the stormwater. The 2004 Connecticut Stormwater Quality Manual further recommends a treatment train approach, which provides a series of BMPs each designed to provide targeted pollution control benefits.
The University of New Hampshire Stormwater Center has field tested many of these stormwater BMPs that demonstrate significant removal of dissolved zinc. For example, the Retention Pond, Subsurface Gravel Wetland and Bioretention System (Bio II) stormwater treatment measures, over a two year period, removed between 90% and 100% of the soluble zinc, based on a median annual influent Event Mean Concentrations (EMC) of 60ug/l (see Appendix B for fact sheets). The three highest zinc concentrations detected in the stormwater from artificial turf fields in our study were 130, 150 and 260 ug/l, respectively. Assuming 80% removal of zinc from the stormwater prior to discharge to surface waters, all three of the highest zinc concentrations would meet the acute aquatic toxicity criteria (26, 30 and 52 ug/l, respectively). To mitigate the risk to aquatic life and surface waters, the DEP strongly recommends that the aforementioned stormwater best management practices be incorporated into the design of the drainage system for artificial turf fields.

10. ENVIRONMENTAL RISK ASSESSMENT IN RECENT STUDIES

Several other studies were conducted to determine the risk to surface waters and groundwater from the stormwater discharges from artificial turf fields. Since artificial turf fields can either discharge to groundwater or surface water, the ecological risks must be evaluated for both potential pathways. This was confirmed by Nilsson et al (2008), that drainage from artificial turf fields can enter the environment by either seeping through the underlying soil and potentially contaminating the groundwater, or alternatively, by stormwater runoff entering the adjacent watercourses.

a) Overall Surface Water Contamination Risk

1) Organic Compounds

The studies conducted by Plesser (2004) indicated that concentrations of the common polycyclic aromatic hydrocarbons (PAHs) anthracene, fluoranthene and pyrene, as well as nonylphenols, would exceed the limits for freshwater specified in the Canadian Environmental Quality Guidelines. Torsten (2005) from the Norwegian Institute for Water Research (2005) also predicted that concentrations of alkyl phenols and octylphenol in particular would exceed the limits for environmental effects in the scenario which was allowed a 10:1 dilution of run-off. Torsten (2005) further determined that the leaching of chemicals from the materials in the artificial turf system would decrease slowly, so that environmental effects could occur over many years. However, Torsten (2005) anticipated only localized impacts due to the relatively small concentration of the leaching pollutants. The SVOCs analysis of the stormwater in our study, utilizing EPA Method 625, and a specific search for 4-(t-octyl)-phenol, detected no anthracene, fluoranthene, pyrene or standard phenol compounds.

Kolitzus (2006) detected no appreciable PAHs concentrations in the runoff analyzed from artificial surface systems. The PAHs that were found above detection limit were ubiquitous substances in the environment. The PAH concentrations in the unbound supporting layer were determined to be in the range of analytic determination limit (0.02 μg/l). The sum of all 16 PAHs was 0.1 to 0.3 μg/l. Similarly, in a recent New York study (Lim et al 2009), no standard organics were detected utilizing EPA Method 624 and 625 in the stormwater sample collected. The
SVOC analysis of the stormwater in our study, utilizing EPA Method 625, detected no standard PAHs.

In surface systems with EPDM and recycled rubber infill, Kolitzus (2006) found several aromatic amino complexes and benzothiazole detected in the range of 10 – 300 μg/l. These concentrations were similar to the results of simulated normal tire wear tests. Lim et al (2009) reported a semi-volatile rubber compound, benzothiazole, at 1,000 μg/l as a Tentatively Identified Compound (TIC) in one stormwater sample. The SVOC analysis of the stormwater in our study, utilizing EPA Method 625, detected no standard aromatic amines, but further TIC analysis did detect identified and unidentified organic compounds. Benzothiazole was detected in two stormwater samples at estimated concentrations of 1.0 and 4.9 μg/l, respectively, which is significantly lower than concentrations found by Lim et al (2009). The Connecticut acute and chronic toxicity benchmark for benzothiazole are 21,333 μg/l and 3,200 μg/l, respectively, based on available toxicity information. The estimated concentrations of benzothiazole are insignificant compared to both the acute and chronic toxicity criteria. Also, a number of unidentified organic compounds were detected during the SVOC TIC analysis at concentrations ranging from 1 μg/l to 150 μg/l, with a median concentration of 6.6 μg/l. The 10/7/09 Field C stormwater sample, which the maximum unidentified compound concentration of 150 μg/l was detected in, was not found to be acutely toxic.

The results from our study appear to be consistent with the results from Kolitzus (2006) and Lim et al (2009), including the detection of benzothiazole in the stormwater samples. Overall, our study did not identify any organic compounds at sufficient concentrations to be considered a potential contamination risk to surface waters.

2) Metals

Based on our analysis of the stormwater collected from the artificial turf fields, zinc is the only metal detected in concentrations which could pose a risk to surface water resources. This finding is consistent with many recent studies which analyzed leachate and stormwater from crumb rubber infill, which indicate that zinc is the primary contaminant of concern coming from artificial turf sites. In sites with limited dilution both the Norwegian Pollution Control Authority (2005) and Verschoor (2007) conclude that the concentration of zinc in the leachate would exceed applicable water quality standards. The Norwegian Pollution Control Authority classifies artificial turf runoff as Environmental Quality Class V (very strongly polluted water) due to the high concentration of zinc in the leachate. The risk assessment conducted by Norwegian Institute for Water Research (2005) shows that the concentration of zinc poses a significant local risk of environmental effects in surface water which receives run-off from artificial turf fields.

Verschoor (2007) also conducted a risk assessment concluding that the estimated concentrations of zinc in the drainage water from artificial football fields to be between 1100-1600 μg/L. This concentration exceeded the Dutch legal criterion for surface water Maximum Permissible Chronic Concentration (MPC) of 40 μg/l by a factor of 27-40. Verschoor explained that drainage water concentrations would be diluted in the receiving surface waters, but indicated that zinc in “small ditches” could exceed MPA (Maximum Permissible Acute). Verschoor espoused a general discharge impact rule that only 10% of the permissible concentration of a contaminant (=
4 ug/l) may be consumed by a particular source. This would imply that the concentration of zinc in smaller receiving water would exceed the water quality criteria by a factor of 45-80. Verschoor identified zinc as a potential eco-toxicological risk to surface water, but did indicate that if the crumb rubber were to be replaced by infill materials with a lower zinc emission, the pollutant concentrations in runoff and adjacent surface water should drop quickly.

Lim et al (2009) conducted a mathematical assessment of the risks to aquatic life from crumb rubber leachate based on the SPLP test results for zinc, aniline and phenol. Based on these concentrations, NYSDEC’s Division of Fish, Wildlife and Marine Resources concluded that there may be a potential aquatic life impact due to zinc being release from crumb rubber solely derived from truck tires. However, New York State also concluded that an impact is unlikely if the crumb rubber material is from mixed tires and concentrations of zinc from a column test were used rather than the SPLP. It should be noted, that for the column test to better simulate field conditions, the material in the column must reflect local soil conditions and pH.

Several recent studies analyzed stormwater samples collected from artificial turf fields for metals. Lim et al (2009) and Kolitzus (2006) detected concentrations of zinc at 59.5 ug/l and 20 ug/l, respectively. Milone and MacBroome (2008), conducted field studies and detected zinc in the stormwater from four of the six sampling dates, with a maximum concentration of 31 ug/l which is below acute aquatic toxicity criteria of 65 ug/l.

The zinc concentrations in our stormwater samples were significantly higher than those of Lim, Kolitzus and Milone and MacBroom, with three of the eight the samples tested exceeding acute surface water quality criteria. If not mitigated with appropriate stormwater treatment measures, the zinc concentrations found in our study could contribute to the environmental risk of aquatic organisms in surface waters.

3) Aquatic Toxicity

Wik (2006) studied the toxicity of various tire brands and determined that different formulas for rubber contributed to varying degrees of toxicity in the leachates to Daphnia magna. By conducting a toxicity identification evaluation on various tire leachates (EPA 600/6-91/003), Wik determined that although zinc was prevalent, the semi-volatile non polar organics also heavily influenced the toxicity of the resulting leachate. Passing the simulated tire leachates through carbon filters was the only manipulation that consistently reduced toxicity. Compared to the results from Milone and MacBroom (2008), this study reported significantly higher levels of both aquatic toxicity and zinc. This study found that three of the eight stormwater samples tested were acutely toxic to both the invertebrate (Daphnia pulex) and the fathead minnow (Pimephales promelas). These acutely toxic samples directly coincided with the exceedences of the acute aquatic life criteria for zinc. Consequently, zinc seems to be the primary pollutant of concern. This study indicates that there is risk associated with whole effluent toxicity and zinc.

b) Overall Groundwater Contamination Risk

Stormwater from the fields can impact groundwater directly by percolating through the artificial turf via an “open” underground drainage system (perforated pipes, coarse bedding materials, stone trenches). The stormwater discharges to the underlying soil layers, and ultimately, enters
the ground water. Based on the nature of the underlying soil and the depth to groundwater, the field stormwater is likely to physically and chemically interact with a mineral soil layer (vadose zone) prior to encountering groundwater. This stormwater/soil interaction would be affected by pH, volume of stormwater and soil characteristics, such as moisture, chemistry, mineralogy, soil texture, hydraulic conductivity and drainage class. These interactions would likely influence the concentrations of contaminants found in the groundwater.

There are two primary concerns with the contamination of groundwater in the environment - the threat to drinking water and the threat to surface water resources via groundwater recharge. Several other studies were conducted on the crumb rubber fill from 2004 to 2009; (Plesser(2004), Nilsson et al (2008), the Norwegian Institute for Water Research (2005), Verschoor, A.J., RIVM Report 601774011/2007(2007) Study, (Milone & MacBroom Study 2007), NYSDEC May 2009 an Kolitzus, Hans J. (2006). These studies compared the relative concentration of contaminants found in laboratory leachates and/or artificial turf generated stormwater with various drinking water and aquatic life criteria.

1) Organic Compounds

It should be noted that substances, to a varying degree, will be absorbed by the sand/clay layers which the drainage water passes. Although Nilsson et al (2008) found that concentrations of nonylphenols in the contact water from leaching tests were in the order of 20-800 times above the threshold values for drinking water, it was uncertain as to whether this concentration would be significant in the actual groundwater. The EPA aquatic life acute criteria for nonylphenol for freshwater and saltwater resources are 28 ug/l and 7.0 ug/l, respectively. It is important to note that nonylphenol has been associated with the disruption of fish endocrine systems at concentrations below EPA’s criteria. No data was available for phthalates and nonylphenols under such realistic conditions from lysimeter data. Nilsson determined that the assessment of the impact on water systems also requires more realistic lysimeter tests or measurements on drainage water from artificial turf fields over time.

Plesser (2004) compared leachate results with Canadian Environmental Quality Guidelines for ground water. Groundwater guidelines are developed for both protection of drinking water and protection of surface water via groundwater recharge. Plesser identified anthracene, fluoranthene, pyrene and nonylphenols as compounds in the leachate that could exceed the more protective criteria for groundwater. Plesser also concluded that analyzing possible paths and changes in leaching properties over time is necessary to determine the degree to which the concentrations of these compounds are actually harmful to people and the environment.

Lim et al (2009) conducted a leachate (SPLP) test on rubber crumble material, and analyzed for zinc, phenol and aniline. The results from recent leaching studies indicated a potential for release of aniline, benzothiazole, phenol, and zinc to the groundwater. However, concentrations of the organic contaminants analyzed were below levels that would impose a risk to drinking water. Lim also collected 32 groundwater samples from wells installed downgradient of four artificial turf fields and analyzed them for SVOCs, including aniline and benzothiazole, using SW-846 Method 8270C. The wells were installed in sandy textured soils with depth to the groundwater ranging from 8.3 to 70 feet. All test results were below the limit of detection for all
groundwater samples analyzed. Based on test results of 32 samples, no organics were detected in the groundwater at the turf fields.

Our results are consistent with the leachate and groundwater sampling results in Lim et al (2009). The concentrations of organic compounds in our study did not exceed groundwater protection criteria.

2) Metals

In general, metals are immobilized in soils by adsorption, absorption and precipitation. All of these mechanisms impede movement of the metals to ground water. Metal-soil interaction is such that when metals are introduced at the soil surface, downward transportation does not occur to any great extent unless the metal retention capacity of the soil is overloaded, or metal interaction with the associated waste matrix enhances mobility.

Zinc is the most prevalent contaminant in the leachate and stormwater studies. In several of these studies, zinc concentrations measured in leachate exceeded drinking water standards. Most of the zinc in soil is absorbed to the soil as zinc hydroxide or oxide and does not dissolve in water. Zinc does show moderate mobility under relatively acid soil conditions (pH 5–7) because of increased solubility and formation of soluble complexes with organic lignands (Elliott et al. 1986; Stevenson and Fitch, 1986; Klamberg et al. 1989). Zinc is retained in an exchangeable form at low pH in iron and manganese oxide dominated soils but becomes non-exchangeable as the pH was increased above 5.5 (Stahl and James, 1991). Therefore, depending on the acidity of the soil and water, some zinc may reach groundwater.

Nillson et al (2008) determined that although leachate concentrations of zinc were in excess of the drinking water quality standards, similar concentrations were not observed in (field) lysimeter tests. Nillson concluded that the concentration of zinc in the lysimeter tests were a more accurate reflection of zinc in the groundwater and, therefore, zinc concentrations would not exceed drinking water standards.

Lim et al (2009) was the only study that did not report concentrations of zinc in the SPLP leachate that exceeded drinking water standards.

Verschoor (2007) concluded that, for the majority of situations, the risks of zinc to public health are minimal since it is not very toxic to humans and the World Health Organization (WHO) drinking water criteria was not exceeded in tests. However, Verschoor (2007) did note that in sandy areas discharges to groundwater may exceed Dutch Intervention Values by a factor of 1.5 to 2.2. In sandy soils, infiltration of water with dissolved zinc will result in weak binding of zinc to the soil matrix and could cause protection criteria to be exceeded by a factor of 12. Verschoor concluded that zinc was a potential eco-toxicological risk to groundwater and soil.

Plesser (2004) and CAES (2009) indicated that zinc was the most likely contaminant to exceed drinking water standards in the leachate. All studies indicate that, although compounds were present in the leachate or stormwater, it was uncertain as to what affect the underlying soils and groundwater would have on the actual concentration of contaminants in the groundwater. Actual groundwater testing may be necessary to determine the impact.
The leachate results reported by CAES showed zinc concentrations up to ten times the drinking water standards and up to 500 times the surface water protection criteria. Our study detected concentrations of zinc in the stormwater significantly lower than CAES results, with no exceedences of drinking water standards and no significant concerns for groundwater quality. It is important to note that no groundwater samples were collected for our study.

11. CONCLUSIONS

The DEP concludes that there is a potential risk to surface waters and aquatic organisms associated with whole effluent and zinc toxicity of stormwater runoff from artificial turf fields. Zinc concentrations in the stormwater may cause exceedences of the acute aquatic toxicity criteria for receiving surface waters, especially smaller watercourses. The DEP suggests that use of stormwater treatment measures, such as stormwater treatment wetlands, wet ponds, infiltration structures, compost filters, sand filters and biofiltration structures, may reduce the concentrations of zinc in the stormwater runoff from artificial turf fields to levels below the acute aquatic toxicity criteria. Individual artificial turf field owners may want to evaluate the stormwater drainage systems at the fields and the hydrologic and water quality characteristics of any receiving waters to determine the appropriateness of a stormwater treatment measure.

This study did not identify any significant risks to groundwater protection criteria in the stormwater runoff from artificial turf fields. It is important to note, that the DEP study did not directly collect and analyze groundwater at these artificial turf fields. Consequently, this conclusion regarding consistency with groundwater protection criteria is an extrapolation of the stormwater results collected and the evaluation of data presented in recent studies, such as Nillson et al (2008) and Lim et al (2009). To make a final conclusion regarding the overall risk from exposure to groundwater affected by stormwater runoff from artificial turf fields, further sampling and analysis of groundwater at the artificial turf fields would be required.

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Benefit of Natural Landscaping

By Alex Wilson and Jessica Boehland

What's Wrong with the Conventional Lawn?

Throughout North America today, the dominant landscaping aesthetic is a broad, open lawn punctuated by trees and shrubs. While this landscaping system has been engrained into us through our culture and media, it creates an ecologically depleted landscape that requires significant amounts of resources and chemicals to maintain, especially in dry climates.

Conventional lawns require inputs of water and energy while causing air, water, and noise pollution. Annually in the U.S. we spend tens of billions of dollars caring for them. In some areas we use over half of our municipal freshwater to irrigate lawns, and we fortify them with millions of tons of fertilizer and thousands of tons of pesticides. What's wrong with this picture?

From an environmental, health, and even economic standpoint, a lot is wrong with conventional turf. Maintenance of turf necessitates regular mowing during the growing season, which is responsible for approximately 5% of the nation's air pollution, according to the U.S. Environmental Protection Agency (EPA)—and a good deal more in many metropolitan areas. A typical 3.5 horsepower gas mower emits about the same quantity of volatile organic compounds (VOCs) in one hour as a late-model car driven 340 miles (550 km), according to the California Air Resources Board. On top of that, EPA estimates that users of such equipment spill 17 million gallons of fuel each year—which is more than the Exxon Valdez oil spill!

Watering lawns consumes 30% of municipal freshwater in the eastern U.S. and 60% in the West. A U.S. News & World Report article reported that a 1,000 square-foot (93 m2) lawn requires, on average, 10,000 gallons (37,850 liters) per summer. With droughts continuing in the West and expected to increase in severity as a result of global climate change, this is a growing concern.

To maintain lush lawns, we use a lot of fertilizer—some 70 million tons (64 million tonnes) per year in the U.S. We use more fertilizer on our lawns in the U.S. than India uses on its food crops. Nitrogen fertilizers are produced by converting molecular nitrogen (N2) in the air into ammonia through the Haber-Bosch process, which is extremely energy-intensive, requiring approximately 18,000 Btus per pound (41 GJ/tonne) of primary energy input, which comes primarily from natural gas. Worldwide, ammonia production accounts for approximately 1% of global primary energy use.

Insecticides, herbicides, fungicides, and other pesticides are a growing concern with lawns. U.S. homeowners use 67 million pounds (30 million kg) of pesticides on lawns each year, according to EPA. Our suburban lawns and gardens receive heavier pesticide applications than our agricultural land: between 3.2 and 9.8 pounds per acre (3.6—11 kg/ha) vs. an average of 2.7 pounds per acre (3.0 kg/ha) for agricultural lands.

Along with the resource and environmental burdens of producing fertilizers and pesticides, a significant portion of these chemicals applied to lawns ends up in stormwater runoff and in groundwater. Stormwater runoff from turf is one of North America's biggest sources of water pollution.

Noise pollution is another concern. Lawnmowers, weed whackers, hedge trimmers, and leaf blowers cause significant noise pollution, a very real but often overlooked health hazard.

Due to the need for all this maintenance, lawns are a huge expense. Homeowners spend roughly $27 billion per year on lawn care, according to the National Wildlife Federation (NWF)—ten times more than we spend on school textbooks.

At the business level, the lawn care industry did approximately $61 billion in business in 1997 and has been experiencing roughly 20% annual growth in recent years. On a per-acre basis, maintenance costs for mowing, irrigation, and application of fertilizer and pesticides average $1,120 per year, according to the organization Wild Ones Natural Landscapers.

Benefits of Natural Landscaping
Just as there are significant environmental burdens and costs associated with conventional turf landscaping, there are benefits associated with natural landscaping. The primary benefits are described below.

**Reduced air pollution.** Native landscaping generally does not require regular mowing, which eliminates or greatly reduces the air pollution resulting from turf landscapes. There can be pollution emissions from natural landscaping, however—see discussion below on pollution from fire management.

**Reduced nutrient runoff.** Native landscaping does not require fertilizer, so the runoff and infiltration of nutrients is eliminated. Buffers of natural landscaping can be used to capture runoff from hard surfaces or less permeable turf to keep the pollutants in that stormwater from entering surface waters. Keeping nutrients out of the groundwater also protects surface waters, because groundwater surfaces in springs and flows into streams and rivers.

**Reduced pesticide use.** Because natural landscaping involves the establishment of balanced ecosystems, the use of herbicides, insecticides, and other pesticides is generally not required (though herbicides are often used to remove invasive plants during the establishment of natural landscapes). Reduced operation of lawnmowers and other lawn-care-related power equipment reduces air pollution both locally and regionally, thus improving health. And keeping pollutants out of water supplies also protects our health.

**Increased biodiversity.** Natural landscapes inherently support greater biodiversity than conventional turf landscapes. Native plants provide diverse food and habitat for birds, small mammals, insects, reptiles, and amphibians. In heavily developed urban areas, even small patches of natural landscape can be critical in maintaining populations of native fauna and flora.

**Cost avoidance.** Significant savings in landscape management costs can be realized by converting lawns to natural landscapes. While the initial costs of creating natural landscapes can be relatively high, annual operating costs of established natural landscapes are generally far lower than annual operating costs of lawn area. Operating cost savings were a primary motivation for the Metropolitan Water Reclamation District of Chicago to convert turf area to tall-grass prairie—to date, approximately 20 acres (8 ha) of turf has been restored to natural landscape, with guidance from Conservation Design Forum of Elmhurst, Illinois.

### Downsides of Natural Landscaping

While the arguments for natural landscaping are compelling, there are some challenges:

- The aesthetic palette is more limited. Strict adherence to an all-native landscaping program restricts plant choices, which many property owners (as well as landscape architects and landscapers) object to.
- Establishing and maintaining natural landscapes requires new knowledge and skills. There are both direct and indirect costs associated with building these skills, and there is often inherent resistance to change in any profession.
- Fire management, a key component of many—if not most—natural landscapes, poses obvious risk and liability. These risks gained national attention when, on May 4, 2000, a prescribed burn at Bandelier National Monument in Los Alamos, New Mexico, got out of hand and burned nearly 48,000 acres (19,400 ha), destroying 400 homes and causing more than a billion dollars in damage.
- Fire management also generates air pollution. Depending on the type of landscape and the weather conditions during a prescribed burn, however, these emissions are usually fairly low.

### Establishing Natural Landscapes

The key to establishing natural landscapes is careful planning to ensure that adequate management and stewardship is carried out until the landscape is established, at which point maintenance requirements become fairly minimal. Natural habitat landscaping is not about individual plant species but about ecosystems. With natural landscaping, the goal is to create balanced, self-sustaining ecosystems, not just assemblages of individual native plants. Because almost any ecosystem existing today has been degraded to some extent, creating a healthy, largely self-sustaining landscape often
requires significant restoration work.

**Dealing with invasive plants**

Invasive exotic plants are the bane of natural landscaping. Hundreds of plant species are wreaking havoc in ecosystems throughout North America. Each region of the country has particular invasive plant species that are problematic: from kudzu in the Southeast to honeysuckle and Japanese knotweed in the Northeast to cheatgrass and garlic mustard in the Midwest and West.

Strategies for removal of invasive plants all have advantages and disadvantages: hand-pulling is labor-intensive but safe for the environment; herbicides (such as Roundup©) are fast and easy but may have unintended consequences for other organisms in the ecosystem; turning over the soil (to kill turf grass, for example) avoids chemicals but may damage the soil structure and soil microorganisms; prescribed burns are often the best method to control invasives and allow the ecosystem to return to a pre-European settlement balance, but they cause safety concerns and air pollution.

The success of invasive plants is often related to changes in overall habitat conditions. When conditions that favor native species are restored through such restoration management tools as selective clearing to provide appropriate light levels and annual burn management, the invasive species are often gradually eliminated.

**Converting turf to natural landscapes**

A number of approaches can be taken to convert turf or other invasive vegetation to natural (restored) ecosystems. Short-lived herbicides are effective, and have the advantage of keeping root systems in place to help prevent erosion while new species are being established. Mechanical strategies, including repeated discing and harrowing, are also effective, and do not present any toxicity concerns. Sometimes simply easing off on mowing allows native species to gradually return—but this approach yields less certain results than complete replacement of the existing vegetation, and often nearby intact habitats do not exist.

In designing landscapes that will be managed with controlled burns, firebreaks often make sense. Roads can serve as firebreaks. Bands of turf grass along road corridors and around building can make sense to keep fire under control.

**Increasing people's comfort with natural ecosystems**

Given the American infatuation with lawns, social and psychological factors often emerge as barriers to natural landscape designs. Joan Nassauer, Ph.D., FASLA, of the University of Michigan, has researched human responses to various landscape designs.

Her research suggests that most Americans (indeed, people in most Western cultures) are uncomfortable with landscapes that they perceive to be wild or unmaintained, but are attracted to natural plantings within an obviously managed context. Signs of human care and attention to a space, whether it is a recently mown lawn or a freshly painted picket fence, represent what Nassauer calls "cues to care." Thus, boundaries of well-maintained turf around naturally landscaped areas not only provide firebreaks but also increase most people's comfort level with the native plantings.

**Which Grass is Greener: Comparing Natural and Artificial Turf**

Another alternative to the resource-intensive conventional lawn is artificial turf. Early adopters of plastic grass were professional sports teams, who had the cash to spend on the newest technologies. Artificial turf continues to replace natural playing fields not just for the pros but for college-level athletes and Little Leaguers alike.

And it doesn't stop there. Artificial turf is replacing grass in a variety of applications, ranging from community parks to parking-lot medians, and even outside American homes. Plastic grass sidesteps many of natural turf's downsides, but could it possibly be greener than grass itself?

**Early Artificial Turf**

The first artificial turf, which would become known as AstroTurf, was made by the Chemstrand Company, a subsidiary of the Monsanto Company, and installed in 1964 at the Moses Brown School in Providence, Rhode Island. In 1965, Monsanto's artificial turf was laid in Houston's Astrodome, the largest indoor sports facility in the world at the time.

Popular for its convenience, early artificial turf was largely loathed by the athletic community. First-generation artificial turf was typically stiff, low-pile polypropylene or nylon fiber adhered to a concrete or asphalt base. The fibers caused "turf burn," the hard base was less forgiving than soil, and athletes are united in their claims that first-generation turf caused more injuries than grass. Although this primitive turf is still available, it has been largely superseded by softer, safer, more naturalistic surfaces.

In the early 1990s, artificial turf began expanding from playing fields to other uses. Increasing incidences of drought, concern over the dangers posed by pesticides, and the grasslike look and feel of modern artificial turf have led to increasingly use of plastic grass in parks, day care centers, dog runs, and the yards of homes and businesses.
Second-generation artificial turf is significantly evolved from earlier products. The part of artificial turf that is the equivalent of the blades of natural grass is generally made of a green-colored, UV-stabilized polyethylene or polypropylene fiber in piles of two inches or higher. These blades are tufted into a porous backing, generally made of polyethylene, polypropylene, or polyurethane. Surrounding the blades of grass is a crumb layer of silica sand and/or rubber bits ranging in diameter from 0.3 to 1.5 millimeters. After the crumb layer is added, the blades typically stand about 3/4" tall (19 mm), though different heights can be specified for different applications. Many products include a shock pad. Finally, most manufacturers incorporate a drainage layer of crushed stone below the backing layer, and a few incorporate perforated-pipe drainage systems. Artificial turf systems are generally warranted for about eight years, but the actual life expectancy is unknown.

Bene it s o Ar tificial Turf

Recycled Content and Reusability.
The rubber bits in the crumb layer of artificial turf are often made from recycled tires. Memorial Stadium field at the University of Nebraska—Lincoln used 14,000 recycled Nebraska tires. Some artificial turf also incorporates recycled tennis shoes. If it is replaced before it is worn out, artificial turf can be reused. When Aloha Stadium, in Honolulu, Hawaii, upgraded its fields in 1999, and again in 2003, state officials donated the used AstroTurf to local high schools. RS Global, Inc., based in Carrollton, Texas, has removed artificial turf from more than one hundred used fields over the past three years. RS Global breaks the turf into pieces for use in smaller applications, such as batting cages.

Reduced water use.
From an environmental perspective, the potential for water savings is probably the most significant benefit of artificial turf. Plastic grass, of course, needs no irrigation to stay green. The only water used on artificial turf is to cool it down in extremely hot conditions or clean it, if necessary. The City of San Marcos, Texas awarded Southwest Texas State University with a Water Efficiency Achievement Award in 2003 for converting the natural field at Bobcat Stadium to SRI's AstroPlay ©, a move which the school estimates is saving more than 2 million gallons (7.5 million liters) of water each year.

Reduced pesticide and fertilizer use.
Since artificial turf needs no regular chemical treatment, it eliminates a major source of non-point-source groundwater pollution and human exposure to chemicals. For residential applications, artificial turf also offers the benefit of reducing the amount of chemicals (and dirt) tracked into homes. Artificial turf's chemical-free care may make it especially appropriate for daycare centers and dog yards, because children and pets spend more time than adults in close contact with grass, and they are affected more severely by contact with pesticides.

Reduced maintenance.
Artificial turf needs no mowing, watering, fertilizing, aerating, or reseeding, and it will not outgrow its painted field lines; synthetic grass, though, demands its own maintenance regimen. Caring for residential artificial turf generally involves just the occasional use of a leaf blower or a carpet rake. When necessary, artificial turf can be washed with a garden hose. Biological material, including leaves and feces, will not decompose as quickly on plastic as on natural grass, so when such materials find their way onto artificial turf, more maintenance is required to keep it tidy. Depending on its use, residential turf can often go six weeks or longer without any maintenance.

Turf Air quality an t e Atmosphere

Through the process of photosynthesis, grass converts carbon dioxide to oxygen and other gases. Turfgrass Producers International (TPI) claims that a 2,500 ft² (230 m²) lawn releases "enough oxygen for a family of four to breathe." Simultaneously, the absorption of carbon dioxide mitigates to some extent the process of global climate change. Another argument for natural grass is its ability to cool the surrounding area through evapotranspiration. According to TPI, lawns are 14°F (8°C) cooler than bare soil on hot days, or 30°F (17°C) cooler than asphalt. Natural grass also helps to clean the air: grass areas trap 12 million tons (10.8 million tonnes) of dust and dirt from the air each year, TPI reports, and some studies have shown that grass absorbs carbon monoxide.

Artificial turf, in contrast, frequently offgasses volatile organic compounds (VOCs). This could be a concern for children, who are often more sensitive to emissions, and especially for the rapidly growing number of Americans with asthma. Artificial turf also contributes to the urban heat-island effect. Although they look green from an angle, artificial fields are often closer to black when viewed from above, owing to the rubber layer surrounding the blades. Darren Gill, marketing manager for artificial turf company FieldTurf, says that in direct sun, artificial turf averages between 6 and 10°F (3—6°C) warmer than grass, though he's seen differences as high as 15°F (8°C). He also mentioned that in especially warm climates, maintenance staff sometimes spray sports fields with water once or twice a day to keep them cool. This tendency to heat up in hot weather makes artificial fields less appropriate in southern climates. Gill stresses that artificial turf cools quickly when it's not in direct sun.
Ecology

Of the 50 species cultivated for use as turf, only a handful dominate the market. In colder climates, four or five species are typically mixed for each application, according to Joyce, while in warmer climates turf is generally close to a true monoculture. The species of grass we commonly use on our lawns did not evolve here and are not adapted to America's climates and ecologies. Left to their own devices, most of these grasses would happily go dormant and turn brown during dry spells. Even where these species are native, they do not naturally grow in a monoculture, bereft of other plant species, as we expect them to do on our lawns and golf courses. Intruding plants and animals are called weeds and pests, and we obliterate them with chemicals. DDT, once a popular turf grass pesticide, was actually marketed as "the atomic bomb of the insect world."

A new movement in turf management shows some promise of improvement for biodiversity. In order to avoid the need for pesticides, fertilizers, and irrigation, some homeowners are planting grass species that are drought-tolerant or native to their climates. Buffalo grass, for example, native to America's central and southern Great Plains, is gaining popularity in hot climates. The Prairie Nursery Corporation, based in Wisconsin, has been marketing a mix of native fescue grasses for lawns since 1993. Their No Mow mix, including cool-season fescue grasses native to Oregon and Canada, was designed for the colder, less sunny climate of the northern U.S.

Kim Sorvig, research associate professor at the University of New Mexico, and co-author of Sustainable Landscape Construction: A Guide to Green Building Outdoors, is concerned about the soil conditions under artificial turf. "It blocks both water and sunlight either completely or in very large degree," he said, "and without that, you can't have a living system in the soil." Sorvig thinks it is ironic that artificial turf is heralded as a solution to water shortages, since it diminishes the health of the underlying soil, thereby decreasing its ability to hold water. "When you remove the vegetation from an area so completely," he said, "you're actually, in the long term, contributing to drought."

The only application for which Sorvig believes artificial turf is appropriate is indoor stadiums, since they are "already separated from the soil system." Ecology may be one area where neither artificial nor conventionally maintained natural turf can claim victory.

Biophilia

The biggest strength of artificial turf is also its biggest weakness. Artificial turf remains a "monofilament ribbon file product"; by definition, it can never be alive. So why bother to make it look or feel like the real thing? Nostalgia begins to explain our intangible trouble with artificial turf—gone are the stubborn grass stains and the smell of freshly mown grass. The best explanation, though, is that we feel an innate connection to good-old-fashioned grass.

Harvard biologist Edward O. Wilson sought to explain this phenomenon in his 1984 book Biophilia: The Human Bond with Other Species. Human beings, he argued, subconsciously seek a connection with other species and with life. Plastic grass will always feel foreign to us because it is not living and robs us of our cues to natural processes. It refuses to die—or even fade—as the seasons change.

So-called natural turf, it has been argued, is itself far from natural. Most turf grass yards and fields would be biological impossibilities without significant inputs of water, chemicals, and energy. Yet, grassy lawns feel natural. Perhaps our biophilic impulse is fooled by this seemingly natural landscape. Or perhaps it doesn't care—a living landscape is a living landscape, no matter how it came to be.

Final Thoughts

Conventionally managed natural turf carries a plethora of environmental burdens, but it does support soil organisms to some degree. The grass and these organisms play a crucial ecological role by purifying water as it leaches into the earth. It is questionable, though, whether this function is positive enough to offset the repercussions of watering, pest treatments, fertilization, and mowing.

Playing fields subject to heavy use, especially where pristine appearance is a priority, may represent a setting in which artificial turf can be justified. But the fact that it doesn't support soil organisms, and therefore is a biologically dead zone, suggests that its use should be limited.

In many situations, the optimal choice, at least from an environmental perspective, is a natural landscape of native or adapted plants. Approaching the condition of a natural ecosystem, such a landscape minimizes maintenance while offering biological diversity.

In places where a uniform, cropped surface is needed, natural turf managed in an ecologically sound manner is a good choice. Natural lawns and fields can be maintained responsibly by beginning with native and adapted species that require little or no water, allowing them to go dormant (and turn brown at times), and feeding them appropriate, organic fertilizers. Even mowing, when necessary, can be done using low-emitting and quiet machinery. The result may not live up to the standards of the Garden Club of America, but other species will approve.
low maintenance landscaping

Agricultural Experiment Station
and Cooperative Extension Service
Although the term Xeriscape* is relatively new in Kansas, the concept is not. It simply imitates nature’s design: putting hardy, adapted plant materials in the places where they grow best. Once established, this kind of landscape requires little maintenance because it is designed to work in harmony with nature, not against it.

Estimates indicate that nearly 50 percent of water the average household uses is for outside landscape and turfgrass areas. You can reduce your water use by imitating nature with a low-maintenance landscape design. It is applicable to both homes and businesses, on new building sites or previously landscaped sites. To be successful, it requires careful consideration and planning.

Ultimately, you will realize a savings not only in water but also in time, labor, equipment, and materials such as fertilizers and herbicides, and that’s dollars in your pocket. Furthermore, because of increasing demands on a limited water supply, a landscape with a record of low water bills may boost the resale value of your home.

A water-conserving landscape design involves using hardy, adapted plant materials which are suited to your particular location in Kansas, its soil and its climate. More specifically, it requires selecting plants according to soil type, slope and available rainfall. It means arranging these plant materials in such a way that they actually can contribute further to water conservation by reducing the evaporative effects of wind and sun in your yard or business site.

Typically the design would include native plant species, those that grow naturally in Kansas, but certainly is not restricted to them and is not boring. In fact, choosing this type of design can result in a greater diversity of plant materials from one yard to the next.

The seven Xeriscape principles are Planning and Design, Limited Turf Areas, Efficient Irrigation, Soil Improvement, Mulching, Lower Water-Demand Plants, and Appropriate Maintenance.

*Xeriscape is a trademark term of the National Xeriscape Council.
Designs can be simple or elaborate, but every plan should take into consideration factors that affect water use. Steep slopes or grades encourage water runoff and soil erosion. Drought-tolerant groundcovers, shrubs and trees can be used to slow down and absorb water, and to reduce evaporation by shading the soil. Terracing with plants is another possibility.

South- or west-facing exposures get maximum sunlight and can benefit from use of mulches or drought-tolerant plants. Wind increases the amount of plant moisture lost through evapotranspiration. Fences and screens can greatly reduce the amount of supplemental water needed by slowing or blocking the wind. Using trees and shrubs as windbreaks can be effective, if the species don’t require watering.

As trees provide shade which reduces the soil temperature and lowers water lost through evaporation, they also reduce air temperatures, which reduces water loss. Trees such as maples should be avoided in the low water use landscape. Their invasive surface-feeding roots compete with nearby plants for water and nutrients.

Plant trees and shrubs in attractive compositions and arrange plant materials along water-need zones to prevent overwatering some plants while underwatering others.

Turfgrass areas usually require the most water and maintenance in a landscape. Limit irrigated turfgrass areas to places with high use. Use low-maintenance and native grasses for other areas. The lawn must fit the landscape, but avoid making it long and narrow, which is more difficult to irrigate effectively. Select hardy, adapted lawn grasses suited to the site. Manage your lawn for stress, deep watering when needed.

Warm-season grasses—bermudagrass, zoysiagrass and buffalograss—are drought resistant. Cool-season grasses—bluegrass, fescue and ryegrass—require watering for maintenance (See table). Keep in mind that warm-season grasses do not grow well in shade. When nature is left to take its course, warm-season grasses will dominate sunny areas and cool-season grasses will dominate shady
<table>
<thead>
<tr>
<th>Turfgrass</th>
<th>Drought Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bermudagrass</td>
<td>excellent</td>
</tr>
<tr>
<td>Buffalograss</td>
<td>excellent</td>
</tr>
<tr>
<td>Zoysiagrass</td>
<td>excellent</td>
</tr>
<tr>
<td>Tall fescue</td>
<td>good</td>
</tr>
<tr>
<td>Bluegrass</td>
<td>fair</td>
</tr>
<tr>
<td>Ryegrass</td>
<td>poor</td>
</tr>
</tbody>
</table>

areas. You may see this as a patchwork look because the two types of grasses are different in texture and color. But the total water required will be reduced, and both types of grasses will grow best in the areas suited to them.

Cool-season grasses green up earlier in the spring and stay green later in the fall, which means a longer growing season. They also require more water than warm-season grasses during hot weather—most of the summer in Kansas.

An increased interest in using native grasses for lawns has developed in recent years due to their low water and maintenance requirements and naturalistic appearance. Most native grasses are warm-season grasses and must be planted in areas that receive full sunlight. Buffalograss is the most common native grass used in lawns. It grows best in areas with less than 25 inches of annual rainfall.

Native grasses should be watered and fertilized sparingly or not at all. Watering and fertilizing these grasses causes them to become weedy and you lose the low maintenance aspect of a native grass lawn. Under suitable conditions, native grasses can save water and maintenance, but the cost of seed is high and some watering to get them established is recommended. Weeds are the major problem in establishing a native grass lawn.

Lawn watering and maintenance reduction must be accompanied by a reduction in the amount of fertilizer applied and adjustment of other cultural practices. Taller mowing helps control weeds and reduces watering and mowing frequency. The amount of fertilizer you put on a lawn determines your maintenance program.

The amount of mowing, watering, problems and pests is largely related to the amount and timing of fertilizer
Total Nitrogen per Year

<table>
<thead>
<tr>
<th>Cool-season grasses</th>
<th>lbs.</th>
<th>Warm-season grasses</th>
<th>lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>High maintenance</td>
<td>4*</td>
<td>(low to high range)</td>
<td></td>
</tr>
<tr>
<td>Good maintenance</td>
<td>3</td>
<td>Bermudagrass</td>
<td>2-4*</td>
</tr>
<tr>
<td>Low maintenance</td>
<td>2</td>
<td>Buffalograss</td>
<td>0-2</td>
</tr>
<tr>
<td>Minimal maintenance</td>
<td>1</td>
<td>Zoysia</td>
<td>1-3</td>
</tr>
</tbody>
</table>

*lbs. AN/1000 sq. ft. (AN = actual nitrogen)

Efficient watering is part of the low-maintenance design. Your landscape design should incorporate zones for water need areas—high, medium, low or none at all.

Prevent runoff; harvest water! Collect or redirect water from the downspouts to areas of the landscape that need it. Select and combine different irrigation systems—drip, trickle, sprinkler. Water slowly, deeply and infrequently.

Each type of plant has a maximum depth to which its roots will grow. Roots will penetrate only to that depth where water, air and nutrients are present. Deep watering encourages deep rooting, increasing the reservoir of water so plants can go longer between watering. Deeply placed water is also less subject to loss by evaporation from the soil surface.

The roots of most small trees and shrubs may reach up to 6 feet deep, while smaller shrubs or flowers may root 2–4 feet deep. Consider grouping plants together that may be shallow rooted and require more frequent watering such as flower beds or a mixed border of small shrubs.

It is important to water only long enough to wet the soil to the depth of the root system and not beyond because this is a waste of water. A soil probe or thin rod pressed into the soil will go in easily until it reaches the dry zone.

The most critical factor in determining water use is weather—temperature, humidity, wind, sunlight, and precipitation. There is a constant flow of water through plants, bringing nutrients to the upper plant parts. This
transpiration flow of water increases as conditions cause
greater movement of water through a plant.

Most of the absorption of water and nutrients occurs
in the upper half of the root system, thus water should be
applied directly to the soil surface or the root zone. Water
applied to plant leaves and tops is wasted, especially in hot
weather, because much of it will evaporate before it
reaches the ground.

Most small trees and shrubs should be watered to wet
the soil to a depth of 4 feet once a month or every 6 weeks.
Plants with shallow roots require more frequent soaking,
perhaps to a depth of 2–3 feet every 2–4 weeks. Remember,
the water requirements for a mature landscape allow
flexibility in this watering pattern; those of a newly planted
landscape do not.

Know your soils. Improving the soil helps conserve
water. Adding organic matter is by far the most important
soil improvement affecting water use. A soil test, which is
available through your county Extension office, will deter-
mine the organic matter level of your soil.

In sandy soils, organic matter slows down the rapid
movement of water through the soil, making it more avail-
able to plant roots. In heavy clay soils, the addition of
organic matter increases infiltration of moisture, which
prevents runoff and wasted water.

Adding organic material is easiest and most effective
before planting. Incorporate at least 2–3 inches of organic
matter into the top 8 inches of the planting area unless your
soil test indicates otherwise. Because organic matter
continually decomposes, it needs to be replenished on
a yearly basis. Applying an organic-type mulch is the most
effective way to do this in an established landscape.

<table>
<thead>
<tr>
<th>Types of Organic Matter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straw</td>
</tr>
<tr>
<td>Well rotted manure</td>
</tr>
<tr>
<td>Leaf mulch</td>
</tr>
<tr>
<td>Peat moss</td>
</tr>
<tr>
<td>Lawn clippings</td>
</tr>
<tr>
<td>Compost</td>
</tr>
<tr>
<td>Well rotted sawdust</td>
</tr>
<tr>
<td>Wood chips</td>
</tr>
<tr>
<td>Shredded bark</td>
</tr>
<tr>
<td>Green manures</td>
</tr>
</tbody>
</table>
In areas with hardpan—an underlying layer of clay—subsoiling is recommended before planting. Plants growing on top of unbroken hardpan are more vulnerable to water fluctuations because of the shallow growing area. Planting a deep-rooted legume can be effective in breaking up hardpan, although it may take some time to accomplish.

Mulches can do much more than cut down on water use. They also can improve soil texture, suppress weeds, lower soil temperature, and add ornamental value to the landscape. How well a mulch conserves moisture is determined by its composition and how deeply it is applied.

Common mulches range from wood chips, stone and gravel to landscape fabric, plastic and polyethylene film. Deciding which mulch to use will depend on its cost, availability, ease of use, durability and appearance in your particular landscape. Each mulch has advantages and disadvantages.

Plastic or polyethylene film prevents moisture evaporation effectively; is thin, lightweight, and inexpensive. Perforated plastic is more expensive. Some disadvantages are you must punch holes to let in water and air; it is unsightly; must be covered with another material; doesn’t improve soil; and can cause roots to concentrate at the soil surface, increasing drought susceptibility.

Landscape fabric—Geotextiles, Weed Barrier, Weed X, Weed Block—are water and air permeable; suppress most water-competing weeds; and are durable. They are, however, expensive; allow some weeds to grow; and must be covered by a top mulch layer.

Wood chips, tree trimmings, and shredded or chunk bark are relatively inexpensive; let in water and retain it in soil; break down to improve soil texture; and suppress weeds if the smaller size is used. The most effective depth for these mulches is 3–4 inches. These materials do break down in 1–3 years, depending on particle size and type of tree used. Smaller sized particles may require addition of nitrogen for plants.
Stone and gravel allow moisture in and retain it in the soil; are long lasting; come in a variety of sizes; suppress weeds; and can have an ornamental appearance. Prices vary with size and type. They do not improve soil; are unattractive if used in a large area; increase soil temperature and glare; and tend to get scattered by lawn mowers and small children.

Selecting lower water use plant materials is essential. A partial list of plants appears at the end of this publication. Check with a nursery for your particular site needs.

Once the planning and planting are complete, maintenance becomes the key to a successful low water use landscape. Mowing, pruning, weeding, mulching and fertilizing will maintain your landscape in a healthy, productive and beautiful condition for years to come.

Selecting Plant Materials

Consider the importance of turfgrass qualities such as drought, cold, heat and shade tolerances, wearability, and fertilizer requirements in your landscape plan; then choose the species that meet your needs. (The following turfgrass information adapted from “Conserving Water in the Landscape,” Nebguide published by Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska—Lincoln.)

- Drought tolerance of popular turfgrasses, ranging from most to least tolerant: buffalograss, bermudagrass, zoysiagrass, tall fescue, Kentucky bluegrass, perennial ryegrass.
- Cold tolerance of popular turfgrasses, ranging from most to least tolerant: Kentucky bluegrass, buffalograss, tall fescue, perennial ryegrass, zoysiagrass, bermudagrass.
- Heat tolerance of popular turfgrasses, ranging from most to least tolerant: buffalograss, bermudagrass, zoysiagrass, tall fescue, Kentucky bluegrass, perennial ryegrass.
- Shade tolerance of popular turfgrasses ranging from most to least tolerant: tall fescue, perennial ryegrass, Kentucky bluegrass, zoysiagrass, bermudagrass, buffalograss.
The shade tolerance of a grass depends on many conditions. Check with your county Extension agent for more information on suitability of turfgrass species for your specific site.

- Wearability of popular turfgrasses, ranging from those that can withstand most wear to least wear: bermudagrass, zoysiagrass, tall fescue, perennial ryegrass, Kentucky bluegrass, buffalograss.

- Fertilizer requirements for popular turfgrasses, ranging from most to least: Kentucky bluegrass, perennial ryegrass, tall fescue, bermudagrass, zoysiagrass, buffalograss.

While a lawn may exist on low amounts of fertilizer, a high-quality lawn will require moderate amounts. The cultivar, soil type and climate greatly influence fertilizer needs.

The following plants are adapted to all parts of Kansas though some may need protection in certain areas of the state. All require regular watering until well-rooted and established. This may take 1–2 years or more, depending on the type and size of plants. Only after the plants are established can water be reduced or, in some cases, eliminated. Remember, check with your nursery for your particular site needs!

- **Tall Deciduous Trees (over 45')**— Black Walnut, Chinkapin Oak, Common Hackberry (‘Prairie Pride’ and other cultivars), Green Ash, Honeylocust (‘Skyline’ and other cultivars), Kentucky Coffeetree, Sawtooth Oak, Bur Oak.

- **Medium Deciduous Trees (30–45')**— Aristocrat Pear, Goldenrain Tree, Lacebark Elm (True Chinese Elm), Osage Orange (thornless and fruitless), White Mulberry (fruitless).


- **Large Deciduous Shrubs (over 8')**— Autumn Olive, Beauty Bush, Border Privet, Chokecherry, Common Buckthorn, Elderberry, Lilac, Mountain Ninebark, Ninebark,

- **Medium Deciduous Shrubs (4-6')**—Butterfly Bush, Cherry Prunsepia, Dwarf Ninebark, Flowering Quince, Forsythia, Fragrant Sumac, Japanese Barberry, Korean Lilac, Mentor Barberry, Mockorange, Serviceberry, Shining Sumac, Spirea (Vanhoutte), Spreading Cotoneaster, Tartarian Honeysuckle, Three Leaf Sumac.

- **Small Deciduous Shrubs (under 4')**—Alpine Currant, Bluemist Spirea, Common Bladder Senna, Coralberry (Buckbrush), False Indigo, Golden Currant, Golden St. Johnswort, Gooseberry, Hardy Potentilla, Leadplant, New Jersey Tea, Prairie Rose, Pygmy Pea Shrub, Russian Sage.


- **Large Evergreen Shrubs**—Junipers, Mugho Pine.

- **Medium Evergreen Shrub**—Junipers, Mahonia, Manhattan Euonymus.

- **Small Evergreen Shrubs**—Compact Mahonia, Compact Mugho Pine, Juniper, Soapweed, Yucca.

- **Groundcovers for shade (beneath trees, shrubs, or along north walls)**—Bergenia, Bishop’s Weed, Hall’s Honeysuckle, Mahonia, Creeping Grape Holly, Periwinkle, Potentilla (Cinquefoil), Sweet Woodruff.

- **Groundcovers for full sun**—Baby’s Breath (Creeping), Bachelor Buttons, Bird’s Foot Trefoil, Crownvetch, Border Jewel (Himalayan), Buttercup (Creeping), Catmint, Creeping Junipers, Daylily (most species), Evergreen Candytuft, Gro-Low Fragrant Sumac, Hall’s Honeysuckle, Hen and Chicks, Lilyturf, Mock Strawberry, Phlox (Creeping), Pussytoes, Ribbon Grass, Rock Soapwort, Sedum (Stonecrop), Silvermound, Snow in Summer, Spurge (Cushion), Spurge (Donkey-tail), Thyme (Creeping), Veronica (Rock Speedwell), Wintercreeper, Woolly Yarrow.
Ornamental Grasses— Big Bluestem, Blue Fescue, Blue Oat Grass, Feather Reed Grass, Fountaingrass (annual), Fountaingrass (perennial), Indiangrass, Little Bluestem, Oat Grass, Quaking Grass (annual), Ravenna Grass, Ribbon Grass, Sideoats Grama, Weeping Lovegrass.


For assistance with identifying low-maintenance, drought-tolerant plants for your home or business landscape design, contact your county Extension office.

*Brand names appearing in this publication are used for product identification. No endorsement is intended, nor is criticism of similar products not mentioned.*
It is the policy of Kansas State University Agricultural Experiment Station and Cooperative Extension Service that all persons shall have equal opportunity and access to its educational programs, services, activities, and materials without regard to race, color, religion, national origin, sex, age or disability. Kansas State University is an equal opportunity organization. Issued in furtherance of Cooperative Extension Work, Acts of May 8 and June 30, 1914, as amended. Kansas State University, County Extension Councils, Extension Districts, and United States Department of Agriculture Cooperating, Marc A. Johnson, Director.
REQUEST FOR SPECIAL EXCEPTION FOR ARTIFICIAL TURF CHECK LIST

☐ Signed & Notarized Special Exception Application

☐ Signed Authorization for Agent Affidavit (if applicable)

☐ $750.00 Application Fee

☐ A copy of the deed or other evidence of ownership.

☐ Date applicant met with the representatives of Urban Design staff prior to the submission of a Special Exception Application ________________

☐ Two copies (2) of a detailed signed and sealed site survey of the property that is less than one year old that indicates the location of existing trees and shrubs and all other improvements on the property.

☐ Two copies (2) of the landscape plot plan indicating the proposed location of the artificial turf and other landscape materials. Setbacks to the seawall will be required to be shown for any trees, large shrubs, curbing, areas of rock beds or boulder type landscape material that is planned. All landscape plans must meet minimum standards as denoted in this Article.

☐ If the property is zoned commercial or multi-family, a copy of an approved Southwest Florida Water Management District Permit shall be included in the permit application.

☐ Evidence that the artificial turf proposed will have a minimum tufted weight of 56 ounces per square foot, be a natural green in color, and have a minimum 8 year warranty. A sample of the turf proposed that meets these standards shall be submitted with the Special Exception application including a copy of the manufacturers specifications and warranty information.

☐ Evidence that all artificial turf installations will have a minimum permeability of 30 inches per hour per square yard and provide anchoring information as to the size and location of anchors to ensure the turf will withstand the effects of wind.

☐ Consideration of the percentage of living plant materials versus percentage of artificial turf proposed for any property shall be part of the review process. Evidence that living plant material will be drought tolerant and consist of 50 percent Florida native species including shrubs, vines, trees, and ground covers.

☐ Certificate of Appropriateness application and application fee if property is located within the National Register Historic Overlay District, listed on the National Register, or property listed on the Florida Master Site File by the State of Florida Department of State, Bureau of Historic Preservation of the Division of Historical Resources.

Florida Master Site File No. ________________________ Contributing Structure ☐ Yes ☐ No
REQUEST FOR SPECIAL EXCEPTION FOR ARTIFICIAL TURF

Date Received ____________________  File Number  SE-

Application Fee: $750.00  
Continuance: $500.00

This application, with all required supplemental data and information, must be completed in accordance with the specific instructions in the application, and returned to the Urban Design before same will be advertised for a hearing.

IMPORTANT: The applicant or his representative MUST be present at the hearing. There will be a fee of $500.00 for a Voluntary Continuance (a request by the applicant to continue a petition before the appropriate board or council, or by the failure of the applicant to attend or be represented at the appropriate meeting).

1. Name of Applicant(s): ________________________________
   Address: ________________________________  Phone: ________

2. Owner(s) of Record: ________________________________
   Address: ________________________________  Phone: ________

4. Attorney or Agent: ________________________________
   Address: ________________________________  Phone: ________

5. Property Address or Street Name: ____________________

6. Property Legal Description:

<table>
<thead>
<tr>
<th>Parcel ID / Account #</th>
<th>Lot #</th>
<th>Block #</th>
<th>Section</th>
<th>Total Sq Feet/ Acres</th>
<th>Existing Zoning</th>
</tr>
</thead>
</table>

7. Artificial Turf Use Location:
8. Written statement describing the proposed use:

9. What is the minimum tufted weigh per square foot: ________________

10. What is the permeability per hour per square yard: ________________

11. What is the anchor size and location: ____________________________

12. How long is the manufactures warranty: __________________________

13. Approval Criteria. The Planning Commission and City Council shall use the following criteria, in addition to other reasonable considerations, in making their decision please explain your position on the following:

(1) The proposed use will not adversely affect the use of neighboring properties.

(2) The use shall comply with applicable district regulations and applicable provisions of the adopted Comprehensive Plan and downtown plans.

(3) The location, size and height of buildings structures, walls and fences, and the nature and extent of screening, buffering and landscaping shall be such that the use will not hinder or discourage the appropriate development and use of adjacent or nearby land and/or buildings.

(4) The proposed use will be such that pedestrian and vehicular traffic generated will not be hazardous or conflict with the existing and anticipated traffic in the neighborhood and on the streets serving the site.
Any Special Exception granted to allow artificial turf shall include the following conditions:

1. Precautions for installation around existing trees shall be monitored and may be restricted to ensure tree roots are not damaged with the installation of the base material.
2. Rubber, sand and any other weighting or infill material is prohibited.
3. If artificial turf is planned to be installed next to the seawall, the artificial turf shall be pinned or staked behind the seawall. Nothing shall be attached directly to or placed on the seawall or seawall cap.
4. A copy of the Special Exception and conditions thereof shall be recorded in the Public Records of Charlotte County so that any subsequent purchaser will be on notice regarding the special rules relating to the artificial turf.
5. A landscape inspection shall be conducted after the installation of the artificial turf to ensure all living plant materials conform to the provided landscape plot plan and meet the drought tolerant and native species requirements.
6. If artificial turf is to be installed in the City right-of-way, a separate right-of-way permit must be obtained prior to commencing work.
7. Artificial turf shall be maintained in a green fadeless condition and shall be maintained free of dirt, mud, stains, weeds, debris, tears, holes, and impressions, as determined by Code Compliance. All edges of the artificial turf shall not be loose, and must be maintained with appropriate edging or stakes.
8. Artificial turf must be replaced if it falls into disrepair with fading or holes or loose areas, as determined by Code Compliance. Replacement shall be completed within 60 days of notification by Code Compliance.
9. If maintenance is required on the City right-of-way, or utility easement, it shall be the responsibility of the property owner to remove, replace and repair, at the owner’s expense, any artificial turf that has been placed in the right-of-way or utility easement within 60 days.
10. If maintenance is required on the seawall and/or seawall cap, it shall be the responsibility of the property owner to remove, replace and repair, at the owner’s expense, any artificial turf that has been placed in the rear yard of the property abutting the seawall within 60 days.
11. The City of Punta Gorda shall not be held liable for any damage to any artificial turf or other items placed within the right-of-way, within six feet of the seawall, or within any area covering any city utilities.
I, the undersigned, being first duly sworn, testify and say that I am the owner, attorney, attorney-in-fact, agent, lessee or representative of the owner(s) of all of the property described and which is the subject matter of the proposed hearing; that all answers to the questions in this application, and all sketches, data and other supplementary material attached to and made a part of the application are honest and true to the best of my knowledge and belief. I understand this application must be complete and accurate before the hearing can be advertised, and that I am authorized to sign the application by the owner or owners.

By submitting this application the owner(s) of the subject property does hereby grant his/her consent to the Zoning Official and his/her designee, to enter upon the subject property for the purposes of making any examinations, surveys, measurements, and inspections deemed necessary to evaluate the subject property relative to this application.

Sworn and subscribed before me this _______ day of ____________, 20__.

Signature of Applicant or Authorized Agent  
Type of Print Name and Title

Address: ________________________________  
______________________________________

STATE OF ____________)  
COUNTY OF ____________)  

The foregoing instrument was acknowledged before me this ______ day of ___  
__________________, 20__, by ________________________________, who is  

personally known to me or who has produced ________________________________ as identification and who did not take an oath.

______________________________  
Notary Public, State of Florida  
(Seal)

My commission Expires: ______________
AFFIDAVIT
AUTHORIZATION FOR AGENT

I/We__________________________________________, property owner(s), hereby authorize ___________________________ to act as Agent on our behalf regarding a __________________ application on the property described as: (legal description) ____________________________________________, a/k/a __________________________ in Punta Gorda, Florida.

_____________________________________________  ______________
Owner                                            Date

STATE OF ____________ )
COUNTY OF ____________ )

The foregoing instrument was acknowledged before me this ______ day of _____
______________, 20__, by ________________________________________________, who is personally known to me or who has produced ______________________________________ as identification and who did not take an oath.

_________________________________________ (Seal)
Notary Public, State of Florida

My commission Expires: _____________________
June 19, 2011

Mr. Charles Blaser, Chairman  
Members  
Lawrence-Douglas County Metropolitan Planning Commission  
City Hall  
Lawrence, Kansas 66044

RE: ITEM NO. 11: TEXT AMENDMENT TO CITY OF LAWRENCE DEVELOPMENT CODE; CHAPTER 20; SYNTHETIC TURF AS LANDSCAPING MATERIAL (MKM)

Dear Chairman Blaser and Planning Commissioners:

We would like to thank the Staff for providing the valuable background information on the use of artificial turf. We especially appreciate staff recommendation of denial for its use in landscaping, and in its place the use of “low maintenance (natural) landscaping.”

The reference material, as did the Staff Report, made clear the important reasons why this material should not be substituted for natural vegetation as groundcover. When it is so important to save energy, conserve our soil and protect the environment from pollution, the use of artificial turf for landscaping is not only counterproductive, but also environmentally damaging. As one of our members pointed out, artificial turf doesn’t even save water because the other portions of the landscaping such as trees and shrubs must still be watered.

Thank you for your valuable information and negative recommendation on the use of artificial turf in landscaping.

Sincerely yours,

Caleb Morse  
Member of the Board

Alan Black  
Chairman  
Land Use Committee
LAWRENCE DOUGLAS COUNTY PLANNING COMMISSION
AGRITOURISM COMMITTEE
REPORT AND RECOMMENDATIONS

The Agritourism Committee of the Lawrence Douglas County Metropolitan Planning Commission was formed in January of 2010 to study agritourism and make recommendations to the Planning Commission regarding options which could be undertaken to promote and facilitate agritourism activities as well as possible revisions to the Zoning Regulations which would ensure the public health, safety, and welfare is protected while agritourism is facilitated. Agritourism is one means of promoting economic development in Douglas County, although there are certainly other benefits, such as providing additional income for residents engaged in agritourism activities, allowing them to maintain the rural/agricultural lifestyle, and increasing the long-term sustainability of family farms in Douglas County.

Members of the Agritourism Committee include:

- Nancy Thellman, Douglas County Commissioner
- Chuck Blaser, Planning Commission Chair
- Rick Hird, Planning Commissioner and Committee Chair
- Mary Miller, Planning Staff
- Judy Billings, Freedoms Frontier Chair
- Clint Hornberger, Farm Bureau and Chamber of Commerce Representative
- Hank Booth, Lawrence Chamber of Commerce
- Becky Rhodes, Kansas Department of Commerce
- Pep Selvan, Bluejacket Crossing Winery
- Linda Finger, Douglas County Planning Resource Coordinator
- Keith Dabney, Douglas County Zoning and Codes Director

PROCESS:
The early meetings of the Agritourism Committee focused on defining agritourism and identifying the agritourism uses that currently exist in Douglas County. A draft definition of agritourism was developed and amended as the meetings progressed. A map showing where the agritourism uses identified by the committee are located is included in Figure 1 at the end of this report.

Township trustees and the County Engineer were invited to the November, 2010 meeting for a discussion on rock roads and agritourism uses. Keith Browning stated that Calcium Chloride is the cheapest and most effective dust palliative treatment available. A map showing where dust palliative was applied in 2010 is included in Figure 2 at the end of this report. The following is a summary of the discussion on the dust palliative program:

Residents pay for the dust palliative treatment and also for the cost of the township to prepare the road. Cost of the dust palliative is $1.60 per linear foot with 60 cents a linear foot going to the township for preparation costs. The township prepares the road to stabilize it, and to create a crown to insure adequate drainage so when
the palliative has been applied they will not need to work it again. Dust palliative usually lasts through the summer and most of the year. It is applied in 2 applications, once in May and again about a month later. For areas that do it 4 to 5 years in a row, there is a residual effect. They could even skip a year and still have effective dust treatment.

Dust palliative is available all year, but the County may not have enough on hand if a person didn’t sign up in January. It would be possible for them to go through the County’s contact to get dust palliative, but they would need to make arrangements with the township about the road preparation.

Agritourism operators in Douglas County were invited to the January, 2011 stakeholder meeting. The meeting’s goal was to identify issues that stakeholders felt presented the greatest challenges to establishing and operating agritourism businesses, and what changes would be most beneficial in supporting and encouraging agritourism. The principal concern noted was the process involved with the Conditional Use Permit (CUP). Suggestions for improvement included the following:

- remove the time-limit on CUPs but have administrative reviews at regular intervals,
- develop a Special Event Permit for infrequent or more temporary agritourism uses.
- allow low-intensity agritourism uses through registration.

This report is divided into five sections:

1. Mission Statement
2. Definition of Agritourism
3. Economic Impact of Agritourism
4. Applicable Zoning, Permits, Codes and Other Laws and Regulations now if effect
5. Issues and Recommendations

1. MISSION STATEMENT

The Mission Statement adopted by the Agritourism Committee is as follows:

The Agritourism Committee will study existing laws, regulations and procedures and propose changes designed to foster and promote Agritourism in Douglas County. The Agritourism Committee will:

- Establish a definition of Agritourism
- Evaluate the economic impact of Agritourism activities
- Evaluate the effect of zoning regulations, building codes and other laws and regulations on the development of Agritourism activities
- Make recommendations to the Planning Commission to assist in the promotion of Agritourism
2. DEFINITION OF AGRITOURISM

Agritourism is defined in several different ways by various agencies and groups. In 2004, the Kansas Legislature adopted the Agritourism Promotion Act, K.S.A. 74-50,165, et seq (the “Act”). The purpose of the Act is described as:

The purpose of this act is to promote rural tourism and rural economic development by encouraging owners or operators of farms, ranches, and rural attractions, including historic, cultural, and natural attractions, to invite members of the public to view, observe and participate in such operations and attractions for recreational or entertainment purposes. This act shall be liberally construed to effectuate that purpose. K.S.A. 74-50,166.

The Act provides a manner for registration of agritourism activities with the Kansas Secretary of Commerce and, with appropriate posted signage, provides some insulation from liability for agritourism operators. The Act defines agritourism as:

...[A]ny activity which allows members of the general public, for recreational, entertainment or educational purposes, to view or enjoy rural activities, including but not limited to, farming activities, ranching activities or historic, cultural or natural attractions. An activity may be an agritourism activity whether or not the participant pays to participate in the activity. An activity is not an agritourism activity if the participant is paid to participate in the activity. K.S.A. 74-50,167(a)

The Committee was somewhat divided regarding the scope of activities that should be considered within the umbrella of agritourism. The following definition adopted by the Committee is a combination of the statutory definition and the definition used by the Kansas Department of Commerce and other authors:

Agritourism: The intersection of agriculture and tourism. When the public goes to rural areas for recreation, education, enjoyment, entertainment, adventure or relaxation. Using the rural experience as a tool for economic development.

Using that definition, the Committee suggests the following as examples (although not exhaustive) of agritourism activities:

- Recreation
  - Hiking
  - Hunting, fishing
  - Equestrian
  - Bicycling

- Education
  - Agricultural operations
  - Food production
  - Ranching operations
  - Historical farms
  - Preserved prairies and other natural areas
- **Entertainment**
  - Demonstrations of agricultural operations
  - Integration of music, theatre, arts to enhance rural experience
  - Gatherings, events, and festivals
  - Shopping
  - Farmer’s Markets

- **Adventure**
  - Discovery of new areas
  - Experiencing wildlife
  - Hands-on involvement in agriculture or ranching

- **Relaxation**
  - Enjoyment of rural settings, vistas
  - Change of pace
  - Escape from urban environment
  - Bird Watching

### 3. ECONOMIC IMPACT OF AGRITOURISM

The following information was taken from the K-State report “Agritourism: If We Build it Will They Come?” written by Dan Bernardo, Luc Valentin, and John Leatherman (Professor and Department Head, Research Assistant, and Associate Professor, respectively, Department of Agricultural Economics, Kansas State University’).

“Despite its relative infancy, agritourism represents a significant revenue source for many farmers across the nation. To lend perspective to the importance of agritourism as a revenue source, estimates of total and average annual income generated from on-farm recreation are reported in Table 2 for eight USDA regions” (page 4) Kansas is included in the ‘Prairie Gateway’ group in the following table along with Western Oklahoma, Nebraska, and Central Texas.

<table>
<thead>
<tr>
<th>Region</th>
<th>Annual Total Income</th>
<th>Average Income/Farm</th>
<th>% of Farms w/ Recreation Income</th>
<th>Avg. Income for Farms w/ Recreation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heartland</td>
<td>$38,500,000</td>
<td>$90</td>
<td>7%</td>
<td>$1,286</td>
</tr>
<tr>
<td>Northern Crescent</td>
<td>$298,000,000</td>
<td>$963</td>
<td>2%</td>
<td>$48,150</td>
</tr>
<tr>
<td>Northern Plains</td>
<td>$14,000,000</td>
<td>$138</td>
<td>5%</td>
<td>$2,760</td>
</tr>
<tr>
<td><strong>Prairie Gateway</strong></td>
<td><strong>$79,000,000</strong></td>
<td><strong>$267</strong></td>
<td><strong>4%</strong></td>
<td><strong>$6,675</strong></td>
</tr>
<tr>
<td>Eastern Uplands</td>
<td>$5,000,000</td>
<td>$14</td>
<td>1%</td>
<td>$1,400</td>
</tr>
<tr>
<td>Southern Seaboard</td>
<td>$37,800,000</td>
<td>$161</td>
<td>3%</td>
<td>$5,366</td>
</tr>
<tr>
<td>Fruitful Rim</td>
<td>$278,600,000</td>
<td>$1,127</td>
<td>3%</td>
<td>$37,566</td>
</tr>
<tr>
<td>Basin &amp; Range</td>
<td>$36,700,000</td>
<td>$437</td>
<td>6%</td>
<td>$7,283</td>
</tr>
<tr>
<td>Mississippi Portal</td>
<td>$8,000,000</td>
<td>$69</td>
<td>1%</td>
<td>$6,900</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$796,000,000</strong></td>
<td><strong>$368</strong></td>
<td><strong>2%</strong></td>
<td><strong>$9,200</strong></td>
</tr>
</tbody>
</table>
The report stated that “Agritourism is being proposed as a local and statewide economic development strategy. As such, it is useful to estimate the economic impact of this industry on the state’s economy. An economic impact analysis was conducted to determine both the direct economic impacts of spending by visitors participating in agritourism and the indirect effects arising from the new income generated by that spending.” (page 11, Agritourism: If We Build It Will They Come?)

Staff contacted the authors of the report who clarified that the information in Table 3 was a model estimation of spending associated with agritourism uses in Kansas. Table 2 shows the total income for the Prairie Gateway and the authors estimated Kansas’ share at $18,000,000. The information in Table 3 shows approximately $18,000,000 of farm income (farm products + farm services). The other figures are associated estimated expenditures that would occur in conjunction with agritourism uses.

<table>
<thead>
<tr>
<th>Table 3.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
</tr>
<tr>
<td>Farm Products</td>
</tr>
<tr>
<td>Farm Services</td>
</tr>
<tr>
<td>Travel Costs</td>
</tr>
<tr>
<td>Lodging</td>
</tr>
<tr>
<td>Eating &amp; Drinking</td>
</tr>
<tr>
<td>Other Retail</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>TOTAL</td>
</tr>
</tbody>
</table>

“The combined direct and indirect economic impact associated with agri-tourism in 2000 was estimated to be between $25 and $78 million (in 2004 dollars). The low estimate arises from spending generated from out-of-state sources and the high estimate is spending originating from both in-state and out-of-state sources. To the extent that spending by Kansas residents would likely not occur in rural regions had it not been spent on an agritourism activity, the high estimate can be construed as an estimate of the economic impact on the state’s rural economy.” (page 12, Agritourism: If We Build It Will They Come?)

In addition, it was estimated that the federal government collected approximately $2.9 million in tax revenues and that state and local governments garnered approximately $2 million from the varied activities associated with agritourism spending by out-of-state visitors in 2000. If in-state tourism activities are included, then tax collections increase to $9.06 and $6.25 million, respectively.

**In summary, agritourism has a positive economic impact not only on the farm family involved in the activity, but the community as a whole.**
4. APPLICABLE ZONING, PERMITS, CODES AND OTHER LAWS AND REGULATIONS

A) ZONING
The following are examples of agritourism uses that are permitted by right, that is no CUP is required:
- Pick Your Own Fruit/Vegetables Patches
- Agricultural Demonstrations
- Seasonal Sale of Products Raised on the Site
- Commercial Hunting and Fishing
- Commercial Riding Stable (site plan is required)
- Country Club (site plan is required)

B) CUP
Some Agritourism uses which are not permitted by right can be approved with a Conditional Use Permit. Uses listed in Section 12-319-4 of the Zoning Regulations require a CUP. These include the following agritourism uses:
- Farmer’s Market,
- Dude Ranch,
- Fruit or Vegetable Stand,
- Recreation Facility.

Outline of the CUP process:
A pre-application meeting with staff is recommended to outline the process and identify possible challenges/opportunities.

— Application.
If the application is filed before the deadline, the Planning Commission may consider it at the meeting following their next meeting. For instance, if a CUP is filed by June 20, 2011 the Commission will consider it at their August 22, 2011 meeting. (Approximately 60 day review period.)

— Review.
The application is distributed to County Staff, Utility Providers, Township Trustees, Drainage District Representatives, and Fire Departments. A letter is then mailed to the applicant listing any concerns which were raised regarding the proposal or the plans which were provided. Revisions to the proposal or revised plans may be requested.

— Public Hearing.
Notice is mailed to property owners within 1000 ft of the property included in the CUP and a public hearing is held with the Planning Commission. If the property is within 3 miles of Eudora, Baldwin City, or Lecompton a joint Planning Commission meeting is held.

— Planning Commission.
The Planning Commission conducts a public hearing and votes to forward the item to the County Commission with a recommendation for approval, approval with conditions, approval with revised conditions or denial. The Commission may also vote to defer the item if additional information is needed.

— **Protest Period.**

A mandatory 14 day waiting period is provided before the CUP request is scheduled for consideration by the Board of County Commissioners to allow time required by State Statutes for the filing of a ‘protest petition’. If a valid protest petition is filed, approval of the CUP requires a unanimous vote of the County Commission (3/4 majority required).

— **County Commission.**

The County Commission considers the CUP request and accepts public comment. The County Commission could take one of the following actions: approve, approve with conditions or deny the CUP. They may also vote to defer the CUP if necessary.

— **Building Permits.**

Building permits may be applied for concurrently with the CUP request and are required for any new building or change of use of an existing building.

— **Conditional Use Permit.**

A permit for the Conditional Use is issued by the Douglas County Zoning and Codes Office.

C) **BUILDING AND OTHER COUNTY CODES**

- Agricultural buildings - K.S.A. 74-50,167(b)
- Douglas County Sanitary Code
- Uniform Building, Uniform Mechanical, and Uniform Plumbing Codes and the National Electrical Codes

D) **OTHER LAWS/STATUTES**

- Agritourism Promotion Act, K.S.A. 74-50,165

5. **ISSUES AND RECOMMENDATIONS**

A. **ROAD DUST.**

**Issue:** The generation of dust by travelers to agritourism activities has been raised as a concern. Opinions vary from the expectation that travel on rural roads will be dusty, to the expectation that properties with increased activity should mitigate the dust created by traffic to the site.

**Recommendation:** note the areas where agritourism uses are clustered or where larger agritourism uses are located and establish a dust palliative treatment program for roads in these areas with assistance being offered by the County
B. SIGNAGE.

Issue: Signage is limited by the Zoning Regulations in the ‘A’ District to accessory identification signs or signs advertising goods which are raised on the premises.
Recommendation: Additional signage should be permitted to advertise agritourism uses both on- and off-site. Various options were discussed, which included the possibility of using standard signage on the highways to identify exits from which agritourism activities can be accessed.

C. APPROVAL PROCESS.

Issue: Some agritourism uses are never pursued due to the time and process involved in getting approved.
Recommendation: Simplify the process for agritourism uses which would not be classified as ‘high intensity’.
   i. Create a tiered level of agritourism activities with different approval process for each. For instance: Low intensity agritourism activities – registration; Medium intensity agritourism activities -- site plan; High intensity activities – conditional use permit.
   ii. Establish standards which would apply to uses which do not require a CUP, such as: attendance limited to that which can be accommodated with on-site parking (no on-street parking permitted), retail sales permitted up to a maximum area of a particular square footage and certain level of assembly without requiring a CUP or full compliance with Commercial Building Codes, (This may require an amendment to the Building Codes to facilitate the use of ag buildings for agritourism uses while requiring minimal inspections to ensure basic health, safety and welfare.)
   iii. Establish a Special Event Permit for infrequent or temporary events. Identify events which could be approved administratively, and those which would require County Commission approval and note the time frame for approval; for instance 5 business days for administrative and 14 business days for County Commission permits. Establish standards for special events. Establish time limits for particular uses, with more flexibility provided for agritourism uses.

D. COMMUNITY-WIDE BENEFITS OF AGRITOURISM.

Issue: As illustrated in the economic impact section of this report, agritourism benefits not only the farm family involved in the activity, but the community as a whole. Increased spending within the county is one benefit; increased sustainability of family farms is another.
Recommendation: Promote Agritourism Activities in the County.
   i. Install an ‘Agritourism’ link on the Douglas County web-site to provide information on the agritourism uses in the county (and links to their websites) as well as the process to establish new uses. This link can provide information for future agritourism activities as well as promote existing activities.
   ii. Prepare brochures which clearly outline the process and requirements for different types of agritourism activities.
E. IMPLEMENTATION AND MONITORING OF RECOMMENDATIONS.

Issue: Many of the recommendations require knowledge of the existing agritourism uses.

Recommendation: Registration of Agritourism Uses. In order to qualify for the simplified approval process or other features, the use must be registered with the Douglas County Zoning and Codes Office as an Agritourism Use and with the State Chamber of Commerce. This registration will assist in the determination of dust palliative treatment program areas, the inclusion of the use on the County Website as well as the monitoring of the effectiveness of the measures adopted to encourage and foster agritourism. The State registration form should double for the County registration, if all necessary information is included on the state form.
Figure 1. Location of Agritourism Activities in Douglas County
Figure 2. Areas where dust palliative was applied in 2010.
Agritourism Use
Federal Highways
County Blacktop
Township Blacktop
Township Rock
Township Minimum Maintenance
Private

DISCLAIMER NOTICE
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Date: 1/20/2011

1 inch = 4 miles