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STORMWATER DRAINAGE STUDY

FOR
CITY OF LAWRENCE, KS
Police Department Facility
Overland Drive & Wakarusa Drive
Douglas County, KS

Prepared by:
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McClure Engineering Company

January 16, 2019





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Table of Contents

Report

General	3
Existing Conditions	3-4
Proposed Improvements	4-5
Summary & Recommendations	5

Appendix

Appendix A, Existing Conditions Maps	A1
Aerial Photo	
Soil Map	
Flood Map	
Appendix B, Drainage Maps.....	A2
Drainage Map - Offsite	
Drainage Map - Existing	
Drainage Map - Proposed	
Appendix C, Drainage Calculations	A3
PondPack Calculations	



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General

Project Description

The proposed project consists of a new building and parking lot for the City of Lawrence Police Department at a site located northwest of the intersection of Overland Drive and Wakarusa Drive in the City of Lawrence, Douglas County, Kansas. The project drains to an unnamed tributary to Baldwin Creek and is located in the southwest quarter of Section 28-12-19. The area of the site is 29.0 acres.

Design Criteria

The stormwater management design criteria consists of the City of Lawrence Stormwater Management Criteria dated February 1996. Runoff volumes and hydrographs were generated using the SCS TR-55 method within Bentley's Pondpack program.

Existing Conditions

Existing Cover & Drainage Patterns

The site is currently undeveloped. The attached aerial photograph (Appendix A) and Existing Conditions Drainage Map (Appendix B) reflects the existing site conditions. The site consists of grass cover and woods with several drainage channels crossing through the site.

The site drains to the east. The majority of the site discharges to the inlet of an existing 2-60" RCP culvert that crosses under Wakarusa Drive. The northern portion of the site drains directly on to Wakarusa Drive and into storm sewer that connects to the above described culvert.

A significant amount of offsite area enters the site from the south and the west. The offsite drainage area is 130 acres and is partially developed with buildings, parking lots and public street improvements. The offsite area flows through the site in multiple drainage channels and exits at the 2-60" culvert. The offsite area contains multiple detention basins. Because the offsite area is detained, the offsite runoff is calculated based on the undeveloped condition.



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Soil Types

The Natural Resources Conservation Service soil maps were referenced to determine the types and characteristics of on-site soils. According to the maps, the majority of site soils belong to hydrologic soils groups (HSG) “C/D” and “D”. Soils designated Type “C/D” are Type “D” in their natural condition. A small portion of the site near the culvert inlet consists of Type “B” soils. A map of the on-site soils can be found in Appendix A.

Flood Zone

According to the applicable Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map, the project lies within Zone X and is outside of the FEMA regulated floodplain. The flood map is included in Appendix A.

Runoff

Calculations for the allowable site release rate are shown below. The allowable release from the site is 1.8 cfs/acre in the 100 year storm with the offsite runoff added to that. The portion of the site that drains east in the existing condition is 26.7 acres. The 2.3 acres of the site that drains north is not included in the allowable release rate calculations. Calculations for the runoff hydrographs developed for the offsite area are included in Appendix C.

Site Area Draining East = 26.7 acres

Site Allowable Release Rate = $(26.7)(1.8 \text{ cfs/acre}) = 48.1 \text{ cfs}$

Q_{100} from Offsite = 756.6 cfs

Allowable Release Rate = $756.6 + 48.1 = 804.7 \text{ cfs}$

Existing Q_{100} from onsite and offsite area = 809.5 cfs (hydrographs combined)

100 year water surface elevation at 2-60” culvert inlet = 965.86

Existing Storage Volume provided upstream of culvert inlet = 5.381 ac.-ft.

Proposed Improvements

The site will be developed with new buildings and associated parking and drives. The parking lot will consist of impervious pavement. A detention basin will be constructed to mitigate the runoff impacts of the proposed development. Proposed conditions are shown on the Proposed Conditions Drainage Map included in Appendix B.

Runoff

The existing drainage patterns will be maintained although there is a slight increase to the drainage area that discharges to the inlet of the 2-60” culvert and a corresponding decrease to



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the north drainage area that discharges directly to the Wakarusa right-of-way. Runoff from the proposed development that drains directly to the 2-60" culvert will be collected with drainage inlets and buried storm sewer pipe and conveyed to the existing drainage channels that cross through the site. Runoff from the offsite drainage area will drain through the site as it does currently.

Detention storage volume will be provided by excavating in the low area of the site upstream of the existing 2-60" culvert. The excavation will occur above the ordinary high water mark so a permit from the Corps of Engineers will not be required for this work. The required peak runoff mitigation was achieved by providing the additional storage volume. Modification to the 2-60" culvert is not necessary.

Stormwater models were developed utilizing Bentley's Pondpack program with the integrated SCS TR55 method to simulate on-site and offsite runoff conditions. The 100 year storm using a Type II 24 hour distribution was modeled.

The proposed site release rate and detention design information are shown below. Runoff from the 2.3 acre area that drains northwest is not included. Further details can be found in Appendix C of this report.

Proposed Runoff & Detention Design Information:

Existing Q_{100} from onsite and offsite area = 809.5 cfs (hydrographs combined, see above)
Allowable Release Rate = 804.7 cfs (see above)
Proposed Q_{100} from onsite and offsite area = 793.2 cfs (hydrographs combined)
100 year water surface elevation at 2-60" culvert inlet = 965.82
Proposed Storage Volume provided upstream of culvert inlet = 5.622 ac.-ft.
Additional Detention Storage Volume provided = $5.622 - 5.381 = 0.241$ ac.-ft.

Summary and Recommendations

The site is currently undeveloped. The proposed project involves the construction of a new Police Department facility that will include new buildings and parking. This will result in an increase in impervious area. To mitigate the resulting increase in stormwater runoff, detention storage volume will be provided by excavating upstream of the existing site outlet.



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Appendix A Existing Conditions Maps

Aerial Photo

Soil Map

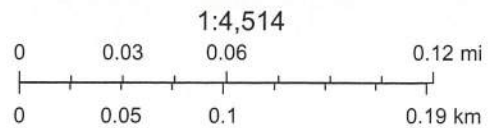
Flood Map

ArcGIS Web Map



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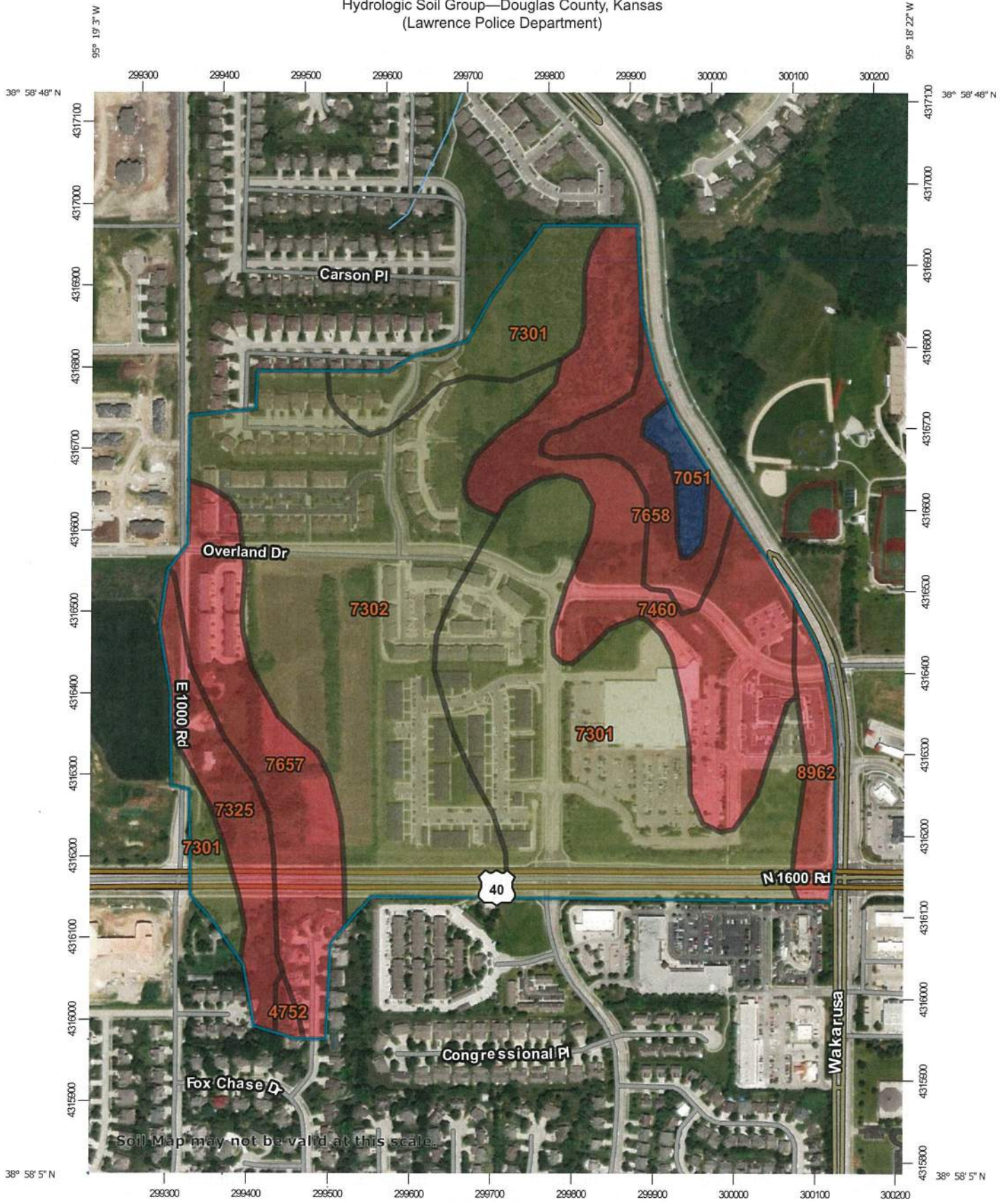
Parcels



Site Aerial Photo

Douglas County, KS GIS Division, Surdex Corporation

Hydrologic Soil Group—Douglas County, Kansas
(Lawrence Police Department)



Soil Map may not be valid at this scale.



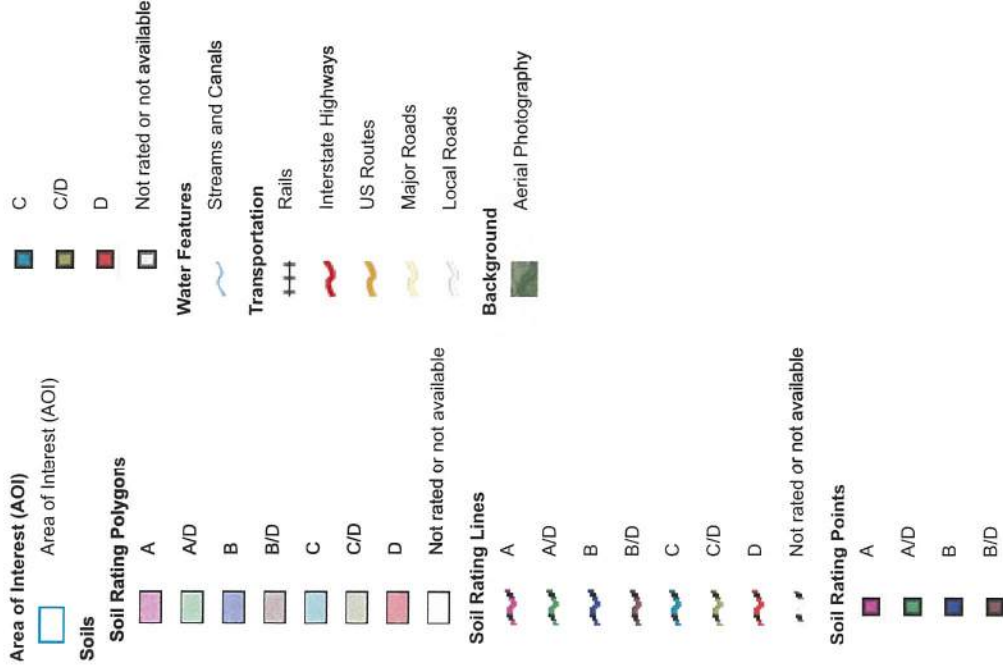
Map Scale: 1:6,460 if printed on A portrait (8.5" x 11") sheet.

0 50 100 200 300 Meters

0 300 600 1200 1800 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND



MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Douglas County, Kansas
 Survey Area Data: Version 15, Sep 12, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 27, 2016—Aug 3, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
4752	Sogn-Vinland complex, 3 to 25 percent slopes	D	0.4	0.3%
7051	Kennebec silt loam, frequently flooded	B	1.7	1.3%
7301	Martin silty clay loam, 1 to 3 percent slopes	C/D	41.1	31.3%
7302	Martin silty clay loam, 3 to 7 percent slopes	C/D	39.4	29.9%
7325	Martin-Oska silty clay loams, 3 to 6 percent slopes	D	6.2	4.7%
7460	Oska silty clay loam, 3 to 6 percent slopes	D	21.5	16.3%
7657	Vinland-Martin complex, 7 to 15 percent slopes	D	12.5	9.5%
7658	Vinland-Rock outcrop complex, 15 to 45 percent slopes	D	5.3	4.0%
8962	Woodson silt loam, 1 to 3 percent slopes	D	3.4	2.6%
Totals for Area of Interest			131.5	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

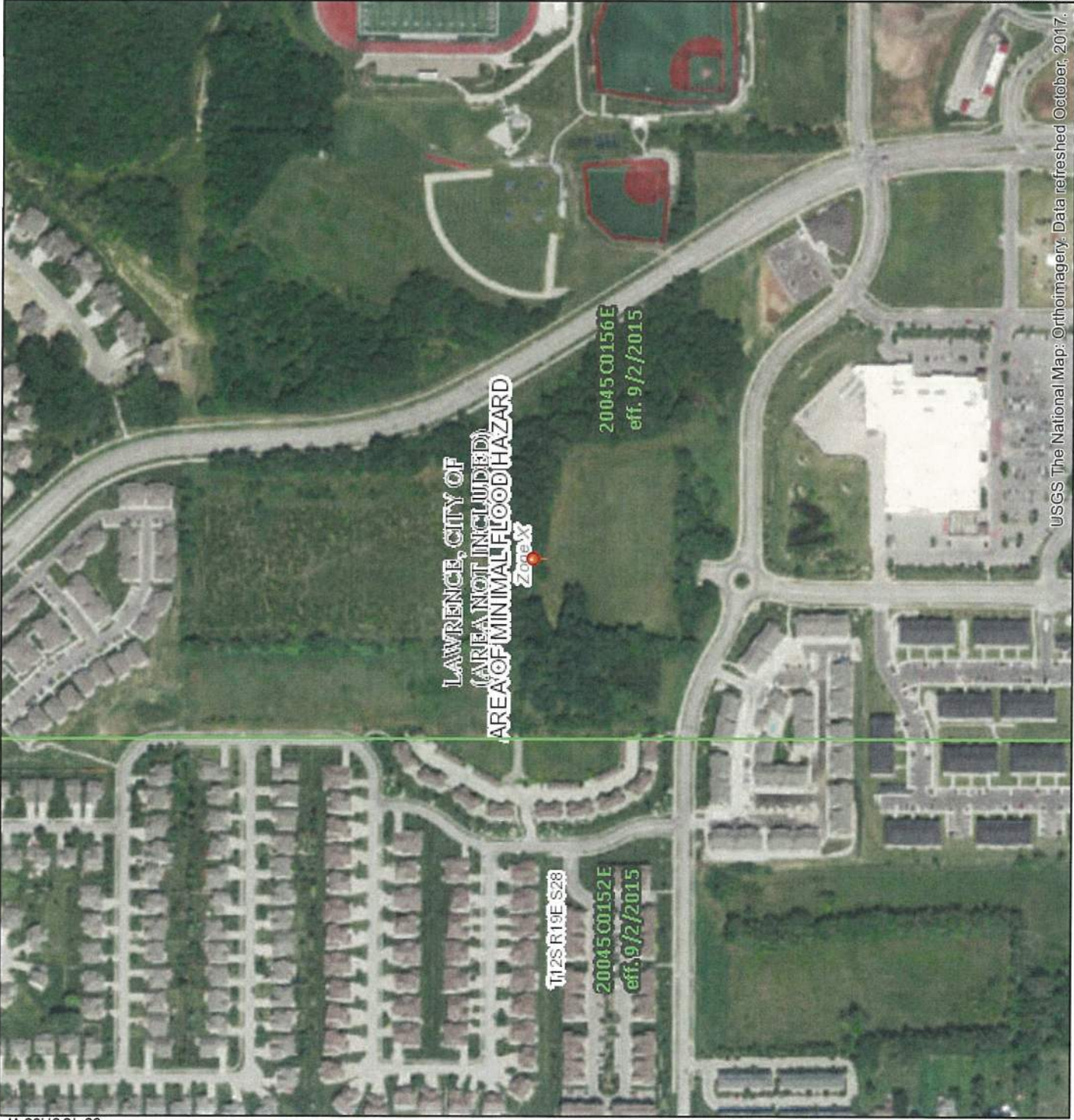
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

National Flood Hazard Layer FIRMette



38°58'48.37"N



USGS The National Map: Orthoimagery. Data refreshed October, 2017.



95°18'20.22"W

38°58'20.40"N

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS

- Without Base Flood Elevation (BFE) Zone A, V, X
- With BFE or Depth Zone AE, AD, AH, VE, AR
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD

- 0.2% Annual Chance Flood Hazard, Area of 1% annual chance flood with average depth less than one foot or with draining areas of less than one square mile Zone .
- Future Conditions 1% Annual Chance Flood Hazard Zone X
- Area with Reduced Flood Risk due to Levee. See Notes. Zone X
- Area with Flood Risk due to Levee Zone D

OTHER AREAS

- NO SCREEN Zone X
- Area of Minimal Flood Hazard Zone X
- Effective LOMRs
- Area of Undetermined Flood Hazard Zone

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS

- Digital Data Available
- No Digital Data Available
- Unmapped

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 1/14/2019 at 2:11:50 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



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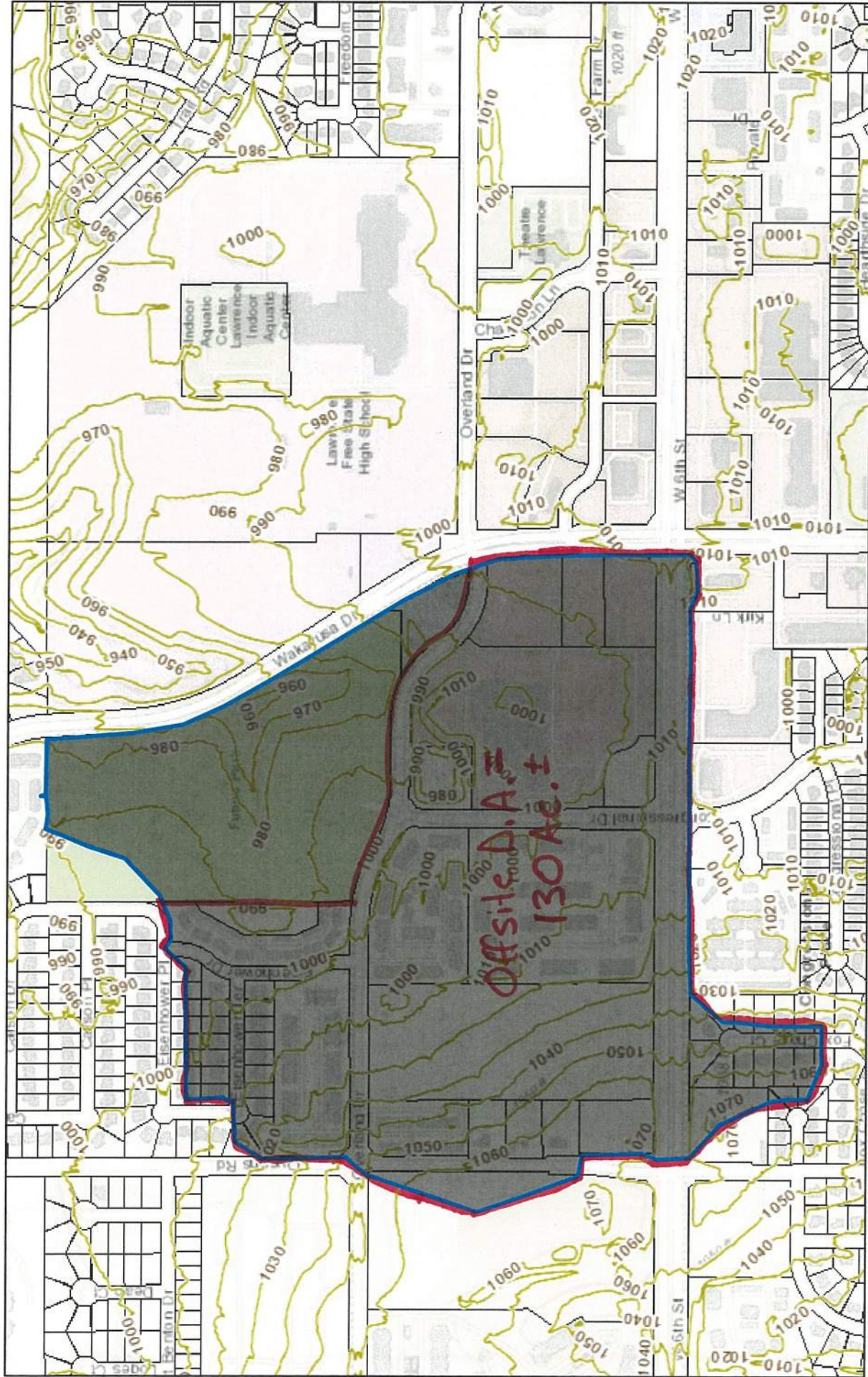
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Appendix B Maps

Drainage Map - Offsite
Drainage Map - Existing
Drainage Map - Proposed

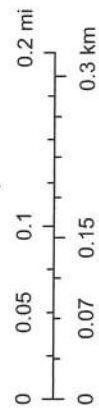
ArcGIS Web Map



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□ Parcels

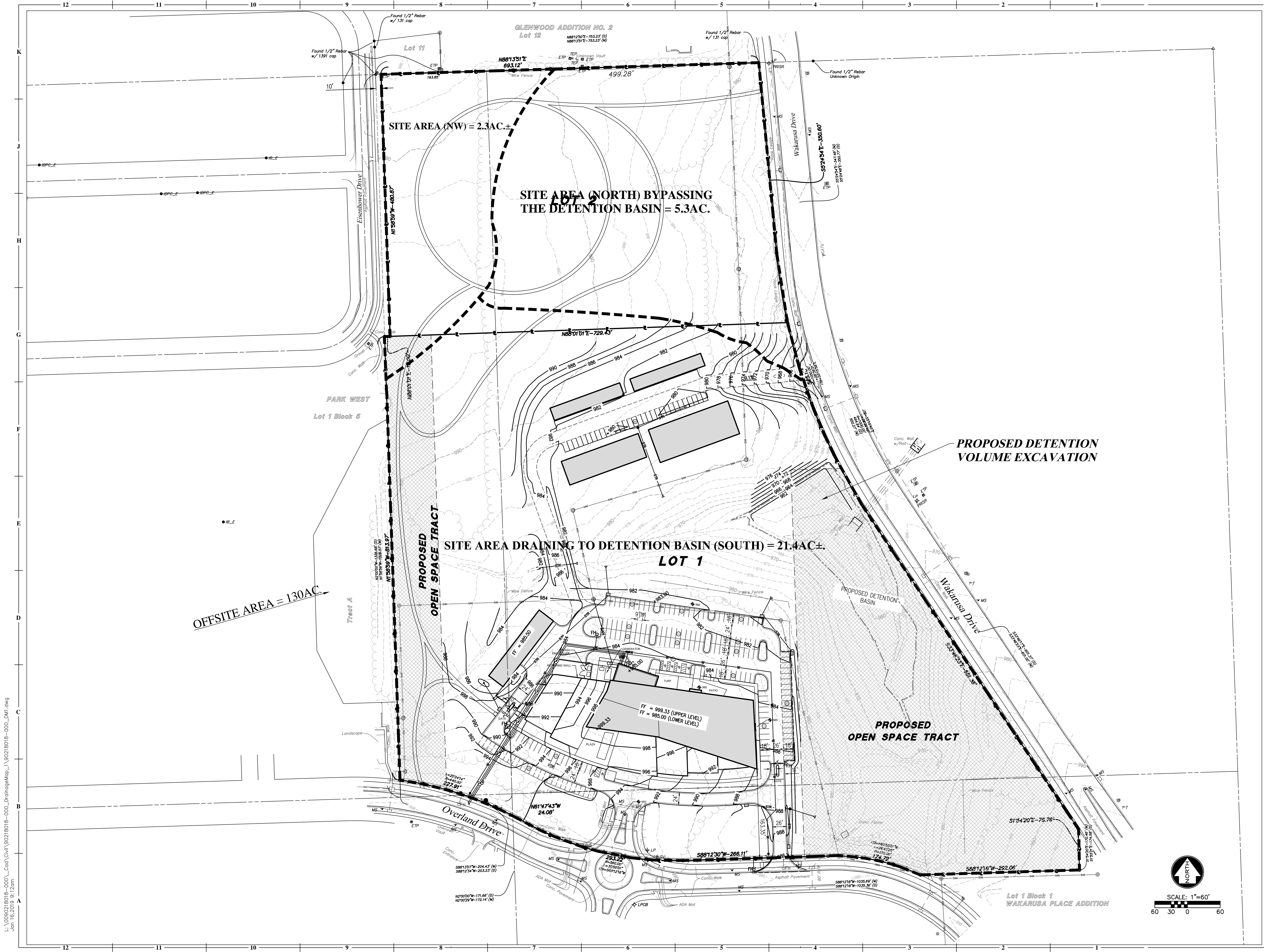
1:9,028



Drainage Map - Offsite



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 Jun 16, 2019 9:12am

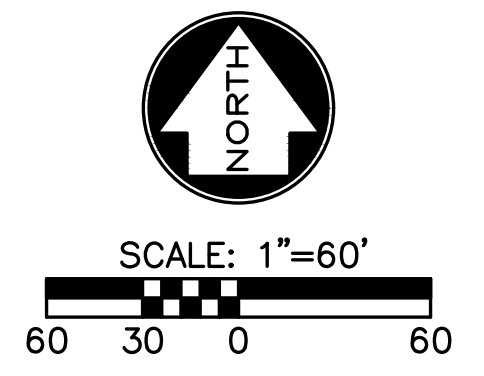
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SCHEMATIC DESIGN

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 ISSUE DATE: 11 JANUARY 2019
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PROPOSED
 CONDITIONS
 DRAINAGE MAP





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Appendix C

Drainage Calculations

PondPack Calculations



Lawrence Police Department Existing Condition

Project Summary

Title	Lawrence Police Department
Engineer	
Company	
Date	1/9/2019

Notes	Existing Conditions
-------	---------------------

Scenario: Douglas County, 100 yr

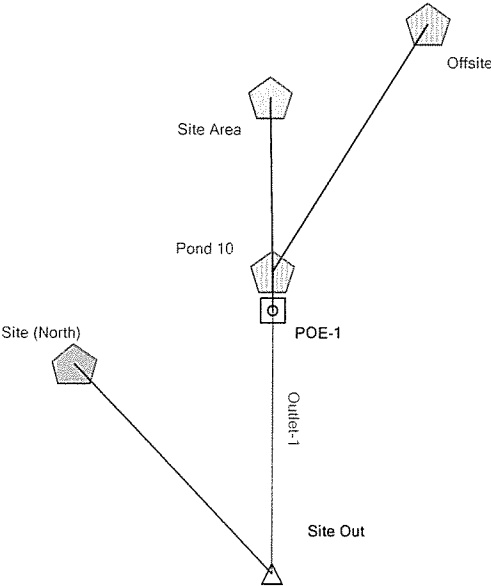


Table of Contents

	Master Network Summary	2
Douglas County	Time-Depth Curve, 100 years	3
Offsite		
	Time of Concentration Calculations, 100 years	5
Site (North)		
	Time of Concentration Calculations, 100 years	7
Site Area		
	Time of Concentration Calculations, 100 years	9
Offsite		
	Runoff CN-Area, 100 years	11
Site (North)		
	Runoff CN-Area, 100 years	12
Site Area		
	Runoff CN-Area, 100 years	13
Pond 10	Elevation-Area Volume Curve, 100 years	14
Outlet 1		
	Outlet Input Data, 100 years	15
	Composite Rating Curve, 100 years	18
Pond 10		
	Elevation-Volume-Flow Table (Pond), 100 years	19
Pond 10 (IN)		
	Level Pool Pond Routing Summary, 100 years	20

Lawrence Police Department Existing Condition

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
Offsite	Douglas County, 100 yr	100	60.952	12.100	756.58
Site (North)	Douglas County, 100 yr	100	2.806	12.000	43.07
Site Area	Douglas County, 100 yr	100	8.879	12.000	143.31

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
Site Out	Douglas County, 100 yr	100	72.611	12.150	809.51

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Pond 10 (IN)	Douglas County, 100 yr	100	69.831	12.050	870.75	(N/A)	(N/A)
Pond 10 (OUT)	Douglas County, 100 yr	100	69.831	12.150	785.63	965.86	5.381

Lawrence Police Department Existing Condition

Subsection: Time-Depth Curve
 Label: Douglas County

Return Event: 100 years
 Storm Event: 100 yr

Time-Depth Curve: 100 yr	
Label	100 yr
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	100 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.0
0.500	0.0	0.0	0.1	0.1	0.1
1.000	0.1	0.1	0.1	0.1	0.1
1.500	0.1	0.1	0.1	0.2	0.2
2.000	0.2	0.2	0.2	0.2	0.2
2.500	0.2	0.2	0.2	0.3	0.3
3.000	0.3	0.3	0.3	0.3	0.3
3.500	0.3	0.3	0.3	0.4	0.4
4.000	0.4	0.4	0.4	0.4	0.4
4.500	0.4	0.4	0.5	0.5	0.5
5.000	0.5	0.5	0.5	0.5	0.5
5.500	0.6	0.6	0.6	0.6	0.6
6.000	0.6	0.6	0.7	0.7	0.7
6.500	0.7	0.7	0.7	0.8	0.8
7.000	0.8	0.8	0.8	0.8	0.8
7.500	0.9	0.9	0.9	0.9	0.9
8.000	0.9	1.0	1.0	1.0	1.0
8.500	1.0	1.1	1.1	1.1	1.1
9.000	1.2	1.2	1.2	1.2	1.3
9.500	1.3	1.3	1.3	1.4	1.4
10.000	1.4	1.5	1.5	1.5	1.6
10.500	1.6	1.7	1.7	1.7	1.8
11.000	1.9	1.9	2.0	2.1	2.1
11.500	2.2	2.4	2.8	3.4	4.5
12.000	5.2	5.4	5.5	5.6	5.7
12.500	5.8	5.9	5.9	6.0	6.0
13.000	6.1	6.1	6.2	6.2	6.3
13.500	6.3	6.3	6.4	6.4	6.4
14.000	6.5	6.5	6.5	6.6	6.6
14.500	6.6	6.6	6.7	6.7	6.7
15.000	6.7	6.8	6.8	6.8	6.8
15.500	6.9	6.9	6.9	6.9	6.9
16.000	7.0	7.0	7.0	7.0	7.0
16.500	7.0	7.1	7.1	7.1	7.1

Lawrence Police Department Existing Condition

Subsection: Time-Depth Curve
 Label: Douglas County

Return Event: 100 years
 Storm Event: 100 yr

CUMULATIVE RAINFALL (in)

Output Time Increment = 0.100 hours

Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.000	7.1	7.1	7.2	7.2	7.2
17.500	7.2	7.2	7.2	7.2	7.3
18.000	7.3	7.3	7.3	7.3	7.3
18.500	7.3	7.4	7.4	7.4	7.4
19.000	7.4	7.4	7.4	7.4	7.5
19.500	7.5	7.5	7.5	7.5	7.5
20.000	7.5	7.5	7.5	7.6	7.6
20.500	7.6	7.6	7.6	7.6	7.6
21.000	7.6	7.6	7.6	7.7	7.7
21.500	7.7	7.7	7.7	7.7	7.7
22.000	7.7	7.7	7.7	7.7	7.8
22.500	7.8	7.8	7.8	7.8	7.8
23.000	7.8	7.8	7.8	7.8	7.8
23.500	7.9	7.9	7.9	7.9	7.9
24.000	7.9	(N/A)	(N/A)	(N/A)	(N/A)

Lawrence Police Department Existing Condition

Subsection: Time of Concentration Calculations
Label: Offsite

Return Event: 100 years
Storm Event: 100 yr

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.010 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.14 ft/s
Segment Time of Concentration	0.203 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	650.00 ft
Is Paved?	False
Slope	0.060 ft/ft
Average Velocity	3.95 ft/s
Segment Time of Concentration	0.046 hours

Segment #3: Length and Velocity	
Hydraulic Length	2,300.00 ft
Velocity	7.00 ft/s
Segment Time of Concentration	0.091 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.340 hours

Lawrence Police Department Existing Condition

Subsection: Time of Concentration Calculations
Label: Offsite

Return Event: 100 years
Storm Event: 100 yr

==== User Defined Length & Velocity

Tc = $(L_f / V) / 3600$
Tc= Time of concentration, hours
Where: Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

Tc = $R = Q_a / W_p$
 $V = (1.49 * (R^{2/3}) * (S_f^{*-0.5})) / n$
 $(L_f / V) / 3600$
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
Where: V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Unpaved surface:
 $V = 16.1345 * (S_f^{*0.5})$
Tc = Paved Surface:
 $V = 20.3282 * (S_f^{*0.5})$
 $(L_f / V) / 3600$
V= Velocity, ft/sec
Where: Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Lawrence Police Department Existing Condition

Subsection: Time of Concentration Calculations
Label: Site (North)

Return Event: 100 years
Storm Event: 100 yr

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.020 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.18 ft/s
Segment Time of Concentration	0.154 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	545.00 ft
Is Paved?	False
Slope	0.040 ft/ft
Average Velocity	3.23 ft/s
Segment Time of Concentration	0.047 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.201 hours

Lawrence Police Department Existing Condition

Subsection: Time of Concentration Calculations
Label: Site (North)

Return Event: 100 years
Storm Event: 100 yr

==== SCS Channel Flow

$$R = Qa / Wp$$
$$Tc = \frac{V = (1.49 * (R^{2/3}) * (Sf^{*-0.5})) / n}{(Lf / V) / 3600}$$

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

$$V = 16.1345 * (Sf^{*0.5})$$

$$Tc = \frac{V = 20.3282 * (Sf^{*0.5})}{(Lf / V) / 3600}$$

Where:
V= Velocity, ft/sec
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Lawrence Police Department Existing Condition

Subsection: Time of Concentration Calculations
Label: Site Area

Return Event: 100 years
Storm Event: 100 yr

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.040 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.24 ft/s
Segment Time of Concentration	0.117 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	440.00 ft
Is Paved?	False
Slope	0.050 ft/ft
Average Velocity	3.61 ft/s
Segment Time of Concentration	0.034 hours

Segment #3: Length and Velocity	
Hydraulic Length	430.00 ft
Velocity	7.00 ft/s
Segment Time of Concentration	0.017 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.168 hours

Lawrence Police Department Existing Condition

Subsection: Time of Concentration Calculations
Label: Site Area

Return Event: 100 years
Storm Event: 100 yr

==== User Defined Length & Velocity

$T_c = (L_f / V) / 3600$
Tc= Time of concentration, hours
Where: Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

$R = Q_a / W_p$
 $V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n$
 $T_c = (L_f / V) / 3600$
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
Where: V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Unpaved surface:
 $V = 16.1345 * (S_f^{0.5})$
Paved Surface:
 $V = 20.3282 * (S_f^{0.5})$
 $T_c = (L_f / V) / 3600$
V= Velocity, ft/sec
Where: Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Lawrence Police Department Existing Condition

Subsection: Runoff CN-Area
Label: Offsite

Return Event: 100 years
Storm Event: 100 yr

Runoff Curve Number Data

Soil/Surface Description	CN	Area (acres)	C (%)	UC (%)	Adjusted CN
Impervious Area	98.000	9.600	0.0	0.0	98.000
Pervious Area - Grassland	80.000	120.400	0.0	0.0	80.000
COMPOSITE AREA & WEIGHTED CN --->	(N/A)	130.000	(N/A)	(N/A)	81.329

Lawrence Police Department Existing Condition

Subsection: Runoff CN-Area
Label: Site (North)

Return Event: 100 years
Storm Event: 100 yr

Runoff Curve Number Data

Soil/Surface Description	CN	Area (acres)	C (%)	UC (%)	Adjusted CN
Woods - good - Soil D	77.000	1.000	0.0	0.0	77.000
Pasture, grassland, or range - good - Soil D	80.000	5.100	0.0	0.0	80.000
COMPOSITE AREA & WEIGHTED CN --->	(N/A)	6.100	(N/A)	(N/A)	79.508

Lawrence Police Department Existing Condition

Subsection: Runoff CN-Area
 Label: Site Area

Return Event: 100 years
 Storm Event: 100 yr

Runoff Curve Number Data

Soil/Surface Description	CN	Area (acres)	C (%)	UC (%)	Adjusted CN
Woods - good - Soil D	77.000	9.300	0.0	0.0	77.000
Pasture, grassland, or range - good - Soil D	80.000	9.600	0.0	0.0	80.000
Woods - good - Soil B	55.000	1.700	0.0	0.0	55.000
COMPOSITE AREA & WEIGHTED CN --->	(N/A)	20.600	(N/A)	(N/A)	76.583

Lawrence Police Department Existing Condition

Subsection: Elevation-Area Volume Curve

Return Event: 100 years

Label: Pond 10

Storm Event: 100 yr

Elevation (ft)	Planimeter (ft ²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
954.20	0.0	0.000	0.000	0.000	0.000
956.00	0.0	0.031	0.031	0.019	0.019
958.00	0.0	0.115	0.206	0.137	0.156
960.00	0.0	0.344	0.658	0.439	0.594
962.00	0.0	0.609	1.411	0.940	1.535
964.00	0.0	1.000	2.389	1.593	3.128
964.50	0.0	1.130	3.193	0.532	3.660
966.00	0.0	1.440	3.846	1.923	5.583

Lawrence Police Department Existing Condition

Subsection: Outlet Input Data
 Label: Outlet 1

Return Event: 100 years
 Storm Event: 100 yr

Requested Pond Water Surface Elevations	
Minimum (Headwater)	954.20 ft
Increment (Headwater)	1.00 ft
Maximum (Headwater)	966.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Culvert-Circular	Culvert - 1	Forward	TW	954.20	966.00
Irregular Weir	Weir - 1	Forward	TW	964.60	966.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Lawrence Police Department Existing Condition

Subsection: Outlet Input Data
 Label: Outlet 1

Return Event: 100 years
 Storm Event: 100 yr

Structure ID: Culvert - 1
 Structure Type: Culvert-Circular

Number of Barrels	2
Diameter	60.0 in
Length	165.00 ft
Length (Computed Barrel)	165.04 ft
Slope (Computed)	0.023 ft/ft

Outlet Control Data

Manning's n	0.013
Ke	0.500
Kb	0.004
Kr	0.000
Convergence Tolerance	0.00 ft

Inlet Control Data

Equation Form	Form 1
K	0.0098
M	2.0000
C	0.0398
Y	0.6700
T1 ratio (HW/D)	1.149
T2 ratio (HW/D)	1.295
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.

Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control, interpolate between flows at T1 & T2...

T1 Elevation	959.94 ft	T1 Flow	153.67 ft ³ /s
T2 Elevation	960.68 ft	T2 Flow	175.62 ft ³ /s

Lawrence Police Department Existing Condition

Subsection: Outlet Input Data
 Label: Outlet 1

Return Event: 100 years
 Storm Event: 100 yr

Structure ID: Weir - 1
Structure Type: Irregular Weir

Station (ft)	Elevation (ft)
0.00	966.00
45.00	964.60
75.00	965.00
130.00	966.00

Lowest Elevation 964.60 ft
 Weir Coefficient 3.00 (ft^{0.5})/s

Structure ID: TW
 Structure Type: TW Setup, DS Channel

Tailwater Type	Free Outfall
----------------	--------------

Convergence Tolerances

Maximum Iterations	40
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft ³ /s
Flow Tolerance (Maximum)	10.000 ft ³ /s

Lawrence Police Department Existing Condition

Subsection: Composite Rating Curve
 Label: Outlet 1

Return Event: 100 years
 Storm Event: 100 yr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)
954.20	0.00	(N/A)	0.00
955.20	11.73	(N/A)	0.00
956.20	44.54	(N/A)	0.00
957.20	94.62	(N/A)	0.00
958.20	157.97	(N/A)	0.00
959.20	229.80	(N/A)	0.00
960.20	305.52	(N/A)	0.00
961.20	378.99	(N/A)	0.00
962.20	427.06	(N/A)	0.00
963.20	470.26	(N/A)	0.00
964.20	509.83	(N/A)	0.00
964.60	524.81	(N/A)	0.00
965.20	579.77	(N/A)	0.00
966.00	829.82	(N/A)	0.00

Contributing Structures

None Contributing
Culvert - 1
Culvert - 1
Culvert - 1
Culvert - 1
Culvert - 1
Culvert - 1
Culvert - 1
Culvert - 1
Culvert - 1
Culvert - 1
Culvert - 1
Culvert - 1 + Weir - 1
Culvert - 1 + Weir - 1
Culvert - 1 + Weir - 1

Lawrence Police Department Existing Condition

Subsection: Elevation-Volume-Flow Table (Pond)
 Label: Pond 10

Return Event: 100 years
 Storm Event: 100 yr

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	954.20 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft ³ /s
Flow (Initial Infiltration)	0.00 ft ³ /s
Flow (Initial, Total)	0.00 ft ³ /s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft ³ /s)	Storage (ac-ft)	Area (acres)	Infiltration (ft ³ /s)	Flow (Total) (ft ³ /s)	2S/t + O (ft ³ /s)
954.20	0.00	0.000	0.000	0.00	0.00	0.00
955.20	11.73	0.003	0.010	0.00	11.73	13.27
956.20	44.54	0.025	0.037	0.00	44.54	56.83
957.20	94.62	0.080	0.075	0.00	94.62	133.48
958.20	157.97	0.180	0.132	0.00	157.97	245.32
959.20	229.80	0.363	0.238	0.00	229.80	405.47
960.20	305.52	0.665	0.367	0.00	305.52	627.59
961.20	378.99	1.094	0.494	0.00	378.99	908.69
962.20	427.06	1.660	0.644	0.00	427.06	1,230.53
963.20	470.26	2.396	0.832	0.00	470.26	1,629.90
964.20	509.83	3.333	1.051	0.00	509.83	2,122.92
964.60	524.81	3.774	1.149	0.00	524.81	2,351.36
965.20	579.77	4.499	1.270	0.00	579.77	2,757.49
966.00	829.82	5.583	1.440	0.00	829.82	3,531.85

Lawrence Police Department Existing Condition

Subsection: Level Pool Pond Routing Summary
 Label: Pond 10 (IN)

Return Event: 100 years
 Storm Event: 100 yr

Infiltration			
Infiltration Method (Computed)	No Infiltration		
Initial Conditions			
Elevation (Water Surface, Initial)	954.20 ft		
Volume (Initial)	0.000 ac-ft		
Flow (Initial Outlet)	0.00 ft ³ /s		
Flow (Initial Infiltration)	0.00 ft ³ /s		
Flow (Initial, Total)	0.00 ft ³ /s		
Time Increment	0.050 hours		
Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	870.75 ft ³ /s	Time to Peak (Flow, In)	12.050 hours
Flow (Peak Outlet)	785.63 ft ³ /s	Time to Peak (Flow, Outlet)	12.150 hours
Peak Conditions			
Elevation (Water Surface, Peak)	965.86 ft		
Volume (Peak)	5.381 ac-ft		
Mass Balance (ac-ft)			
Volume (Initial)	0.000 ac-ft		
Volume (Total Inflow)	69.831 ac-ft		
Volume (Total Infiltration)	0.000 ac-ft		
Volume (Total Outlet Outflow)	69.831 ac-ft		
Volume (Retained)	0.000 ac-ft		
Volume (Unrouted)	0.000 ac-ft		
Error (Mass Balance)	0.0 %		

Lawrence Police Department Existing Condition

Index

D

Douglas County (Time-Depth Curve, 100 years)...3, 4

M

Master Network Summary...2

O

Offsite (Runoff CN-Area, 100 years)...11

Offsite (Time of Concentration Calculations, 100 years)...5, 6

Outlet 1 (Composite Rating Curve, 100 years)...18

Outlet 1 (Outlet Input Data, 100 years)...15, 16, 17

P

Pond 10 (Elevation-Area Volume Curve, 100 years)...14

Pond 10 (Elevation-Volume-Flow Table (Pond), 100 years)...19

Pond 10 (IN) (Level Pool Pond Routing Summary, 100 years)...20

S

Site (North) (Runoff CN-Area, 100 years)...12

Site (North) (Time of Concentration Calculations, 100 years)...7, 8

Site Area (Runoff CN-Area, 100 years)...13

Site Area (Time of Concentration Calculations, 100 years)...9, 10

Lawrence Police Department Proposed Condition

Project Summary

Title	Lawrence Police Department
Engineer	
Company	
Date	1/9/2019

Notes	Proposed Conditions
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Scenario: Douglas County, 100 yr

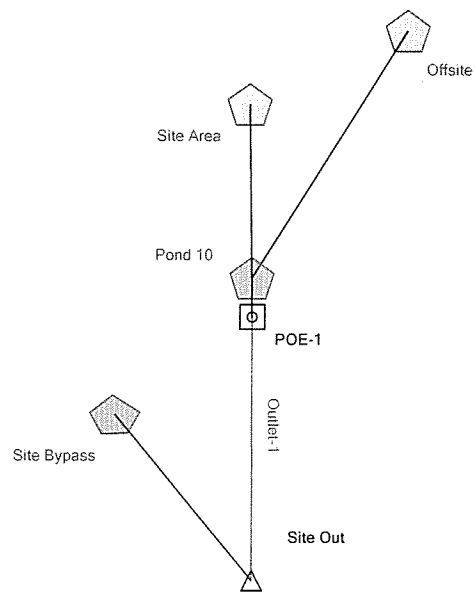


Table of Contents

	Master Network Summary	2
Douglas County	Time-Depth Curve, 100 years	3
Offsite		
	Time of Concentration Calculations, 100 years	5
Site Area		
	Time of Concentration Calculations, 100 years	7
Site Bypass		
	Time of Concentration Calculations, 100 years	9
Offsite		
	Runoff CN-Area, 100 years	11
Site Area		
	Runoff CN-Area, 100 years	12
Site Bypass		
	Runoff CN-Area, 100 years	13
Pond 10	Elevation-Area Volume Curve, 100 years	14
Outlet 1		
	Outlet Input Data, 100 years	15
	Composite Rating Curve, 100 years	18
Pond 10		
	Elevation-Volume-Flow Table (Pond), 100 years	19
Pond 10 (IN)		
	Level Pool Pond Routing Summary, 100 years	20

Lawrence Police Department Proposed Condition

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
Offsite	Douglas County, 100 yr	100	60.952	12.100	756.58
Site Area	Douglas County, 100 yr	100	10.892	11.950	185.14
Site Bypass	Douglas County, 100 yr	100	2.490	12.000	38.08

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)
Site Out	Douglas County, 100 yr	100	74.307	12.150	793.19

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft ³ /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Pond 10 (IN)	Douglas County, 100 yr	100	71.844	12.050	870.82	(N/A)	(N/A)
Pond 10 (OUT)	Douglas County, 100 yr	100	71.844	12.150	772.14	965.82	5.622

Lawrence Police Department Proposed Condition

Subsection: Time-Depth Curve
 Label: Douglas County

Return Event: 100 years
 Storm Event: 100 yr

Time-Depth Curve: 100 yr	
Label	100 yr
Start Time	0.000 hours
Increment	0.100 hours
End Time	24.000 hours
Return Event	100 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.100 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.0
0.500	0.0	0.0	0.1	0.1	0.1
1.000	0.1	0.1	0.1	0.1	0.1
1.500	0.1	0.1	0.1	0.2	0.2
2.000	0.2	0.2	0.2	0.2	0.2
2.500	0.2	0.2	0.2	0.3	0.3
3.000	0.3	0.3	0.3	0.3	0.3
3.500	0.3	0.3	0.3	0.4	0.4
4.000	0.4	0.4	0.4	0.4	0.4
4.500	0.4	0.4	0.5	0.5	0.5
5.000	0.5	0.5	0.5	0.5	0.5
5.500	0.6	0.6	0.6	0.6	0.6
6.000	0.6	0.6	0.7	0.7	0.7
6.500	0.7	0.7	0.7	0.8	0.8
7.000	0.8	0.8	0.8	0.8	0.8
7.500	0.9	0.9	0.9	0.9	0.9
8.000	0.9	1.0	1.0	1.0	1.0
8.500	1.0	1.1	1.1	1.1	1.1
9.000	1.2	1.2	1.2	1.2	1.3
9.500	1.3	1.3	1.3	1.4	1.4
10.000	1.4	1.5	1.5	1.5	1.6
10.500	1.6	1.7	1.7	1.7	1.8
11.000	1.9	1.9	2.0	2.1	2.1
11.500	2.2	2.4	2.8	3.4	4.5
12.000	5.2	5.4	5.5	5.6	5.7
12.500	5.8	5.9	5.9	6.0	6.0
13.000	6.1	6.1	6.2	6.2	6.3
13.500	6.3	6.3	6.4	6.4	6.4
14.000	6.5	6.5	6.5	6.6	6.6
14.500	6.6	6.6	6.7	6.7	6.7
15.000	6.7	6.8	6.8	6.8	6.8
15.500	6.9	6.9	6.9	6.9	6.9
16.000	7.0	7.0	7.0	7.0	7.0
16.500	7.0	7.1	7.1	7.1	7.1

Lawrence Police Department Proposed Condition

Subsection: Time-Depth Curve
 Label: Douglas County

Return Event: 100 years
 Storm Event: 100 yr

CUMULATIVE RAINFALL (in) Output Time Increment = 0.100 hours Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
17.000	7.1	7.1	7.2	7.2	7.2
17.500	7.2	7.2	7.2	7.2	7.3
18.000	7.3	7.3	7.3	7.3	7.3
18.500	7.3	7.4	7.4	7.4	7.4
19.000	7.4	7.4	7.4	7.4	7.5
19.500	7.5	7.5	7.5	7.5	7.5
20.000	7.5	7.5	7.5	7.6	7.6
20.500	7.6	7.6	7.6	7.6	7.6
21.000	7.6	7.6	7.6	7.7	7.7
21.500	7.7	7.7	7.7	7.7	7.7
22.000	7.7	7.7	7.7	7.7	7.8
22.500	7.8	7.8	7.8	7.8	7.8
23.000	7.8	7.8	7.8	7.8	7.8
23.500	7.9	7.9	7.9	7.9	7.9
24.000	7.9	(N/A)	(N/A)	(N/A)	(N/A)

Lawrence Police Department Proposed Condition

Subsection: Time of Concentration Calculations
Label: Offsite

Return Event: 100 years
Storm Event: 100 yr

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.010 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.14 ft/s
Segment Time of Concentration	0.203 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	650.00 ft
Is Paved?	False
Slope	0.060 ft/ft
Average Velocity	3.95 ft/s
Segment Time of Concentration	0.046 hours

Segment #3: Length and Velocity	
Hydraulic Length	2,300.00 ft
Velocity	7.00 ft/s
Segment Time of Concentration	0.091 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.340 hours

Lawrence Police Department Proposed Condition

Subsection: Time of Concentration Calculations
Label: Offsite

Return Event: 100 years
Storm Event: 100 yr

==== User Defined Length & Velocity

$T_c = (L_f / V) / 3600$
Tc= Time of concentration, hours
Where: Lf= Flow length, feet
V= Velocity, ft/sec

==== SCS Channel Flow

$R = Q_a / W_p$
 $V = (1.49 * (R^{2/3}) * (S_f^{0.5})) / n$
 $T_c = (L_f / V) / 3600$
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Where: Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Unpaved surface:
 $V = 16.1345 * (S_f^{0.5})$
Paved Surface:
 $V = 20.3282 * (S_f^{0.5})$
 $T_c = (L_f / V) / 3600$
V= Velocity, ft/sec
Where: Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Lawrence Police Department Proposed Condition

Subsection: Time of Concentration Calculations
Label: Site Area

Return Event: 100 years
Storm Event: 100 yr

Time of Concentration Results

Segment #1: User Defined Tc	
Time of Concentration	0.083 hours

Segment #2: Length and Velocity	
Hydraulic Length	700.00 ft
Velocity	7.00 ft/s
Segment Time of Concentration	0.028 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.111 hours

Lawrence Police Department Proposed Condition

Subsection: Time of Concentration Calculations
Label: Site Area

Return Event: 100 years
Storm Event: 100 yr

==== User Defined

Tc = Value entered by user
Where: Tc= Time of concentration, hours

==== User Defined Length & Velocity

Tc = $(L_f / V) / 3600$
Tc= Time of concentration, hours
Where: Lf= Flow length, feet
V= Velocity, ft/sec

Lawrence Police Department Proposed Condition

Subsection: Time of Concentration Calculations
Label: Site Bypass

Return Event: 100 years
Storm Event: 100 yr

Time of Concentration Results

Segment #1: TR-55 Sheet Flow	
Hydraulic Length	100.00 ft
Manning's n	0.150
Slope	0.020 ft/ft
2 Year 24 Hour Depth	3.6 in
Average Velocity	0.18 ft/s
Segment Time of Concentration	0.154 hours

Segment #2: TR-55 Shallow Concentrated Flow	
Hydraulic Length	545.00 ft
Is Paved?	False
Slope	0.040 ft/ft
Average Velocity	3.23 ft/s
Segment Time of Concentration	0.047 hours

Time of Concentration (Composite)	
Time of Concentration (Composite)	0.201 hours

Lawrence Police Department Proposed Condition

Subsection: Time of Concentration Calculations
Label: Site Bypass

Return Event: 100 years
Storm Event: 100 yr

==== SCS Channel Flow

$$R = Qa / Wp$$
$$Tc = \frac{V = (1.49 * (R^{2/3}) * (Sf^{*-0.5})) / n}{(Lf / V) / 3600}$$

Where:
R= Hydraulic radius
Aq= Flow area, square feet
Wp= Wetted perimeter, feet
V= Velocity, ft/sec
Sf= Slope, ft/ft
n= Manning's n
Tc= Time of concentration, hours
Lf= Flow length, feet

==== SCS TR-55 Shallow Concentration Flow

Unpaved surface:
 $V = 16.1345 * (Sf^{*0.5})$

Paved Surface:
 $V = 20.3282 * (Sf^{*0.5})$

$$Tc = \frac{(Lf / V) / 3600}{V = \text{Velocity, ft/sec}}$$

Where:
Sf= Slope, ft/ft
Tc= Time of concentration, hours
Lf= Flow length, feet

Lawrence Police Department Proposed Condition

Subsection: Runoff CN-Area
Label: Offsite

Return Event: 100 years
Storm Event: 100 yr

Runoff Curve Number Data

Soil/Surface Description	CN	Area (acres)	C (%)	UC (%)	Adjusted CN
Impervious Area	98.000	9.600	0.0	0.0	98.000
Pervious Area - Grassland	80.000	120.400	0.0	0.0	80.000
COMPOSITE AREA & WEIGHTED CN --->	(N/A)	130.000	(N/A)	(N/A)	81.329

Lawrence Police Department Proposed Condition

Subsection: Runoff CN-Area
 Label: Site Area

Return Event: 100 years
 Storm Event: 100 yr

Runoff Curve Number Data

Soil/Surface Description	CN	Area (acres)	C (%)	UC (%)	Adjusted CN
Woods - good - Soil D	77.000	7.100	0.0	0.0	77.000
Pasture, grassland, or range - good - Soil D	80.000	3.000	0.0	0.0	80.000
Woods - good - Soil B	55.000	1.700	0.0	0.0	55.000
Impervious Area	98.000	9.600	0.0	0.0	98.000
COMPOSITE AREA & WEIGHTED CN --->	(N/A)	21.400	(N/A)	(N/A)	85.093

Lawrence Police Department Proposed Condition

Subsection: Runoff CN-Area
 Label: Site Bypass

Return Event: 100 years
 Storm Event: 100 yr

Runoff Curve Number Data

Soil/Surface Description	CN	Area (acres)	C (%)	UC (%)	Adjusted CN
Pasture, grassland, or range - good - Soil D	80.000	4.000	0.0	0.0	80.000
Impervious Area	98.000	0.400	0.0	0.0	98.000
Woods - good - Soil D	77.000	0.900	0.0	0.0	77.000
COMPOSITE AREA & WEIGHTED CN --->	(N/A)	5.300	(N/A)	(N/A)	80.849

Lawrence Police Department Proposed Condition

Subsection: Elevation-Area Volume Curve
 Label: Pond 10

Return Event: 100 years
 Storm Event: 100 yr

Elevation (ft)	Planimeter (ft ²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
954.20	0.0	0.000	0.000	0.000	0.000
956.00	0.0	0.031	0.031	0.019	0.019
958.00	0.0	0.115	0.206	0.137	0.156
960.00	0.0	0.344	0.658	0.439	0.594
962.00	0.0	0.609	1.411	0.940	1.535
964.00	0.0	1.110	2.541	1.694	3.229
964.50	0.0	1.240	3.523	0.587	3.816
966.00	0.0	1.550	4.176	2.088	5.904

Lawrence Police Department Proposed Condition

Subsection: Outlet Input Data
 Label: Outlet 1

Return Event: 100 years
 Storm Event: 100 yr

Requested Pond Water Surface Elevations	
Minimum (Headwater)	954.20 ft
Increment (Headwater)	1.00 ft
Maximum (Headwater)	966.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Culvert-Circular	Culvert - 1	Forward	TW	954.20	966.00
Irregular Weir	Weir - 1	Forward	TW	964.60	966.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Lawrence Police Department Proposed Condition

Subsection: Outlet Input Data
Label: Outlet 1

Return Event: 100 years
Storm Event: 100 yr

Structure ID: Culvert - 1	
Structure Type: Culvert-Circular	
Number of Barrels	2
Diameter	60.0 in
Length	165.00 ft
Length (Computed Barrel)	165.04 ft
Slope (Computed)	0.023 ft/ft
<hr/>	
Outlet Control Data	
Manning's n	0.013
Ke	0.500
Kb	0.004
Kr	0.000
Convergence Tolerance	0.00 ft
<hr/>	
Inlet Control Data	
Equation Form	Form 1
K	0.0098
M	2.0000
C	0.0398
Y	0.6700
T1 ratio (HW/D)	1.149
T2 ratio (HW/D)	1.295
Slope Correction Factor	-0.500

Use unsubmerged inlet control 0 equation below T1 elevation.
Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,
interpolate between flows at T1 & T2...

T1 Elevation	959.94 ft	T1 Flow	153.67 ft ³ /s
T2 Elevation	960.68 ft	T2 Flow	175.62 ft ³ /s

Lawrence Police Department Proposed Condition

Subsection: Outlet Input Data
 Label: Outlet 1

Return Event: 100 years
 Storm Event: 100 yr

Structure ID: Weir - 1
Structure Type: Irregular Weir

Station (ft)	Elevation (ft)
0.00	966.00
45.00	964.60
75.00	965.00
130.00	966.00

Lowest Elevation 964.60 ft
 Weir Coefficient 3.00 (ft^{0.5})/s

Structure ID: TW
 Structure Type: TW Setup, DS Channel

Tailwater Type Free Outfall

Convergence Tolerances

Maximum Iterations	40
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft ³ /s
Flow Tolerance (Maximum)	10.000 ft ³ /s

Lawrence Police Department Proposed Condition

Subsection: Composite Rating Curve
 Label: Outlet 1

Return Event: 100 years
 Storm Event: 100 yr

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)
954.20	0.00	(N/A)	0.00
955.20	11.73	(N/A)	0.00
956.20	44.54	(N/A)	0.00
957.20	94.62	(N/A)	0.00
958.20	157.97	(N/A)	0.00
959.20	229.80	(N/A)	0.00
960.20	305.52	(N/A)	0.00
961.20	378.99	(N/A)	0.00
962.20	427.06	(N/A)	0.00
963.20	470.26	(N/A)	0.00
964.20	509.83	(N/A)	0.00
964.60	524.81	(N/A)	0.00
965.20	579.77	(N/A)	0.00
966.00	829.82	(N/A)	0.00

Contributing Structures

None Contributing
Culvert - 1
Culvert - 1
Culvert - 1
Culvert - 1
Culvert - 1
Culvert - 1
Culvert - 1
Culvert - 1
Culvert - 1
Culvert - 1
Culvert - 1
Culvert - 1 + Weir - 1
Culvert - 1 + Weir - 1
Culvert - 1 + Weir - 1

Lawrence Police Department Proposed Condition

Subsection: Elevation-Volume-Flow Table (Pond)
 Label: Pond 10

Return Event: 100 years
 Storm Event: 100 yr

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	954.20 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft ³ /s
Flow (Initial Infiltration)	0.00 ft ³ /s
Flow (Initial, Total)	0.00 ft ³ /s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft ³ /s)	Storage (ac-ft)	Area (acres)	Infiltration (ft ³ /s)	Flow (Total) (ft ³ /s)	2S/t + O (ft ³ /s)
954.20	0.00	0.000	0.000	0.00	0.00	0.00
955.20	11.73	0.003	0.010	0.00	11.73	13.27
956.20	44.54	0.025	0.037	0.00	44.54	56.83
957.20	94.62	0.080	0.075	0.00	94.62	133.48
958.20	157.97	0.180	0.132	0.00	157.97	245.32
959.20	229.80	0.363	0.238	0.00	229.80	405.47
960.20	305.52	0.665	0.367	0.00	305.52	627.59
961.20	378.99	1.094	0.494	0.00	378.99	908.69
962.20	427.06	1.661	0.652	0.00	427.06	1,230.94
963.20	470.26	2.430	0.892	0.00	470.26	1,646.30
964.20	509.83	3.456	1.161	0.00	509.83	2,182.55
964.60	524.81	3.941	1.260	0.00	524.81	2,432.30
965.20	579.77	4.733	1.380	0.00	579.77	2,870.46
966.00	829.82	5.904	1.550	0.00	829.82	3,687.51

Lawrence Police Department Proposed Condition

Subsection: Level Pool Pond Routing Summary
 Label: Pond 10 (IN)

Return Event: 100 years
 Storm Event: 100 yr

Infiltration			
Infiltration Method (Computed)	No Infiltration		
Initial Conditions			
Elevation (Water Surface, Initial)	954.20 ft		
Volume (Initial)	0.000 ac-ft		
Flow (Initial Outlet)	0.00 ft ³ /s		
Flow (Initial Infiltration)	0.00 ft ³ /s		
Flow (Initial, Total)	0.00 ft ³ /s		
Time Increment	0.050 hours		
Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	870.82 ft ³ /s	Time to Peak (Flow, In)	12.050 hours
Flow (Peak Outlet)	772.14 ft ³ /s	Time to Peak (Flow, Outlet)	12.150 hours
Peak Conditions			
Elevation (Water Surface, Peak)	965.82 ft		
Volume (Peak)	5.622 ac-ft		
Mass Balance (ac-ft)			
Volume (Initial)	0.000 ac-ft		
Volume (Total Inflow)	71.844 ac-ft		
Volume (Total Infiltration)	0.000 ac-ft		
Volume (Total Outlet Outflow)	71.844 ac-ft		
Volume (Retained)	0.000 ac-ft		
Volume (Unrouted)	0.000 ac-ft		
Error (Mass Balance)	0.0 %		

Lawrence Police Department Proposed Condition

Index

D

Douglas County (Time-Depth Curve, 100 years)...3, 4

M

Master Network Summary...2

O

Offsite (Runoff CN-Area, 100 years)...11

Offsite (Time of Concentration Calculations, 100 years)...5, 6

Outlet 1 (Composite Rating Curve, 100 years)...18

Outlet 1 (Outlet Input Data, 100 years)...15, 16, 17

P

Pond 10 (Elevation-Area Volume Curve, 100 years)...14

Pond 10 (Elevation-Volume-Flow Table (Pond), 100 years)...19

Pond 10 (IN) (Level Pool Pond Routing Summary, 100 years)...20

S

Site Area (Runoff CN-Area, 100 years)...12

Site Area (Time of Concentration Calculations, 100 years)...7, 8

Site Bypass (Runoff CN-Area, 100 years)...13

Site Bypass (Time of Concentration Calculations, 100 years)...9, 10