DEVITT FARMS
REGIONAL DETENTION FACILITY
DRAINAGE ANALYSIS

September 2016

PROJECT: Devitt Farms
Regional Detention Facility
Harrisburg, South Dakota

PROJECT NO: 3315

DATE: September 13, 2016

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of South Dakota.

Heidi Condon, P.E.

S.D. Registration No. 8469

EXECUTIVE SUMMARY

The City of Harrisburg authorized Stockwell Engineers to analyze the existing storm drainage system at what has been historically referred to as Lake Ole as part of a much larger, overall Comprehensive Drainage Analysis for the City. The drainage basin that contributes runoff is the northern reach of a larger basin that has commonly been referred to as the Tiger Basin. This analysis will include the basin that extends north of Willow Street between Cliff Avenue and the BNSF Railroad and conveys flow to the basin low point located northwest of the intersection of Willow Street and Columbia Street in Harrisburg. The intent of the Comprehensive Master Plan is to provide a tool, to be referred to in order to ensure sound development within the City as Harrisburg continues to grow. This report specifically outlines existing conditions in the basin that will develop into the Devitt Farms commercial and residential development and presents recommendations for improvements to alleviate existing flooding concerns and ensure development does not negatively impact downstream properties.

Significant, and intense rainfall events that have occurred in recent years have caused damage to Liberty Elementary and have brought to light the severity of drainage issues that can occur within the basin. The Harrisburg School District, along with the owners of the Devitt Farms property brought their concerns to the City, resulting in the authorization for detailed hydrologic and hydraulic modeling of the drainage basin.

SCOPE OF STUDY

The scope of services for this project include the following:

- Identify drainage basin boundaries for existing conditions and identify land uses.
- Identify major drainage ways and controlling structures.
- Identify problem areas regarding drainage.
- Develop a hydrologic model to estimate peak flows for the 5 and 100-year rainfall events for all basins.
- Develop hydraulic analysis for major drainage ways and determine necessary upgrades.
- Identify recommended locations for flood control detention facilities.
- Make recommendations necessary to upgrade the storm sewer system to meet current design standards.

BASIS OF ANALYSIS

Recommendations within this report are based on the analysis of the existing network of storm sewer, within the drainage basin, based on an existing topographic survey performed by Stockwell Engineers. This report includes analysis of the existing storm sewer system, and natural detention areas. Estimated flow rates for drainage basins during the 5 and 100-year rainfall events are provided in this study and are used as a planning tool for the recommended improvements to the storm drainage system.

Review of the Flood Insurance Rate Maps issued by the Federal Emergency Management Agency indicates that the City of Harrisburg and surrounding areas are classified as Zone X. Zone X is defined as areas of minimal flood hazard, and are not located within the Special Flood Hazard Area (SFHA). The area included in this study is not subject to inundation by the 1% annual chance flood (100-year) in accordance with FEMA standards and definitions. We do, however, believe that areas within the development would fall into the SFHA if the maps were to be revised to reflect current conditions.

PROJECT OVERVIEW

HISTORY OF CONCERN

Lake Ole has been an ongoing concern for the City of Harrisburg. The existing basin includes industrial, agricultural, recreational and institutional land uses. The basin drains to an agricultural field that has historically provided natural detention located at the downstream end of the subdivision. Rainfall events that occurred in July of 2011, May of 2013 and June of 2014 resulted in significant flooding, and water entering Liberty Elementary on a couple of occurrences. Properties within the industrial park have developed over time without the necessary storage that would limit increases in existing runoff rates. As a result, the amount of runoff that enters Lake Ole has significantly increased. Historically, the only outlet for storm flows from Lake Ole has been though an agricultural drain tile system that drains south through existing development.

The extension of storm sewer included in the 2014 Columbia Basin storm sewer improvement project has provided a critical point of release of storm water for

Lake Ole, however the size of the discharge pipe, 18” RCP, does not provide the relief that is needed to prevent the school from flooding. Additional storage is needed to prevent flooding during significant rainfall events.

COORDINATING A REGIONAL SOLUTION

The City of Harrisburg 2005-2025 Comprehensive Plan identifies a need for improvements at the location of Lake Ole. The Comprehensive plan has identified these improvements as the top priority stormwater facilities project.

> *“Storm Sewer - A regional detention basin is needed north of Willow Street on the west side of Liberty Elementary School. Storm water piping will need to be extended south from the basin to the Ninemile Creek tributary. Piping to handle storm drainage will be part of the street improvements. On-site drainage and retention will also be addressed for each area as it develops.”*

A regional detention facility at this location would serve all of the properties in the contributing basin, significantly reduce the probability of a flooding occurrence at Liberty Elementary, allow for development of the Devitt Property and protect downstream properties. A single facility benefitting all properties proves to be the most cost effective way to serve all properties. The cost to design, construct, operate and maintain a single facility is significantly less than associated costs for individual property owners to build standalone facilities.

MODEL DEVELOPMENT

PROCEDURE

Storm water drainage basins were developed by analyzing existing topographic maps for the contributing basin and surrounding areas. Peak flows were determined for each of the subbasins, based on existing land uses within the basin, as well as fully developed land uses to design the regional facility to accommodate the 5 and 100-year rainfall events. For the purpose of this report, all flow data used in the analysis was estimated through standard engineering practices. Actual or recorded flow data was researched for model calibration and comparison to real-time events.

Factors affecting runoff include the size and slope of the basin, hydrologic soil group classification, imperviousness, land use or type of crop cover, travel time and the intensity of the rainfall event. Stockwell Engineers utilized XP-SWMM modeling software specifically designed for hydrology modeling and runoff routing to determine design flows. This hydrologic analysis is paired with an integrated 1D/2D detailed hydraulic analysis of both the existing enclosed system and the digital terrain model to simulate the conveyance of storm flows on the surface.

Current city design standards outline that the drainage system shall be designed to provide protection against regularly recurring damage, to reduce street maintenance costs, and to provide an orderly urban drainage system. Consequently, urban areas generally have two separate and distinct drainage systems. First is the enclosed system that corresponds to the minor (5-year) storm event recurring at regular intervals. The other is the overflow system that is designed to convey the major storm event which has a one percent probability of occurring in any one year, also referred to as the 100-year storm event.

EXISTING HYDROLOGIC & HYDRAULIC ANALYSIS

Determining flow for a storm sewer conveyance system is largely contingent upon the size of the contributing watershed boundary. The watershed boundary is determined by the topography of the basin. It is defined by the area tributary to a specific discharge point and is separated from adjacent basins by a divide or ridge that can be traced on topographic maps. Watershed boundaries can be relatively large depending on the location of the discharge point. Typically, they are divided into smaller tributary basins and sub-basins. Watershed boundaries for existing conditions are shown in Figure 1 and indicate areas that contribute storm flows to Lake Ole.

Other significant factors in determining storm runoff for a basin is the type of land use and slope of the land. Existing land uses were used for properties within the basin. From there, each sub-basin was analyzed to determine the imperviousness used to calculate weighted runoff coefficients. This information is then used to calculate the time it takes for runoff to travel from the hydraulically most distant point to reach the point of discharge, referred to as the time of concentration.

Figure 2 identifies the existing storm sewer elements that were located and incorporated into the existing conditions Hydrologic and Hydraulic model. These elements include pipe culverts, intake structures, enclosed storm sewer networks and discharge lines. The Columbia Basin storm sewer extension project that was constructed in 2014 provides the only outlet to the area where natural detention is occurring. This 18" RCP pipe does not have the capacity to handle the 5-year storm, however it does provide a critical outlet for Lake Ole that has historically been served by a small agricultural drain tile that appears to have clogged over time.

The hydraulic analysis was performed by developing an integrated 1D/2D hydraulic model using XP-SWMM that models the 1D sewer system and the 2D overland flow in tandem. The model was set up by delineating drainage basins and applying the hydrologic and hydraulic parameters described. The existing enclosed system was input into the software program based on the topographic field survey conducted by Stockwell Engineers that included inlet locations and types along with pipe lengths, sizes, types and slopes.

A digital elevation model (DEM) was used to represent the surface. The DEM was taken from LiDAR data provided by Lincoln County, that was flown in 2012. Roughness coefficients were assigned for existing land uses, which included industrial, commercial, agricultural, recreational and institutional uses. The model was executed to simulate the 5-year and 100-year events through the stormwater collection and conveyance system. Figure 3 shows a side by side comparison of the resulting inundated areas for both rainfall events. The tables shown in Figure 4 indicate the variables used to calculate the reported peak flows from each of the designated basins for both the 5-year and 100-year rainfall events. These tables also include resulting flow rates for each node element, and reports the resulting hydraulic data, such as pipe capacity, maximum flow through each 1D element, velocity and high water elevations at critical locations.

A 500-year event was run through the existing conditions model in an effort to simulate the July 2014 rainfall event for calibration purposes. The model was calibrated by reviewing rainfall data from the July, 2014 event and verifying the high water marks taken after the event ended. Observed rainfall for the 3-day event totaled 7.71 inches recorded in Sioux Falls, and 8.27 inches in Sioux City. High water elevations verified in the field were within 2 inches of what was reported in the hydrologic and hydraulic model simulation. Figure 5 compares the calculated 500 year inundation and an actual photo of inundation resulting from the July 2014 event.

PROPOSED HYDROLOGIC & HYDRAULIC ANALYSIS

The proposed analysis included an in depth breakdown of the drainage basin where improvements are planned on all remaining undeveloped parcels within the drainage basin. These areas considered specified proposed land uses for the Devitt Farms planned development, and improvements to park and recreational facilities north of Liberty Elementary. The Devitt Farms planned development includes commercial, multi-family residential, and single family residential uses. The land uses and general terrain used in the model were derived from the preliminary plan on record at City Hall. The proposed variables for all properties within the drainage basin were input into the 1D/2D simulation to project runoff rates for the basin once completely built out.

Stockwell Engineers developed a hypothetical elevation terrain and drainage plan, based on the preliminary plan of record, to present pose-developed conditions. Rainfall events were routed through the hypothetical model to determine approximate detention volumes and drainage facilities.

Input variables and results of the proposed conditions xpswmm hydrologic and hydraulic model are presenting in Figures 6 through 9. Figure 6 depicts the delineated subbasins from the proposed grading plan. Figure 7 includes a schematic of the xpswmm model, and each node and link that make up the 1D element of the analysis. The proposed grading plan replaced the existing conditions digital elevation model to represent the 2D element of the analysis.

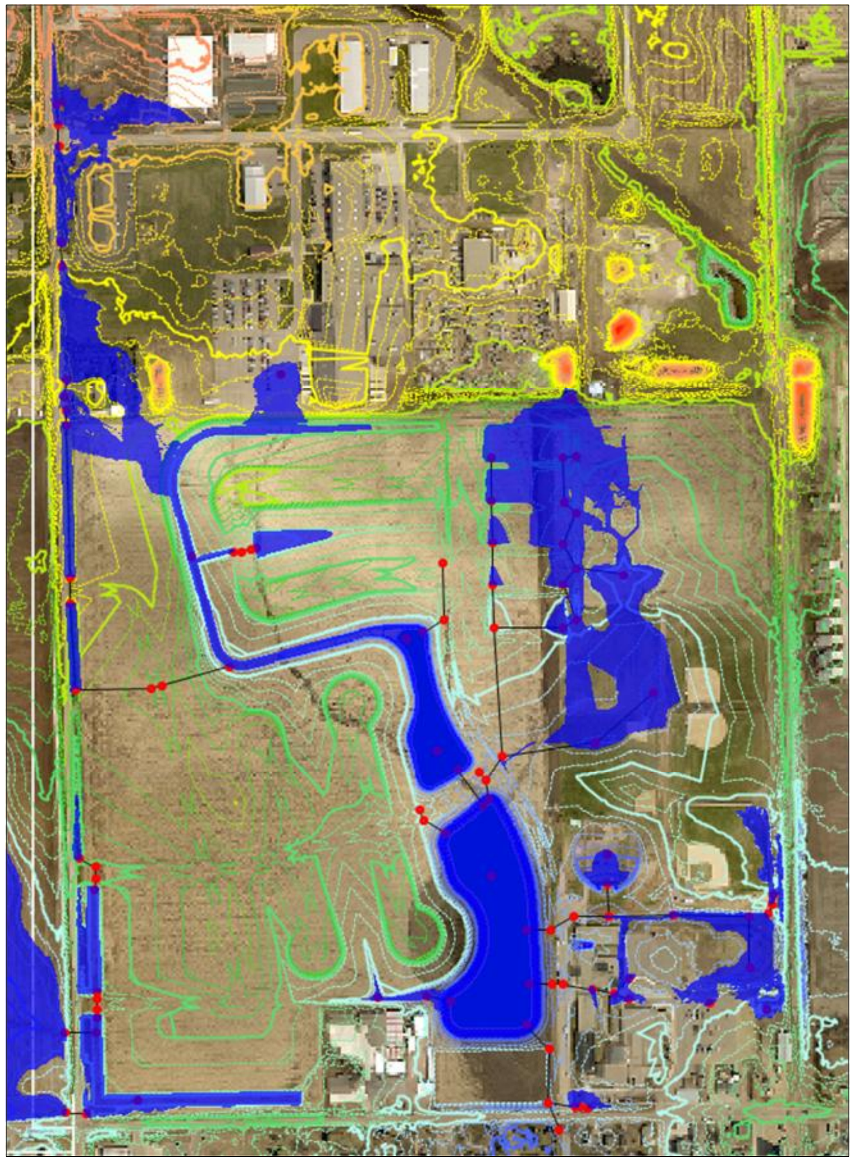
A visual side by side comparison of the proposed conditions model results for both the 5 and 100-year storm events is shown on Figure 8. The simulated model results are shown on Figure 9 that include peak flows, network capacity and maximum flows along with projected high water elevations shown in tabular form. The completed model indicates the high water elevation (HWE) at the regional facility to be 1417.86 during the 100-year rainfall event as opposed to the existing conditions HWE of 1422.68. The regional detention facility will be a retention pond that utilizes a permanent pool of water that will be maintained at the 1411 elevation for the lower pond, and 1416 for the upper pond. The retention pond will be used to manage stormwater runoff to prevent flooding to adjacent and downstream properties as well as provide improved water quality benefits.

ENGINEERING DESIGN STANDARDS

City of Harrisburg Engineering Design standards require urban areas to have two separate and distinct drainage systems. One is the minor system corresponding to the minor, or 5-year event for storms that occur at regular intervals. The other is the major system that corresponds to the Major, or 100-year event that has a one percent probability of occurring in any one year.

The minor storm drainage system shall be designed to provide protection against regularly recurring damage, to reduce street maintenance costs, to provide and orderly urban drainage system and to provide convenience to the urban residents. Storm sewer systems consisting of underground piping, natural drainageways, and other required appurtenances shall be considered as part of the minor storm drainage system

The major storm drainage system shall be designed to prevent major property damage or loss of life. The route of the major storm shall be noted to assure an outlet to a designated major drainageway is available. All channels shall be designed for the 5-year and 100-year storm frequencies considered. Property corner elevations of properties abutting a major drainageway shall be 1 foot above the 100-year design storm. Recommended minimum ground elevations for homes abutting or affected by the major drainageway shall be 2 feet above the overflow elevation. Recommended minimum ground elevations for homes abutting or affected by major drainageways, where an overflow system is not available, will be either a minimum of 4 feet



above the 100-year high water elevation or at an elevation that provides for 150 percent of the 100-year flow capacity.

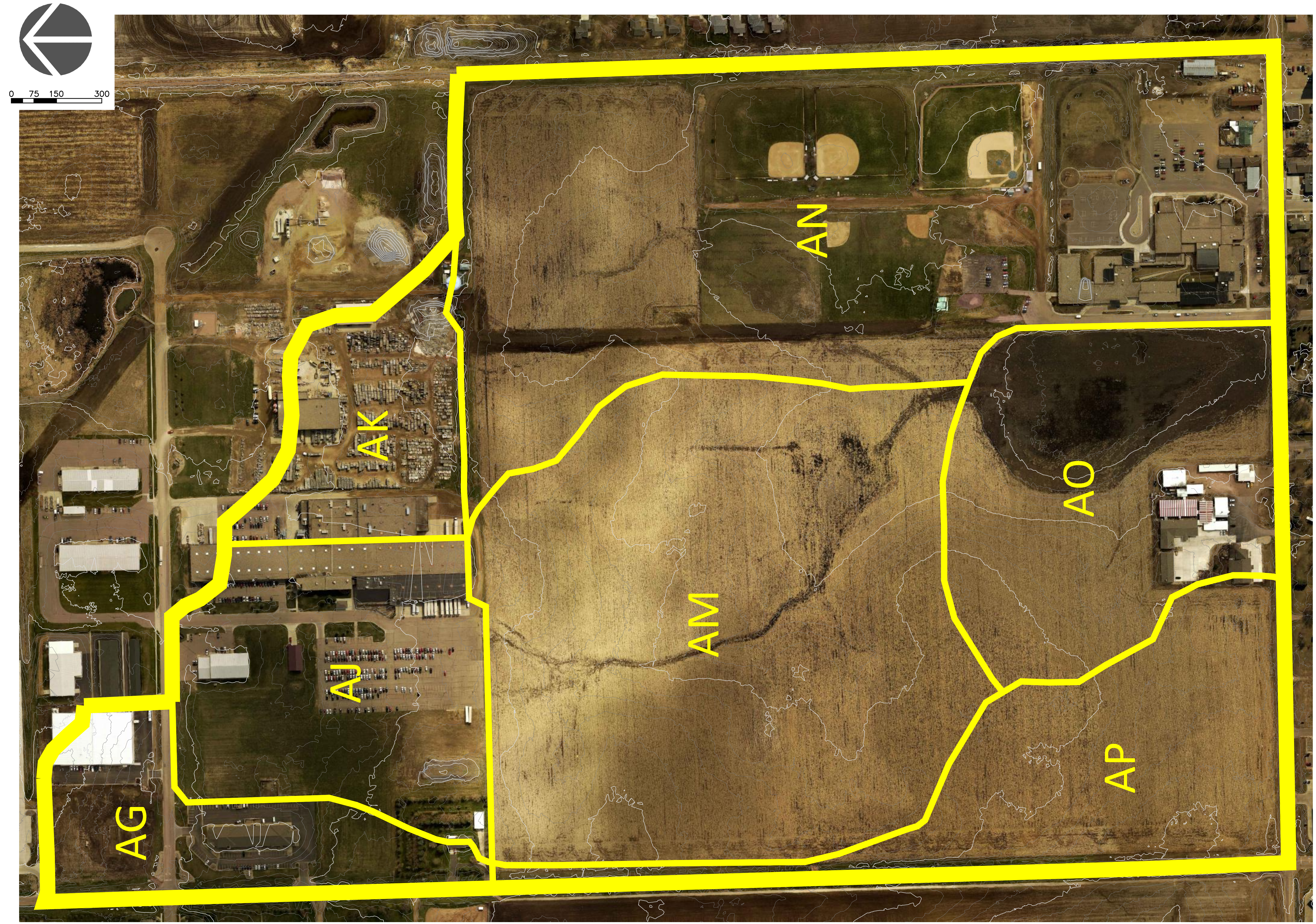
The proposed analysis contained in this report assumes there is no overflow system available as the low point in Willow Street is 2.5 feet higher than the top of pond and almost 2’ higher than the finish floor elevation of Liberty Elementary. To summarize, the proposed design allows for 4.8 feet of freeboard above the 100-year high water elevation before water would reach the finish floor elevation of Liberty Elementary, and over 6.5 feet of freeboard before overtopping Willow Street. The proposed design should adequately protect the school and downstream properties during extreme rainfall events like the ones experienced in 2011, 2013 and 2014.

City of Harrisburg subdivision regulations and design standards require separate and specific storm water analysis for each proposed development. These developments within the Devitt Farms watershed identified I this study must separately include storm water analysis based on actual proposed grading and storm sewer plans for comparison and conformance with the regional plan.

CONCLUSION

The proposed regional detention system included in this report is designed to store storm water for the 100-year event, plus an addition freeboard of 4 feet as outlined in Harrisburg Engineering Design Standards. Runoff from the basin shall be conveyed to the facility through enclosed systems, street right-of-way and open channels. The proposed facility includes a series of 2 interconnected retention ponds that each include a permanent pool of water set at the 1416 and 1411 elevations. The proposed facility will discharge through an outlet that utilizes the Columbia Basin extended storm sewer network that was constructed in 2014.

The main function of the facility will be to contain the surge during significant rainfall events and release runoff slowly into the Columbia Basin enclosed storm sewer system before discharging into Ninemile Creek. This slow release mitigates the size and intensity of storm induced flooding on downstream receiving waters. The retention facility will also collect suspended sediments, which are often found in high concentrations in storm water. Retention ponds are often landscaped with a variety of grasses, shrubs and wetland plants to provide bank stability and aesthetic benefits. Vegetation also provides water quality benefits by removing soluble nutrients through uptake.



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DEVITT FARMS
REGIONAL DETENTION FACILITY
Harrisburg, SD

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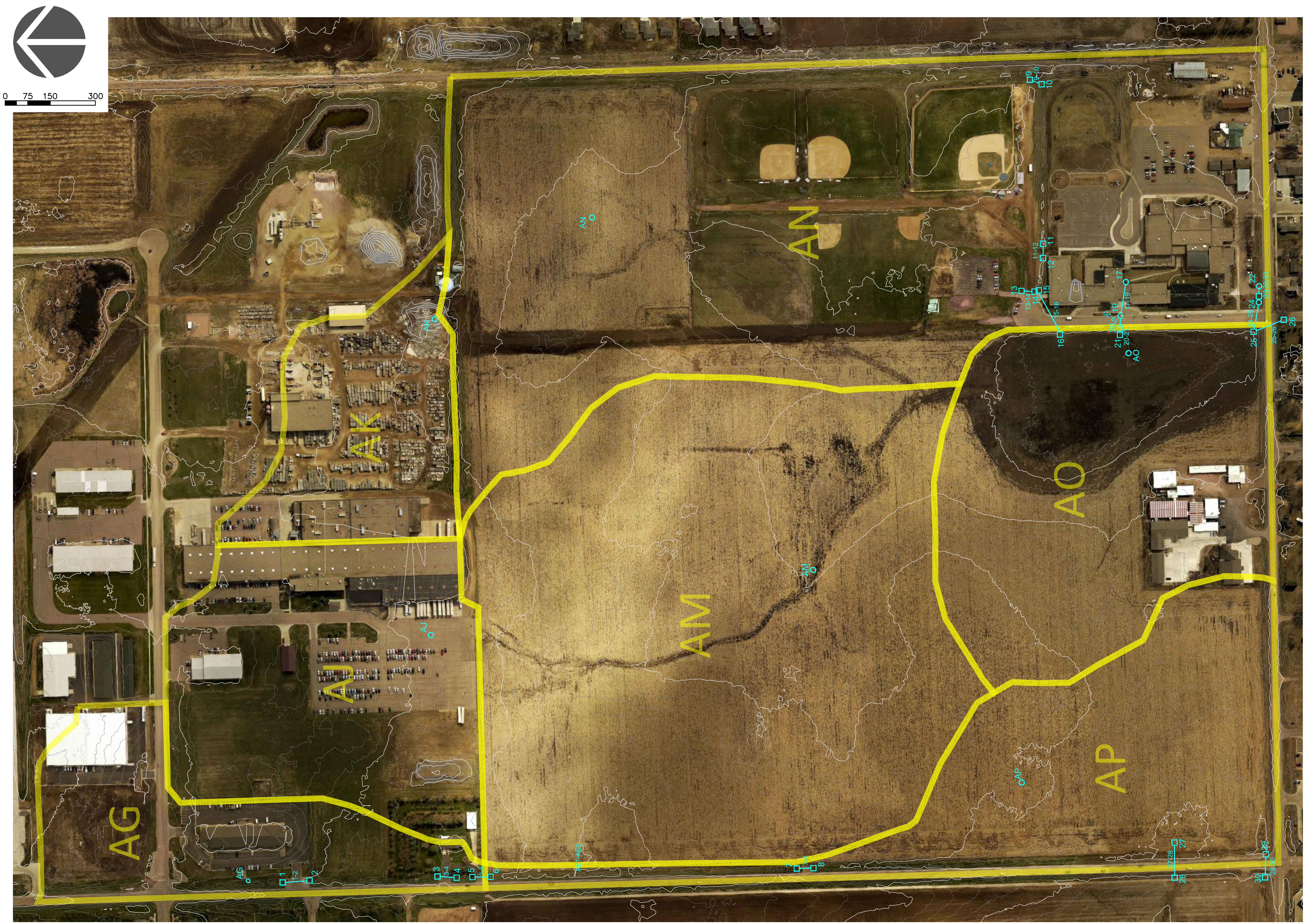
	September 6, 2016

SEI PROJECT #: 3315

existing drainage basins

1

EXISTING DEVITT BASINS.dwg



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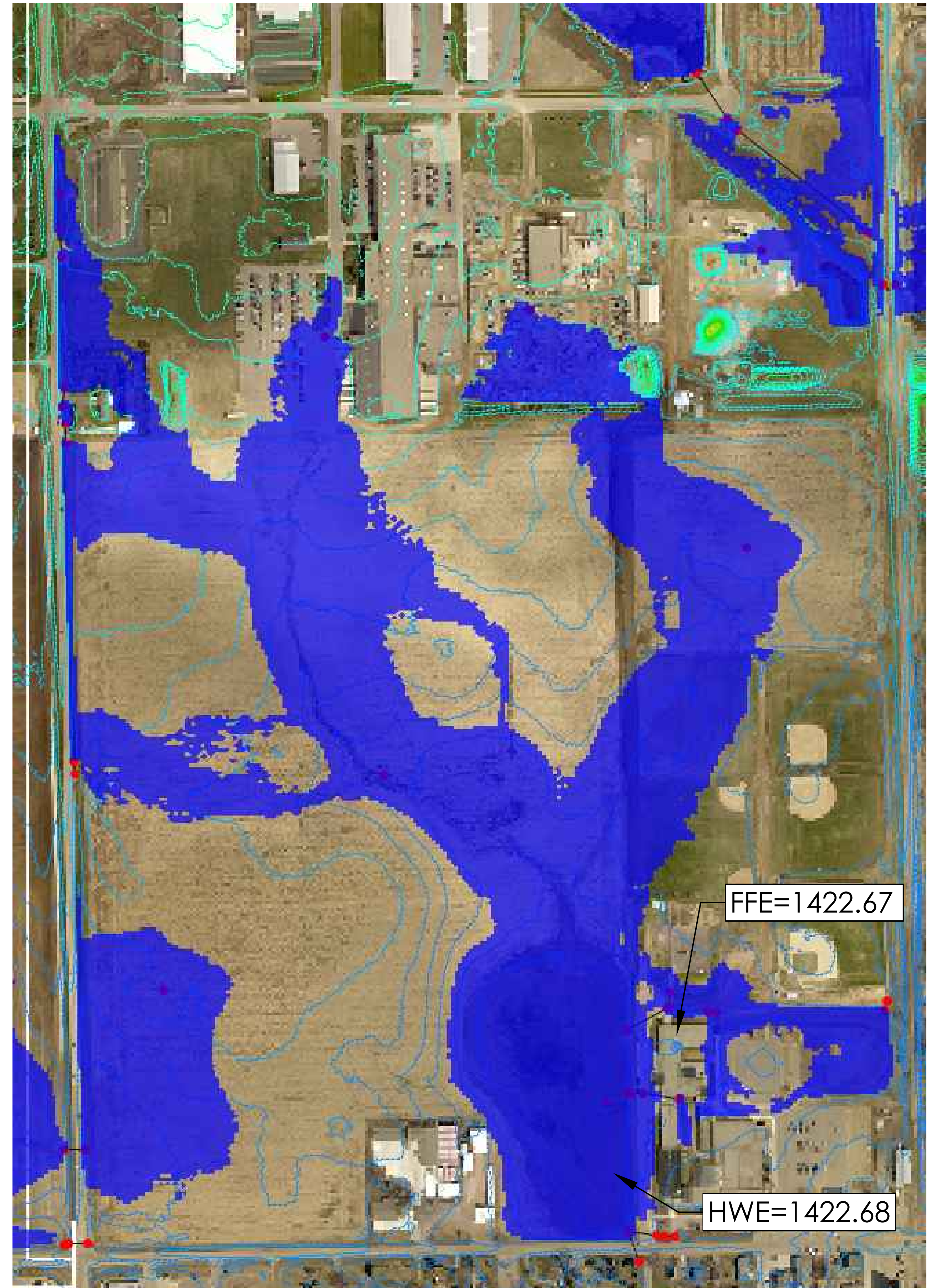
existing xpswmm schematic

EXISTING DEVITT BASINS.dwg

5-YEAR EVENT - EXISTING CONDITIONS



100-YEAR EVENT - EXISTING CONDITIONS

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xpswmm existing results schematic

3

EXISTING DEVITT BASINS.dwg

Node Name	Area (acres)	CN Value	Time of Conc (min)	5-YEAR Max Flow (cfs)	100-YEAR Max Flow (cfs)
AG	12.3	90.5	19.4	30.2	62.9
AJ	20.7	88.1	17.6	48.7	106.1
AK	11.2	88	15	28.0	61.0
AM	54.2	69.3	44.3	24.3	94.3
AN	65.5	65	45	19.4	94.1
AO	25.5	76.4	55.1	16.2	48.6
AP	22.1	65	53.1	5.8	28.2

Link Name	Length (ft)	Diameter or Height (ft)	Shape	Conduit Slope (%)	Roughness	Design Full Flow (cfs)	Upstream Node Name	Upstream Invert Elevation (ft)	Downstream Node Name	Downstream Invert Elevation (ft)	5-YEAR			100-YEAR		
											Max Flow (cfs)	Max Velocity (ft/s)	Maximum Water Elevation US (ft)	Max Flow (cfs)	Max Velocity (ft/s)	Maximum Water Elevation US (ft)
1-2	90.0	1.5	Circular	0.80	0.013	9.4	1	1439.95	2	1439.23	15.3	8.6	1442.48	15.8	8.9	1442.72
11-12	30.5	1.5	Circular	0.95	0.013	10.2	11	1419.22	12	1418.93	0.0	0.0	NA	-3.7	-2.1	1422.67
13-14	43.5	1.5	Circular	0.81	0.013	9.4	13	1419.31	14	1418.96	-0.3	-0.7	1420.43	-1.9	-1.1	1422.67
15-16	148.0	2	Circular	0.78	0.013	19.9	15	1418.91	16	1417.76	-0.7	-0.3	1420.43	-6.8	-2.1	1422.67
17-18	114.0	1.25	Circular	0.50	0.013	4.6	17	1418.55	19	1417.98	-2.2	-3.5	1421.31	-9.0	-7.6	1422.68
19-20	42.0	1.25	Circular	0.50	0.013	4.6	19	1417.98	20	1417.77	-2.2	-1.8	1420.68	-6.1	-4.9	1422.68
20-21	12.0	1.25	Circular	0.50	0.013	4.6	20	1417.77	21	1417.71	-2.2	-1.8	1420.41	-4.9	-4.0	1422.68
22-23	33.5	1.25	Circular	0.72	0.013	5.5	22	1420.50	23	1420.26	0.0	0.0	NA	0.0	0.0	NA
24-25	95.0	1.5	Circular	3.20	0.013	18.8	24	1414.77	25	1411.73	0.0	0.0	NA	0.0	0.0	NA
29-30	60.0	1.25	Circular	0.48	0.013	4.5	29	1423.19	30	1422.90	0.0	0.0	NA	0.0	0.0	NA
3-4	65.0	1.5	Circular	1.54	0.013	13.0	3	1436.83	4	1435.83	13.2	7.2	1438.66	14.4	8.1	1438.99
5-6	65.0	1.5	Circular	1.28	0.013	11.9	5	1435.76	6	1434.93	12.5	6.9	1437.59	13.3	7.5	1437.78
7-8	38.0	1.5	Circular	0.11	0.022	2.0	7	1430.00	8	1429.96	0.0	0.0	NA	0.0	0.0	NA
9-10	33.0	1	Circular	4.97	0.022	4.7	9	1423.08	10	1421.44	0.0	0.0	NA	0.0	0.0	1423.08
AP1-AP2	64.0	2	Circular	0.83	0.013	20.6	27	1422.42	28	1421.89	2.4	2.9	1423.35	15.0	5.2	1424.19
25-26	103.0	1.5	Circular	0.38	0.013	6.5	25	1409.23	26	1408.84	0.0	0.0	NA	0.0	0.0	NA

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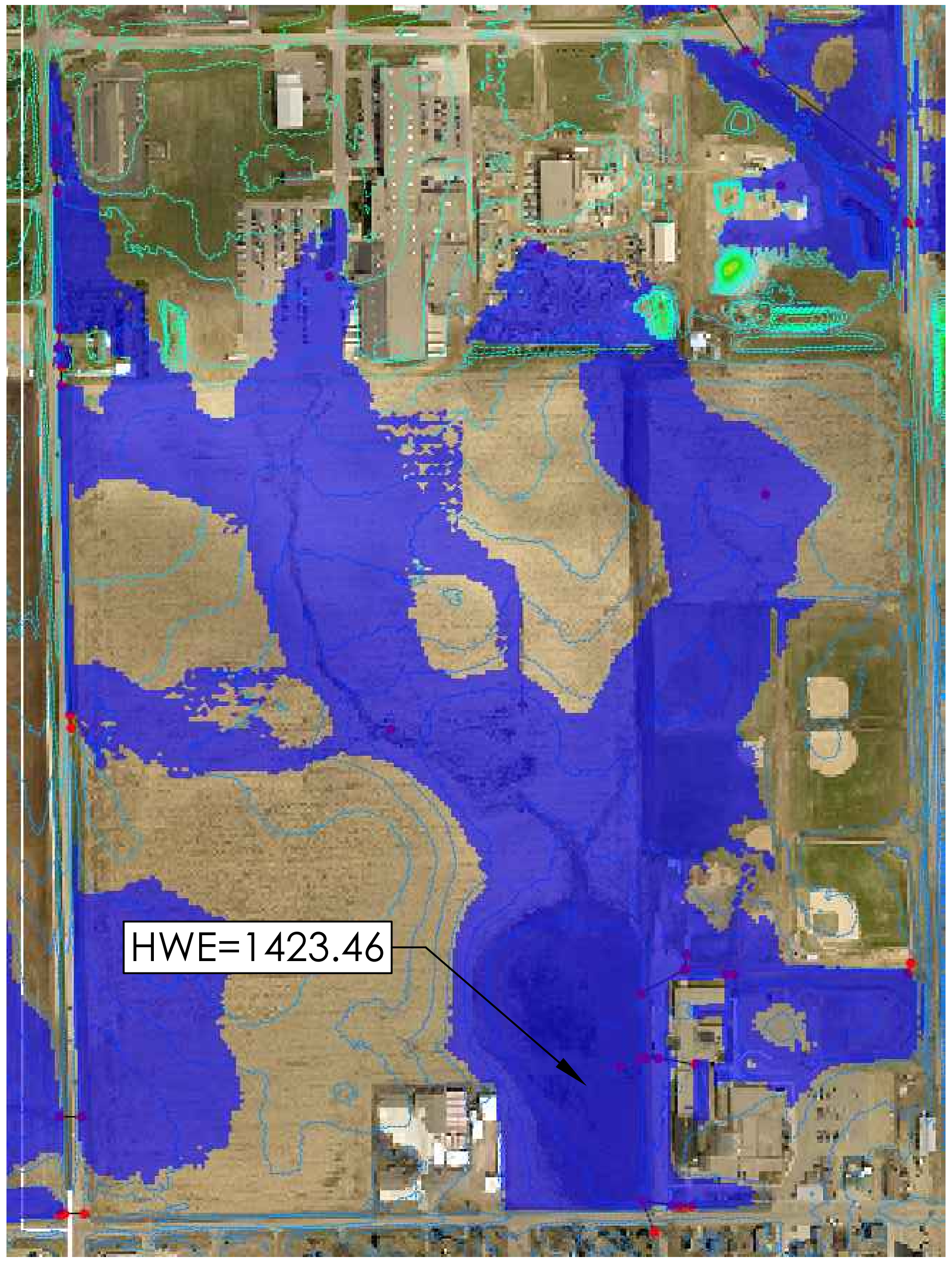
xpswmm results existing conditions

EXISTING DEVITT BASINS.dwg



500-YEAR EVENT SIMULATION

AERIAL PHOTO TAKEN 06/17/2014

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June 2014 rainfall event

EXISTING DEVITT BASINS.dwg

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proposed drainage basins

6

EXISTING DEVITT BASINS.dwg

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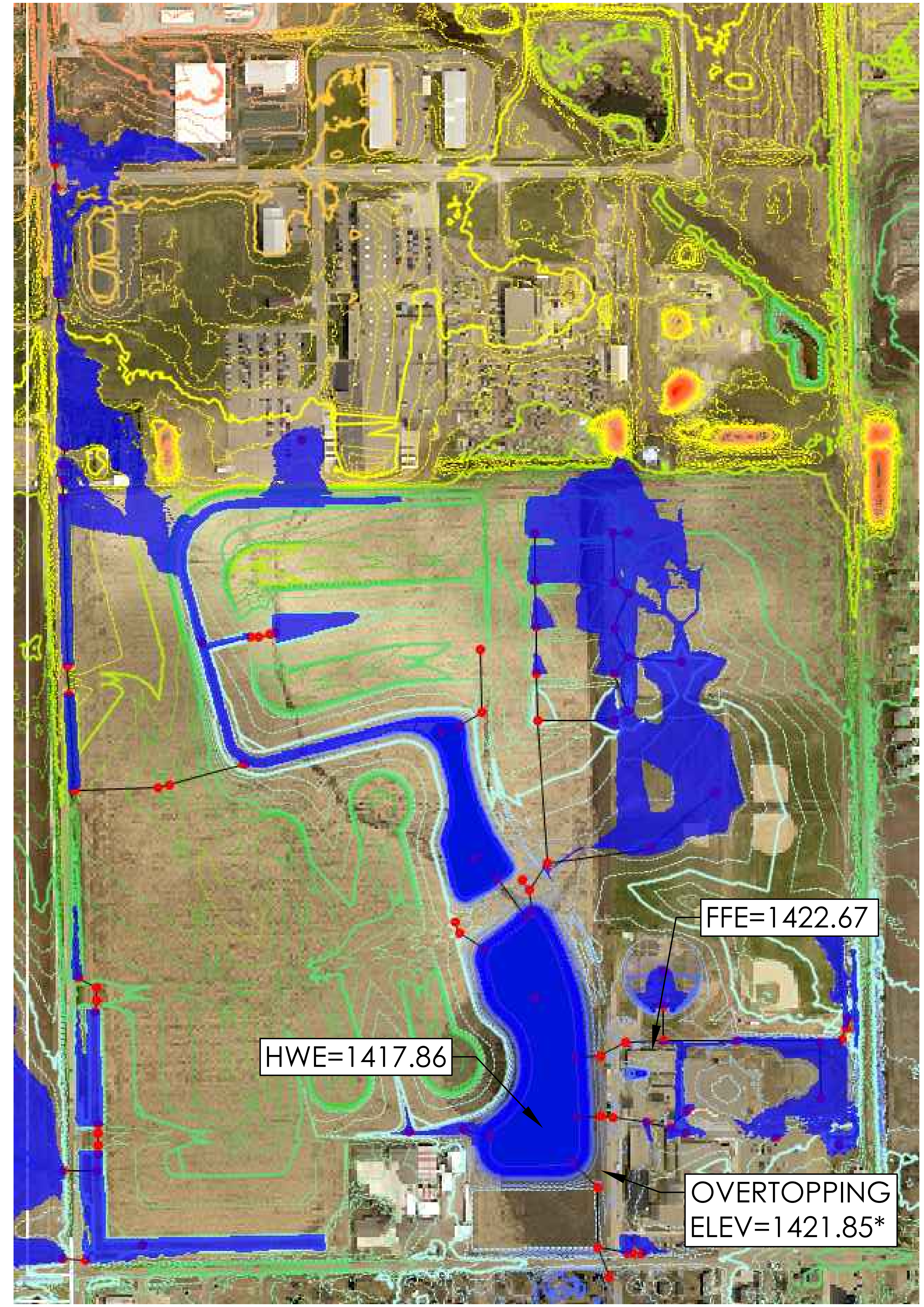
proposed
xpswmm
schematic

5-YEAR EVENT - PROPOSED SIMULATION



100-YEAR EVENT - PROPOSED SIMULATION
*500-YEAR EVENT - HWE=1420.12

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xpswmm proposed results schematic

EXISTING DEVITT BASINS.dwg

Node Name	Area (acres)	CN Value	Time of Conc (min)	5-YEAR Max Flow (cfs)	100-YEAR Max Flow (cfs)
1	0.4	61	20	0.1	0.8
10	0.7	61	25	0.2	1.2
11	1.2	61	25	0.3	2.1
12	0.7	61	25	0.2	1.2
13	0.6	61	25	0.2	1.1
14	0.6	61	25	0.2	1.1
15	0.7	61	25	0.2	1.2
17	6.4	89	15	16.6	35.5
2	1.2	61	25	0.3	2.1
22	1.5	80	25	2.0	5.4
25	0.7	64	20	0.3	1.6
26	3.1	72	30	2.3	7.8
28	0.8	98	15	2.7	4.9
3	0.6	61	25	0.2	1.1
30	0.5	89	15	1.3	2.8
32	0.5	98	15	1.7	3.1
33	0.9	98	15	3.0	5.5
4	0.3	61	20	0.1	0.6
5	0.6	61	25	0.2	1.1
6	12.5	64.8	72	2.6	12.6
7	0.3	61	20	0.1	0.6
8	0.6	61	25	0.2	1.1
9	0.3	61	20	0.1	0.6
A1	0.87	92	15	2.5	5.0
A2	1.46	92	15	4.2	8.5
A3	3.65	92	15	10.5	21.2
AA	4.5	92	15	13.0	26.1
AB	1.2	92	15	3.5	7.0
AC	1	92	15	2.9	5.8
AD	3.9	87.2	15	9.5	20.9
AE	0.4	73.8	15	0.5	1.5
AE2	1.5	85	15	3.3	7.7
B1	1.3	92	15	3.7	7.5
B2	3.23	92	15	9.3	18.7
B3	3.17	92	15	9.1	18.4
CM	11.2	88	15	28.0	61.0
D1	0.47	75	15	0.6	1.9
D2	0.69	75	15	0.9	2.8
D4	3.28	75	15.8	4.3	12.8
D5	5.11	75	16.4	6.5	19.7
F1	1.37	85	15	3.0	7.0
F2	3.6	85	15.59	7.8	18.2
G	6	75	25	6.1	18.6
H	11.9	82.9	46.5	12.3	30.7
H1	1.91	75	15.3	2.5	7.5
H2	2.6	75	17.5	3.2	9.7
HH	4.8	82.9	20	8.5	20.8
I	12.7	75	44.4	8.7	27.0
J	9.9	82.7	45	10.4	26.0
J1	0.77	75	15	1.0	3.1
J2	0.34	75	15	0.5	1.4
J3	4.11	75	22.6	4.4	13.5
L	3.6	84.8	15	7.9	18.4
M	9.7	77	39.3	8.2	23.9
N	5.2	61	55	0.8	5.3
O1	4.2	64.7	35	1.4	7.1
O2	1.6	88	20	3.5	7.7
O3	2.8	80	20	4.3	11.3
P	2	84.2	15	4.3	10.1
Q	0.1	80	15	0.2	0.5
R	1.2	82.5	15	2.4	5.8
S	1.5	83.8	15	3.1	7.5
SP	22	88.1	17.6	51.7	112.8
T	7.5	92	15	21.6	43.5

Link Name	Length (ft)	Diameter or Height (ft)	Shape	Conduit Slope (%)	Roughness	Design Full Flow (cfs)	Upstream Node Name	Upstream Invert Elevation (ft)	Downstream Node Name	Downstream Invert Elevation (ft)	5-YEAR			100-YEAR		
											Max Flow (cfs)	Max Velocity (ft/s)	Maximum Water Elevation US (ft)	Max Flow (cfs)	Max Velocity (ft/s)	Maximum Water Elevation US (ft)
1-2	50.2	1	Circular	0.50	0.013	2.5	1	1423.30	2	1423.05	2.8	3.5	1430.53	2.8	3.5	1430.87
10-15	258.9	1.25	Circular	0.50	0.014	4.3	10	1419.30	15	1418.00	3.7	3.9	1420.20	7.4	5.9	1424.83
11-12	161.1	0.5	Circular	0.62	0.013	0.4	11	1423.00	12	1422.00	0.8	3.7	1430.12	0.9	4.2	1430.68
12-13	159.5	0.5	Circular	1.51	0.013	0.7	12	1422.00	13	1419.60	0.8	3.8	1427.94	0.8	3.9	1429.33
13-14	158.9	0.5	Circular	0.50	0.013	0.4	13	1419.60	14	1418.80	0.8	3.9	1425.74	0.9	4.3	1427.79
14-15	161.0	0.5	Circular	0.50	0.013	0.4	14	1418.80	15	1418.00	0.9	4.6	1423.00	1.1	5.2	1426.55
15-17	484.8	1.5	Circular	0.37	0.013	6.4	15	1418.00	17	1416.20	4.6	3.9	1418.94	8.5	4.8	1422.90
17-20	120.0	2.5	Circular	0.50	0.013	29.0	17	1416.20	D1	1415.60	28.8	7.2	1418.13	54.2	11.0	1421.42
18-19	150.0	4	Circular	0.93	0.013	138.8	18	1412.40	19	1411.00	48.8	4.7	1415.39	126.4	10.0	1418.35
2-3	167.3	0.5	Circular	0.51	0.013	0.4	2	1423.05	3	1422.20	1.0	4.9	1430.25	0.8	3.9	1430.70
22-25	193.4	1.5	Circular	0.39	0.013	6.5	22	1417.50	25	1416.75	2.0	3.2	1418.08	5.4	4.1	1422.34
23-24	42.0	1	Circular	3.91	0.022	4.2	23	1423.08	24	1421.44	0.5	3.2	1423.32	2.8	5.5	1423.72
25-26	279.5	2	Circular	0.64	0.013	18.2	25	1416.25	26	1414.45	4.7	4.7	1416.94	11.6	5.3	1421.48
26-28	245.6	2	Circular	0.65	0.013	18.3	26	1414.45	28	1412.85	8.2	5.5	1415.40	26.4	8.3	1421.22
27-28	118.4	1.25	Circular	0.34	0.013	3.8	27	1413.25	28	1412.85	1.3	2.1	1413.96	7.3	5.9	1418.54
28-29	130.7	2	Circular	0.65	0.013	18.2	28	1412.85	29	1412.00	9.8	5.9	1413.89	30.3	9.6	1418.14
29-30	99.2	2	Circular	0.68	0.013	18.3	29	1412.00	30	1411.35	9.8	5.8	1413.56	30.3	9.6	1417.87
3-4	61.7	0.5	Circular	0.49	0.013	0.4	3	1422.20	4	1421.90	0.9	4.2	1428.45	0.8	4.0	1429.31
30-31	89.1	2.5	Circular	0.39	0.013	25.7	30	1411.35	31	1411.00	10.0	4.9	1413.56	31.8	7.0	1417.86
32-34	80.8	1.25	Circular	0.45	0.013	4.3	32	1419.25	34	1418.89	1.6	2.7	1420.42	2.7	2.6	1422.20
33-34	55.0	1.25	Circular	0.42	0.013	4.2	33	1419.12	34	1418.89	3.0	3.5	1420.48	4.4	3.6	1422.22
34-R	83.8	1.25	Circular	0.41	0.013	4.1	34	1418.89	R	1418.55	4.6	2.8	1420.38	6.7	2.7	1422.13
35-36	83.3	1.5	Circular	8.13	0.013	30.0	35	1417.77	36	1411.00	10.1	14.2	1418.37	17.5	16.5	1418.60
37-38	123.6	1.5	Circular	0.45	0.012	7.6	37	1411.00	38	1410.45	9.9	5.6	1413.49	14.8	8.2	1417.83
38-39	201.9	1.5	Circular	0.51	0.012	8.1	38	1410.35	39	1409.33	9.9	5.6	1412.36	14.8	8.3	1415.39
39-40	107.6	1.5	Circular	0.36	0.012	6.9	39	1409.23	40	1408.84	10.0	5.5	1410.87	15.0	8.5	1412.06
4-5	125.2	0.5	Circular	0.52	0.013	0.4	4	1421.90	5	1421.25	0.9	4.3	1427.49	0.9	4.3	1429.08
5-7	109.8	0.5	Circular	0.50	0.014	0.4	5	1421.25	7	1420.70	1.0	4.7	1424.93	1.4	6.4	1428.59
6-7	179.8	1.25	Circular	0.45	0.013	4.3	6	1421.50	7	1420.70	2.6	3.5	1422.21	-6.1	-4.8	1425.98
7-8	76.9	1.25	Circular	0.52	0.013	4.7	7	1420.70	8	1420.30	3.5	4.1	1421.52	7.2	5.8	1427.23
8-9	139.6	1.25	Circular	0.50	0.013	4.6	8	1420.30	9	1419.60	3.6	4.1	1421.14	7.1	5.6	1426.75
9-10	59.2	1.25	Circular	0.51	0.013	4.6	9	1419.60	10	1419.30	3.6	4.0	1420.46	8.2	6.5	1425.59
A1-A0	22.0	2.5	Circular	0.46	0.013	27.7	A1	1423.10	A0	1423.00	21.5	6.6	1425.14	34.3	7.0	1426.32
A2-A1	29.0	2.5	Circular	0.69	0.013	34.1	A2	1423.40	A1	1423.20	19.5	6.5	1425.13	30.3	6.4	1426.44
A3-A2	20.0	2.5	Circular	0.50	0.013	29.0	A3	1423.60	A2	1423.50	16.7	4.1	1425.61	25.5	5.2	1426.76
AA-AA1	21.0	1.25	Circular	0.52	0.022	2.8	AA	1442.96	AA1	1442.85	6.9	5.6	1446.85	6.9	5.5	1447.18
AA1-AB	60.0	3.3	Trapezoidal	1.22	0.030	497.1	AA1	1443.85	AB	1443.12	5.4	0.3	1446.52	5.5	0.3	1446.94
AB-AB1	82.5	1.5	Circular	0.72	0.022	5.3	AB	1443.12	AB1	1442.53	7.9	4.4	1446.52	8.9	5.0	1446.94
AC-AC1	90.0	1.5	Circular	0.80	0.013	9.4	AC	1439.95	AC1	1439.23	9.5	6.1	1441.20	13.7	7.8	1442.18
AD-AD1	65.0	1.5	Circular	1.54	0.013	13.0	AD	1436.83	AD1	1435.83	7.3	4.1	1438.71	9.3	5.3	1439.00
AE-AE1	65.0	1.5	Circular	1.28	0.013	11.9	AE	1435.76	AE1	1434.93	5.7	6.6	1436.53	6.9	7.0	1436.63
AE1-AE2	586.5	2	Natural	0.33	0.030	140.1	AE1	1434.93	AE2	1433.00	7.2	1.1	1435.35	9.8	1.1	1435.43
AE2-AE3	101.6	3	Circular	0.49	0.013	46.8	AE2	1433.00	AE3	1432.50	7.7	4.3	1434.09	14.5	4.3	1434.62
AE3-F3	326.9	0	Natural	0.46	0.030	391.8	AE3	1432.50	F3	1431.00	7.7	1.5	1432.89	14.2	1.8	1433.08
B1-B0	32.0	2	Circular	1.25	0.013	25.3	B1	1424.00	B0	1423.60	22.0	8.3	1425.80	37.5	11.9	1427.54
B2-B1	41.0	2	Circular	1.22	0.013	25.0	B2	1424.60	B1	1424.10	18.4	8.0	1426.07	29.9	9.5	1428.21
B3-B2	60.9	2	Circular	1.48	0.013	27.5	B3	1425.60	B2	1424.70	9.1	4.5	1427.15	14.5	4.6	1429.13
D1-D0	117.2	2.5	Circular	0.51	0.013	29.3	D1	1415.60	D0	1415.00	30.4	8.6	1417.39	58.8	12.4	1419.35
D2-D1	39.0	1.5	Circular	1.03	0.013	10.6	D2	1416.10	D1	1415.70	0.9	1.3	1417.39	2.7	1.5	1419.38
D4-D3	86.4	2	Circular	2.32	0.013	34.4	D4	1417.00	D3	1415.00	10.8	8.7	1417.79	32.4	11.4	1418.68
D5-D4	39.0	2	Circular	2.05	0.013	32.4	D5	1420.80	D4	1420.00	6.5	8.1	1421.41	19.6	10.8	1421.93
F1-F0	241.7	3	Circular	1.59	0.013	84.2	F1	1425.85	F0	1422.00	14.8	8.1	1426.84	36.7	11.1	1427.43
F2-F1	38.6	3	Circular	1.68	0.013	86.5	F2	1426.60	F1	1425.95	12.1	8.1	1427.38	29.7	10.5	1427.90
F3-F2	271.5	3	Circular	1.58	0.013	83.9	F3	1431.00	F2	1426.70	7.7	6.6	1431.67	13.0	7.2	1432.50
G1-G0	86.0	1.5	Circular	0.81	0.013	9.5	G1	1411.70	G0	1411.00	5.9	3.2	1420.42	13.0	7.1	1421.23
H1-H0	132.9	1.5	Circular	3.01	0.013	18.2	H1	1419.00	H0	1415.00	5.7	3.1	1428.22	9.5	5.2	1428.85
H2-H1	209.5	1.5	Circular	1.38	0.013	12.4	H2	1423.90	H1	1421.00	3.2	2.5	1428.41	4.8	2.7	1428.91
J1-J0	20.0	1.5	Circular	0.50	0.013	7.4	J1	1423.80	J0	1423.70	2.8	2.9	1424.61	8.1	6.0	1424.96
J2-J1	35.0	1.5	Circular	0.57	0.013	7.9	J2	1424.10	J1	1423.90	2.2	3.4	1424.69	5.9	5.0	1425.10
J3-J2	14.1	1.5	Circular	0.71	0.013	8.9	J3	1424.30	J2	1424.20	2.1	2.7	1425.02	5.6	3.4	1425.67
L-17	353.7	2	Circular	0.27	0.013	11.7	L	1417.15	17	1416.20	12.4	4.3	1419.03	18.3	5.8	1422.61
M-L	287.9	1.5	Circular	0.51	0.013	7.5	M	1418.60	L	1417.15	8.2	4.8	1420.28	11.5	6.5	1422.91
P-41	33.53	1.25	Circular	0.72	0.013	5.47	P	1420.50	41	1420.26	2.1	1.7	1422.67	4.1	3.3	1423.02
Q-39	98.98	1.5	Circular	3.19	0.013	18.4	Q	1414.77	39	1411.74	4.1	6.6	1415.87	9.9	6.7	1416.78
R-S	114.04	1.25	Circular	0.37	0.013	3.92	R	1418.32	S	1417.90	7.0	2.8	1420.23	10.8	4.4	1421.93
S-35	42.14	1.25	Circular	0.405	0.013	4.1	S	1417.9	35	1417.73	10.135	4.33	1419.73	17.557	7.29	1420.713
T3-T4	116.78	2	Circular	0.951	0.013	22.06	T3	1423	T4	1421.89	7.885	2.47	1425.067	15.007	4.76	1426.042
T5-T6	60	1.25	Circular	0.483	0.013	4.49	T5	1423.19	T6	1422.9	0.421	2.18	1423.451	9.396	7.65	1425.424

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DEVITT FARMS REGIONAL DETENTION FACILITY

Harrisburg, SD

REVISION SCHEDULE

ISSUE/REVISION	DATE
	September 6, 2016

SEI PROJECT #: 3315

proposed xpswmm results