

Tumbledown Trails Flood Study

Submitted to: Town of Middleton

Submitted by: Nahn and Associates LLC

Date: December 27, 2018

1st Revision: Feb 19, 2019

2nd Revision: June 13, 2019

Engineer's Stamp:

Engineers Signature:

Date of Signature:

Introduction- Tumbledown Trails Golf Course (Golf Course) is in the Town of Middleton (Town), south of Mineral Point Road and west of Pioneer Road. The Golf Course is proposed to be redeveloped with fewer holes to accommodate 91 single family parcels adjacent to the reconfigured golf course holes. Item #19 of the Town’s “Design Requirements for Public Improvements” (2/15/17 update) states:

“Drainage areas (1 square mile or larger) require a base flood elevation study (100-year). A hydraulic study must be approved by the Town Engineer or Wisconsin DNR. A FEMA base flood elevation should be used if available. Adjacent structures and opening elevations should meet requirements in the Dane County Floodplain Ordinance.”

The purpose of this flood study is to describe the methodology and results of a 100-year base flood elevation study conducted for the Golf Course redevelopment including the existing and proposed 100-year floodplain boundaries.

Hydrology- Wisconsin Administrative Rule NR 116 (116.07(3) (a) (1. to 7.) and 116.07(3)(b) (1. To 7.) requires the development of the 100-year flow utilizing two different methods. The report “Badger Mill Creek Hydrologic Model (November 8, 2006)” listed in Appendix A was obtained from the WDNR. This report includes a comparison of 100-year volumes and peak discharges between the HEC-HMS and XP-SWMM (Earth Tech 2003) models. This report was approved by the WNDNR and lists the proposed future conditions 100-year flow as 623 cubic feet per second (c.f.s.) at the Pioneer Road East crossing of the Dry Unnamed Tributary to Badger Mill Creek (“Comparison of Future HEC-HMS results to XP-SWMM” table on Page 5).

A second method to generate the 100-year flow is the drainage area transfer method, as listed in Appendix B, using the FEMA-approved base flood flow elevation downstream at the Shady Oak Lane crossing. As shown in Appendix B, the 100-year flow is 529.3 c.f.s. using the drainage area transfer method. The higher conservative value of 623 c.f.s. was selected as the 100-year flow for the Pioneer Road crossing at the southeast corner of the Golf Course. Appendix B also lists the 100-year flows for the Southwest and North Swales based on contributing drainage areas. The upstream drainage area map is listed in Appendix C.

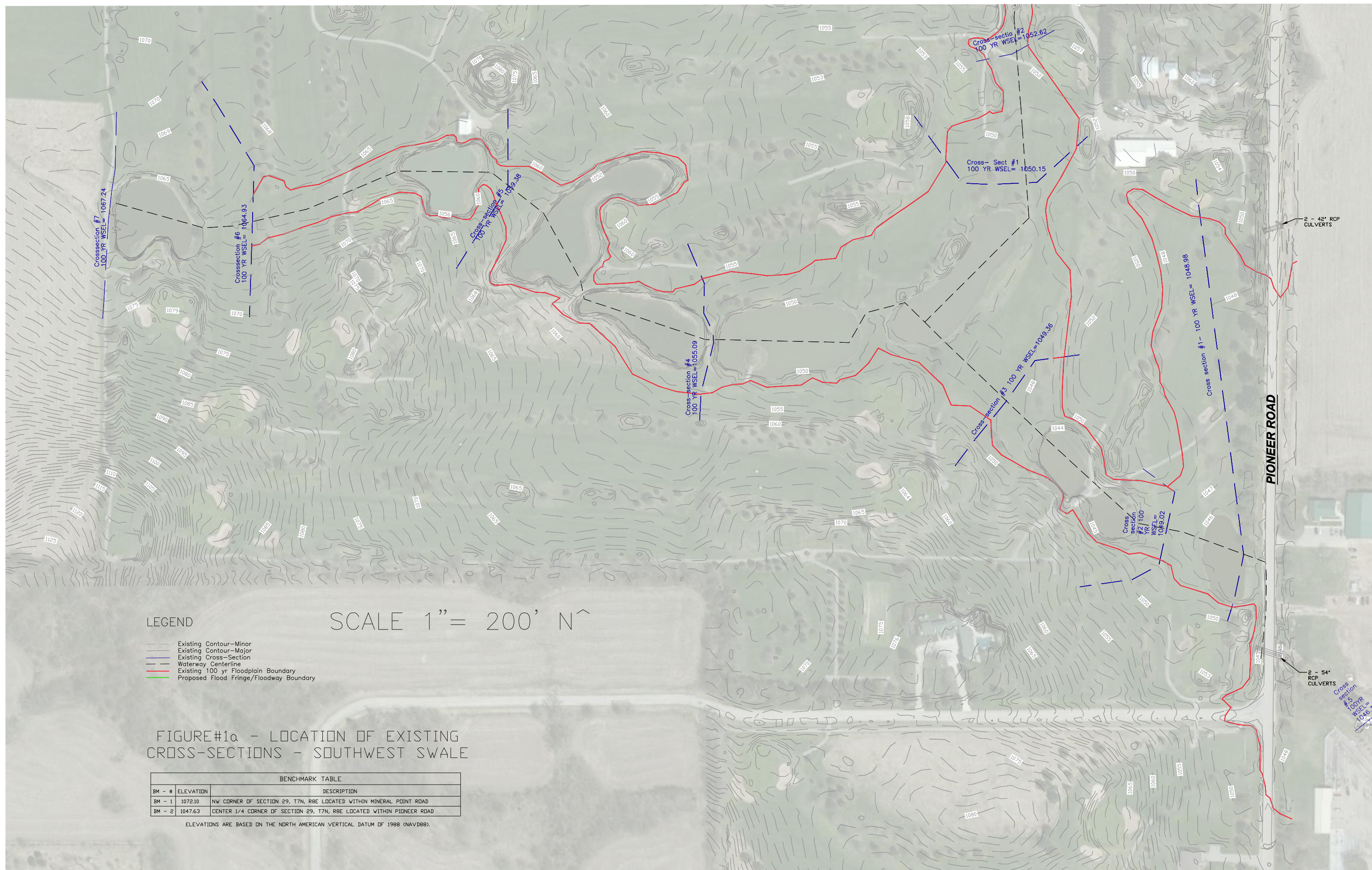
Hydraulics- The 100-year floodplain elevations were determined for the Existing and Proposed Conditions using the U.S. Army Corps HEC-RAS model (Version 5.0.3) to determine floodplain elevations: (Please note the HEC-RAS files are comprised of two separate HEC-RAS project runs for the Southwest and North Swales separately.) The input files for the Existing and Proposed HEC-RAS models are summarized in Table #1.

Table #1-HEC-RAS Input File Summary- Existing and Proposed Conditions- Tumbledown Trails Redevelopment

Model Name	Project Name	Plan Name	Geometry File	Flow data
Southwest Swale-Existing	ttrails.prj	Plan 12 ttrails.p12	ttrails.g03	ttrails.f03
Southwest Swale- Proposed	ttrails.prj	Plan 19 ttrails.p19	ttrails.g12	ttrails.f02
North Swale-Existing	ntribtttdown.prj	Plan 09 ntribtttdown.p09	ntribtttdown.g05	ntribtttdown.f02
North Swale-Proposed	ntribtttdown.prj	Plan 19 ntribtttdown.p14	ntribtttdown.g11	ntribtttdown.f03

Starting Water Surface Elevation- The starting water surface elevation for both the Existing and Proposed Conditions model was selected using two different methods. The FEMA -approved downstream water surface elevation at the upstream invert of the Mid Town Road bridge was increased by the difference in channel invert elevations from Mid-Town Road to 260 feet downstream of Pioneer Road (Starting point of HEC-RAS runs) as shown in Appendix D. A second method utilized the normal water surface elevation as the starting water surface elevation at the starting point of the HEC-RAS model. The normal water surface elevation was higher than the transferred FEMA elevation (1046.33>1045.61) and was used as the starting water surface elevation.

Existing Conditions- An existing topographic conditions HEC-RAS model was compiled for the “Southwest” and “North” Swales through the Golf Course using the publicly-available Dane County GIS data based on the 2017 flyover (1-foot contour intervals). The existing culvert data and cross-sections downstream of Pioneer Road are based on a site survey by Wyser Engineering in August and September of 2018. The locations of the Existing Conditions cross-sections are shown in Figure #1a and #1b for the Southwest and North Swales respectively. The flow attenuation effects of the existing Golf Course landscape ponds (Ponds) were neglected to be conservative. These Ponds have no flood control storage (storage above the normal water level) and were not designed as stormwater attenuation basins to reduce peak flows. Instead these Ponds were designed to provide water supply/aesthetic features for the Golf Course operation. In addition, the existing floodgate dam on the upstream side of the two 36-inch culvert crossing of the existing Golf Course entrance driveway was also neglected to be conservative (North Swale). The Existing Conditions profile summary table is listed in Appendix E for both the Southwest and North Swales.



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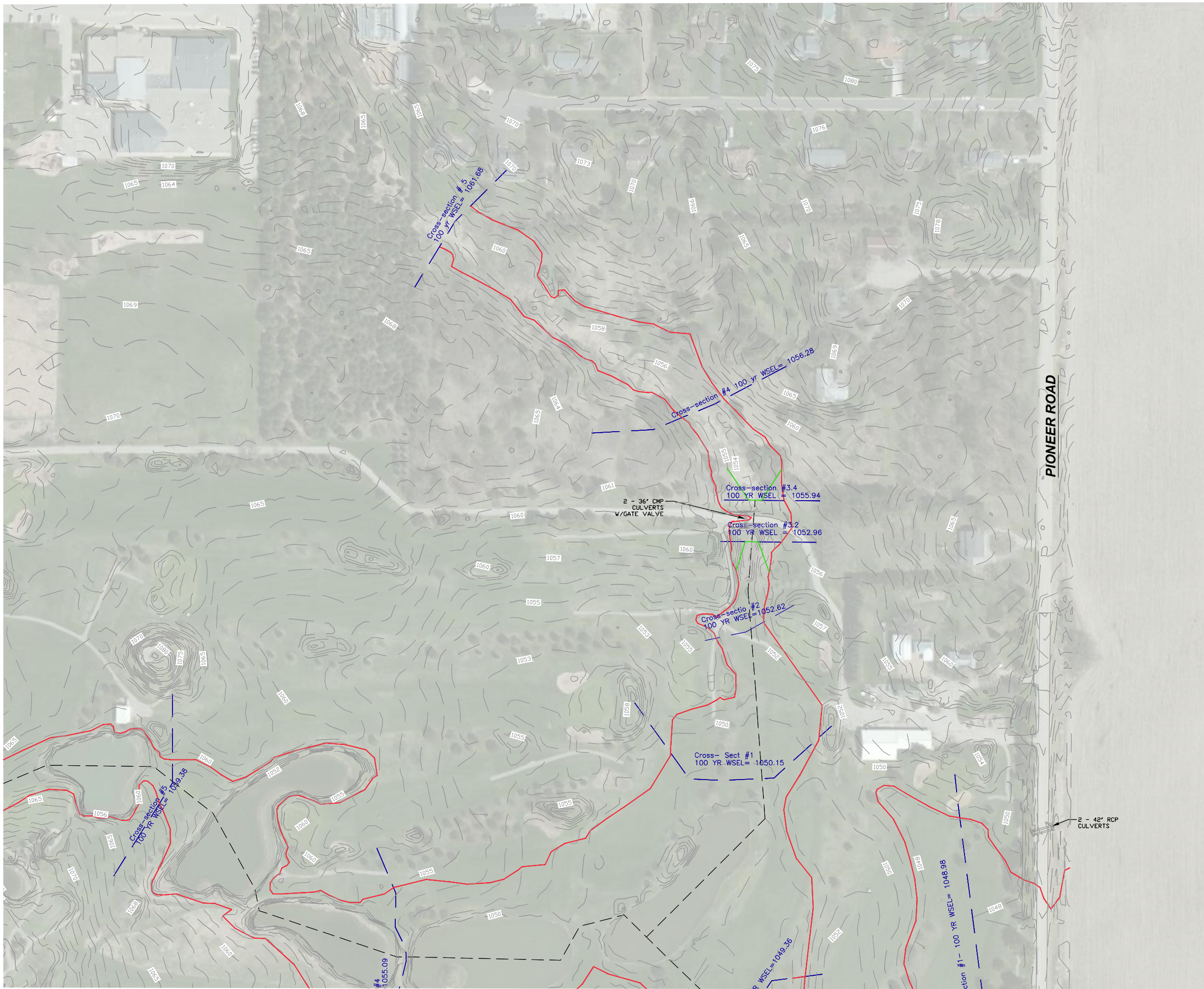
- Existing Contour—Minor
- Existing Contour—Major
- Existing Cross-Section
- Waterway Centerline
- Existing 100 yr Floodplain Boundary
- Proposed Flood Fringe/Floodway Boundary

SCALE 1" = 200' N[^]

FIGURE#1a - LOCATION OF EXISTING CROSS-SECTIONS - SOUTHWEST SWALE

BENCHMARK TABLE		
BM - #	ELEVATION	DESCRIPTION
BM - 1	1072.10	NW CORNER OF SECTION 29, T7N, R8E LOCATED WITHIN MINERAL POINT ROAD
BM - 2	1047.63	CENTER 1/4 CORNER OF SECTION 29, T7N, R8E LOCATED WITHIN PIONEER ROAD

ELEVATIONS ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).



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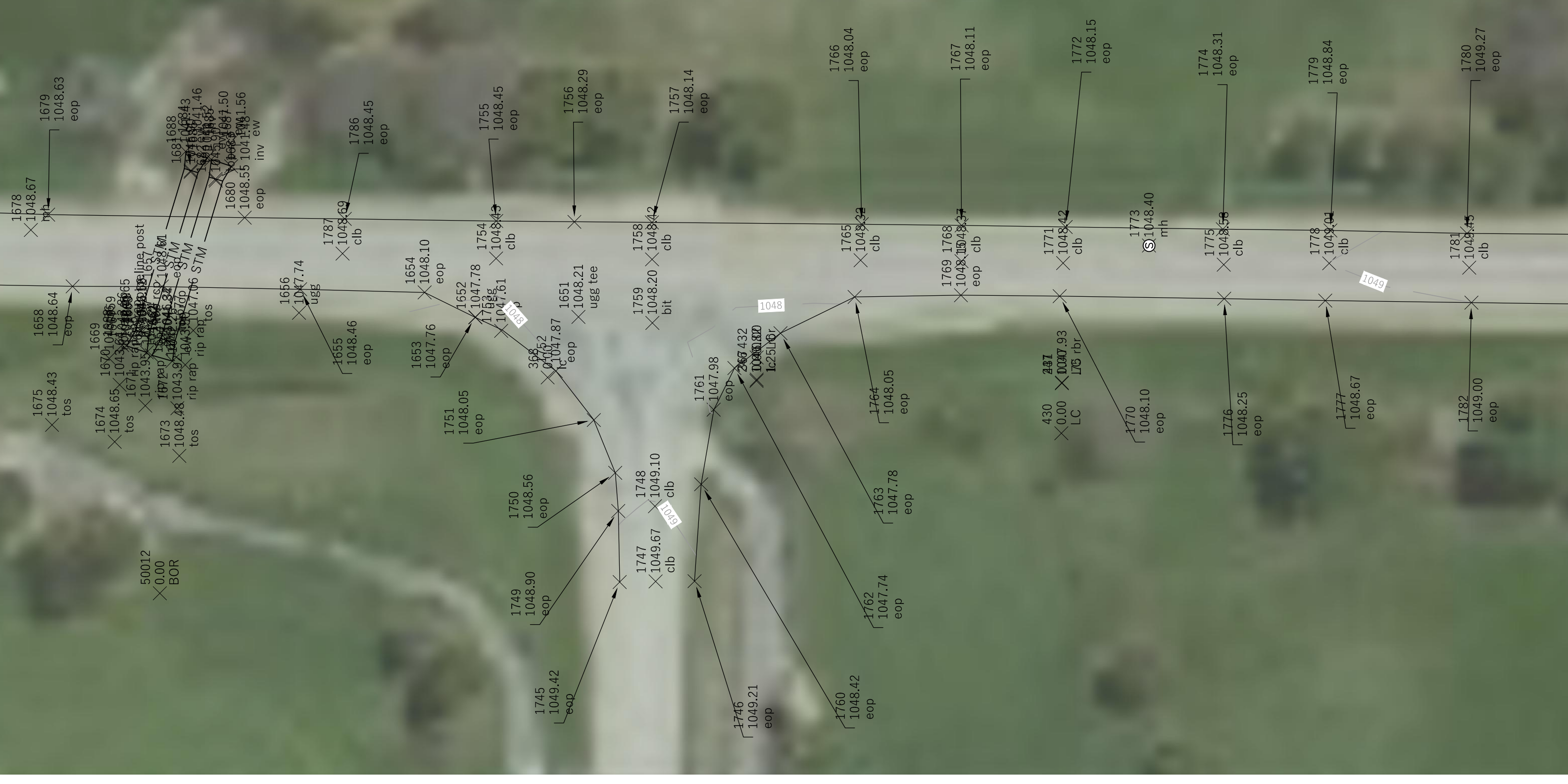
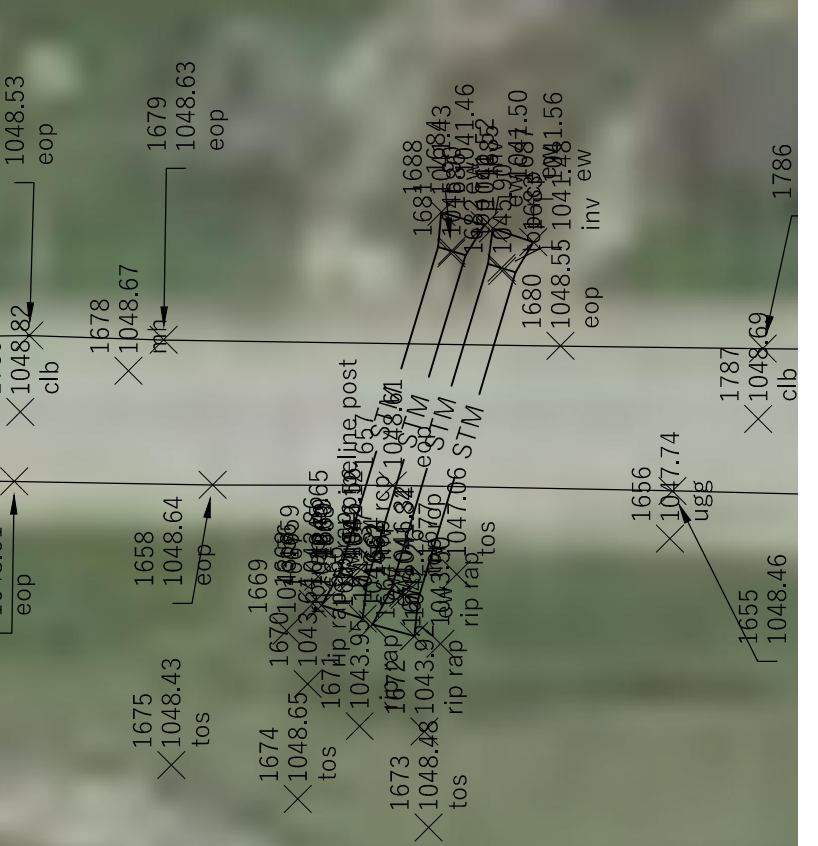
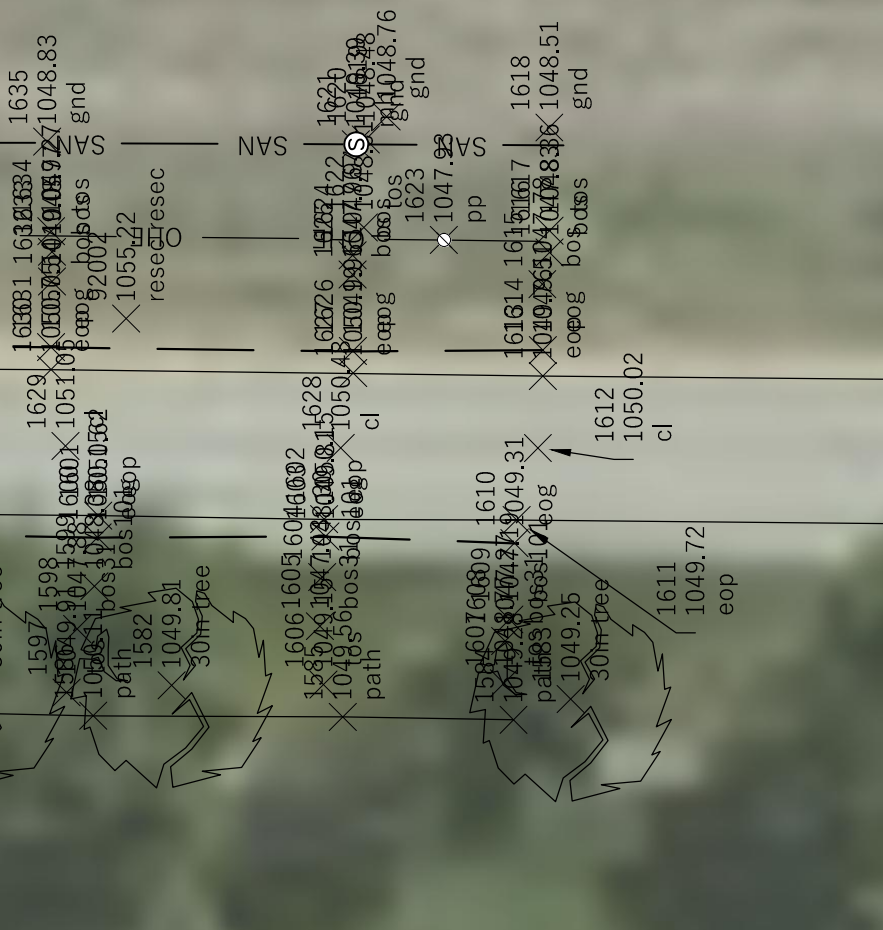
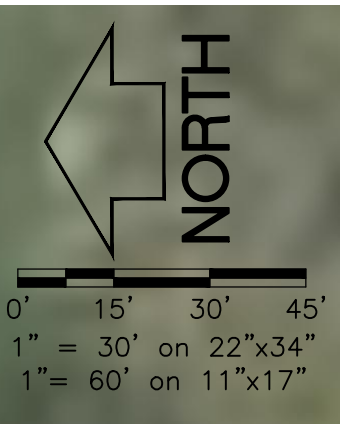
- Existing Contour-Minor
- Existing Contour-Major
- Existing Cross-Section
- Waterway Centerline
- Existing 100 yr Floodplain Boundary
- Proposed Flood Fringe/Floodway Boundary

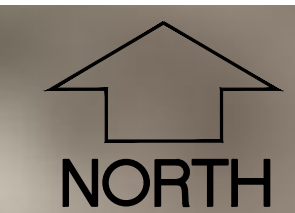
SCALE 1" = 200' N[^]

FIGURE#1b - LOCATION OF EXISTING CROSS-SECTIONS - NORTH SWALE

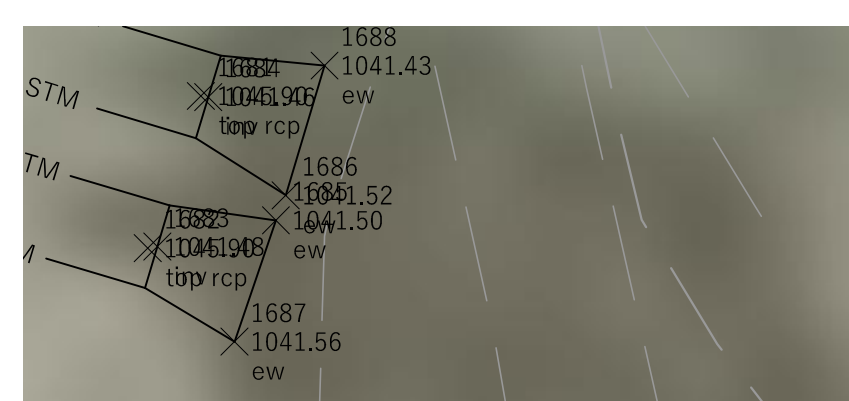
BENCHMARK TABLE		
BM - #	ELEVATION	DESCRIPTION
BM - 1	1072.10	NW CORNER OF SECTION 29, T7N, R8E LOCATED WITHIN MINERAL POINT ROAD
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ELEVATIONS ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).

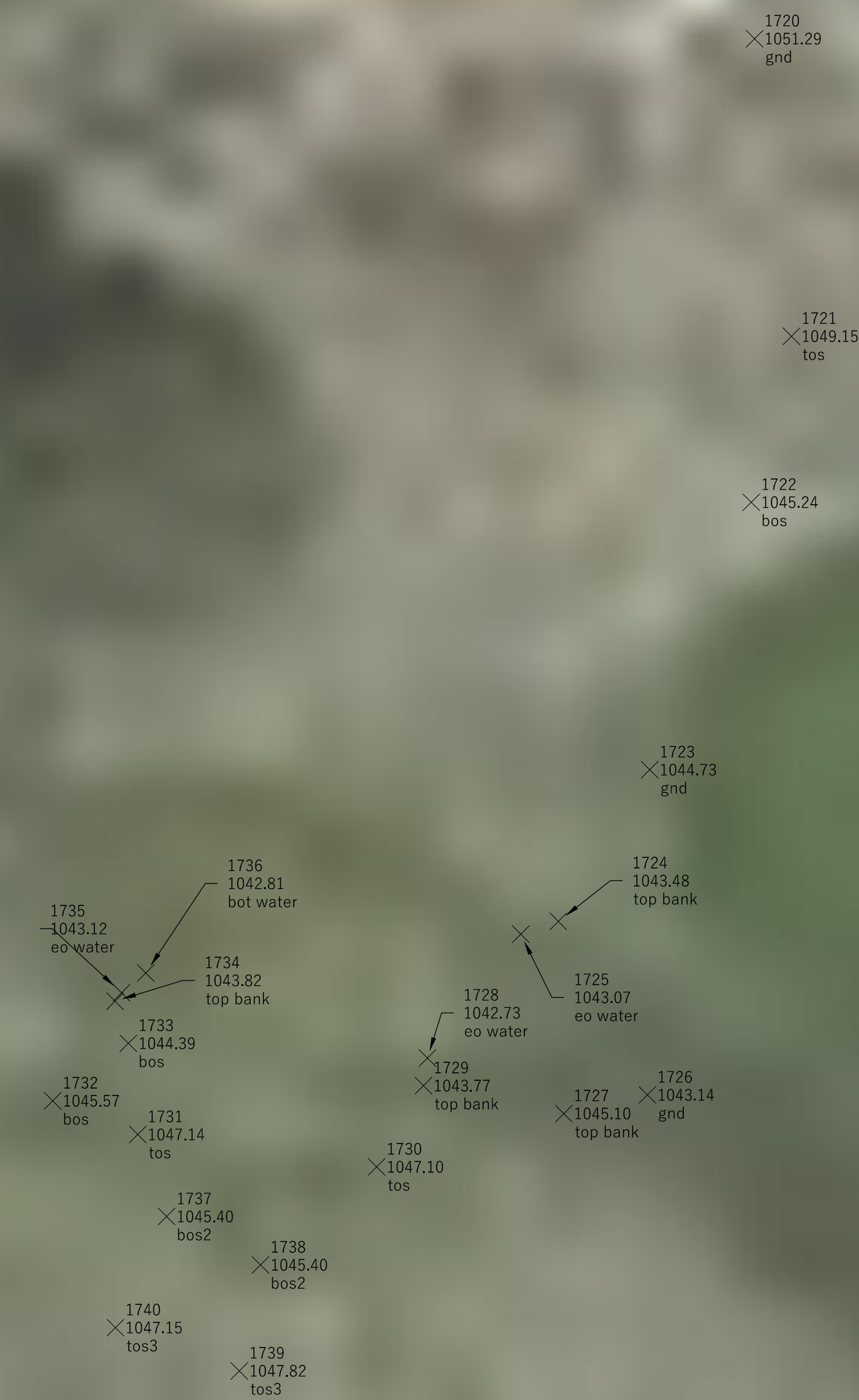




0' 5' 10' 15'
1" = 10' on 22"x34"
1" = 20' on 11"x17"



File: W:\2018\180551_Hoeh_Road_Estate-Tumbledown-Trails\180551_Tumbledown_Excon.dwg Layout: Site Plan User: WYSEK - Z240 - W10 Plotted: Sep 13, 2018 - 10:25am



Proposed Conditions - A Proposed Conditions HEC-RAS model was assembled for the Southwest and North Swales through the Golf Course using the preliminary grading plan by Wyser Engineering. The locations of the Proposed Conditions cross-sections are shown in Figure #2a and #2b for the Southwest and North Swales respectively. The Proposed Conditions model contains additional culvert crossings of the East-West Main Roadway (North Swale) and two culvert crossings of the East-West Secondary Roadway (Southwest Swale). The dimensions of these culverts were designed to convey the 100-year flow with no road overtopping and .5 foot freeboard to meet Item #16 and #23 of the Town's "Design Requirements for Public Improvements" (2/15/17 update) under "Swale and Drainway Design Calculations"(page 7) and "Culvert Design Calculations" (page8) which states:

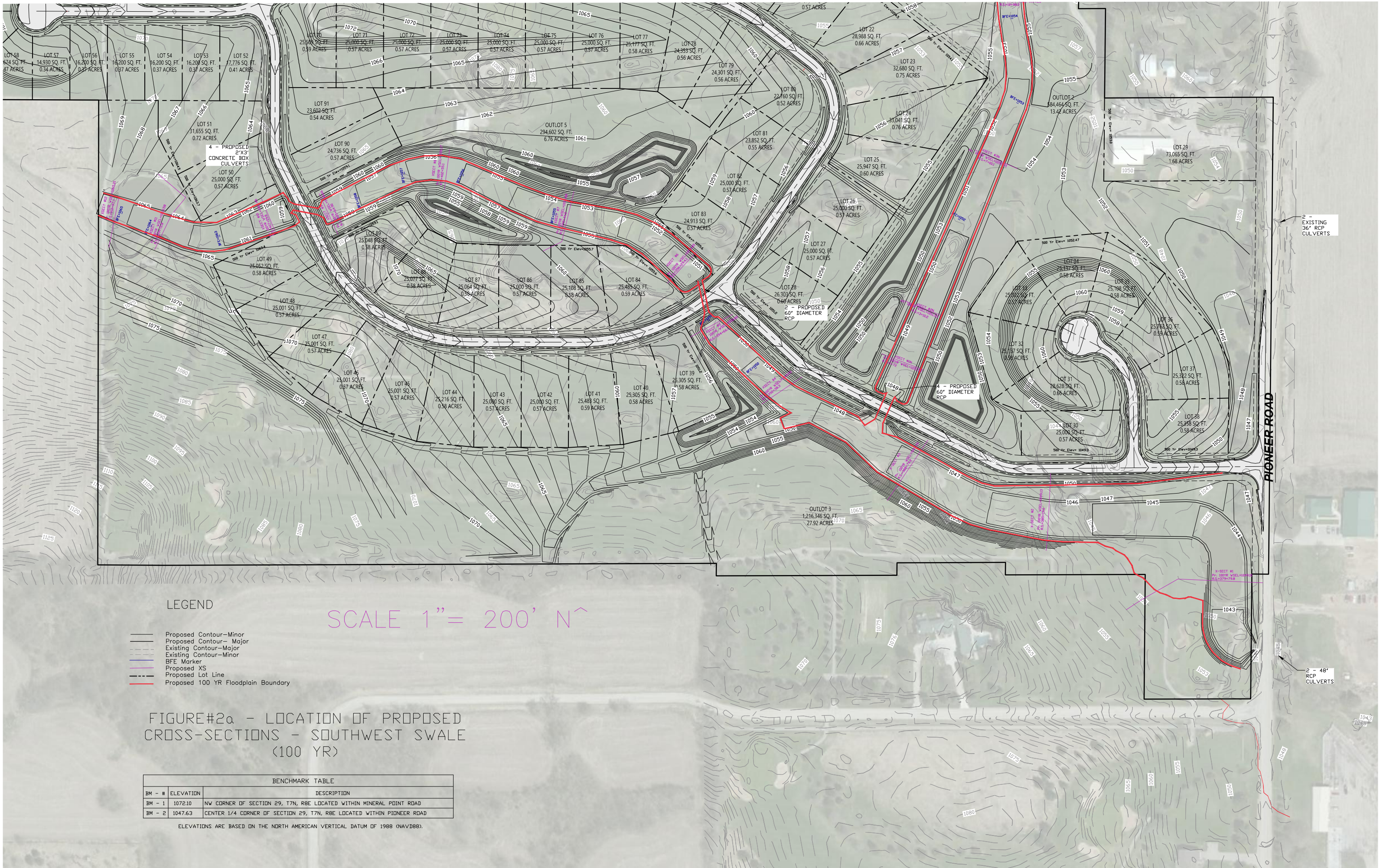
"16. Major and minor drainways need to be defined during final design since capacity and freeboard requirements may differ. Major drainways must be designed for the 100-year event with 0.5' minimum freeboard. Some major drainways might require more detailed analysis if there are flooding concerns with adjacent properties."

"23. Roadway culverts under streets must be designed, at a minimum, for the 25-year event. The 100-year event cannot inundate the pavement or building envelopes, or potentially cause personal injury or flooding damage to property. If a street culvert is within a major drain way, it should be designed for the 100-year event."

The proposed culverts for the Golf Course redevelopment roads are:

- North Swale crossing of East-West Main Roadway- Four (4) 60-inch diameter Reinforced Concrete Pipe (RCP) culverts,
- Southwest Swale crossing of East-West Secondary roadway (East)- Two (2) 60-inch diameter RCP culverts, and
- Southwest Swale crossing of East-West Secondary roadway (West)- Four (4) 2'(H) by 3'(W) RCB culverts.

The Proposed Conditions profile summary table is listed in Appendix F for both the Southwest and North Swales.



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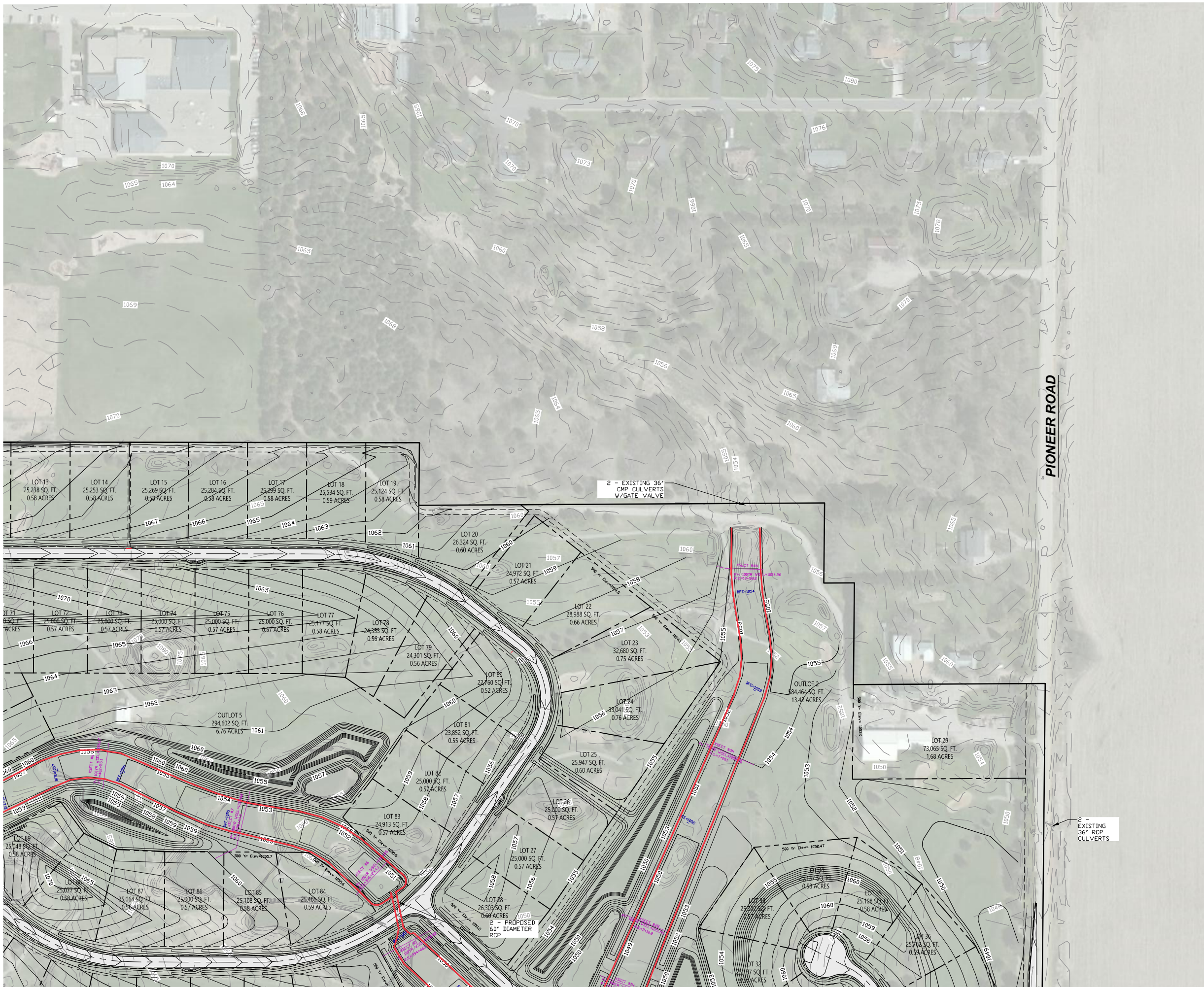
- Proposed Contour—Minor
- Proposed Contour—Major
- Existing Contour—Major
- Existing Contour—Minor
- BFE Marker
- Proposed XS
- Proposed Lot Line
- Proposed 100 YR Floodplain Boundary

SCALE 1" = 200' N[^]

FIGURE#2a - LOCATION OF PROPOSED CROSS-SECTIONS - SOUTHWEST SWALE (100 YR)

BENCHMARK TABLE		
BM - #	ELEVATION	DESCRIPTION
BM - 1	1072.10	NW CORNER OF SECTION 29, T7N, R8E LOCATED WITHIN MINERAL POINT ROAD
BM - 2	1047.63	CENTER 1/4 CORNER OF SECTION 29, T7N, R8E LOCATED WITHIN PIONEER ROAD

ELEVATIONS ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).



LEGEND

- Proposed Contour—Minor
- Proposed Contour—Major
- - - Existing Contour—Major
- - - Existing Contour—Minor
- BFE Marker
- Proposed XS
- Proposed Lot Line
- Proposed 100 YR Floodplain Boundary

SCALE 1" = 200' N[^]

FIGURE#2b - LOCATION OF PROPOSED CROSS-SECTIONS - NORTH SWALE (100 YR)

BENCHMARK TABLE		
BM - #	ELEVATION	DESCRIPTION
BM - 1	1072.10	NW CORNER OF SECTION 29, T7N, R8E LOCATED WITHIN MINERAL POINT ROAD
BM - 2	1047.63	CENTER 1/4 CORNER OF SECTION 29, T7N, R8E LOCATED WITHIN PIONEER ROAD

ELEVATIONS ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).

HEC-RAS Modeling Results- A comparison of the Existing and Proposed Conditions
100-year floodplain elevations are shown in Table #2.

**Table #2-Floodplain Elevation Summary- Existing and Proposed Conditions- Tumbledown Trails
Redevelopment**

Flood Study Backwater Analysis-Elevation Summary					
Tumbledown Trails- Southwest Swale					
Existing Run- HEC-RAS			Proposed Run - HEC-RAS		
Sect	100-YR WSEL	Dist upstream Pioneer Culverts	Sect	100-YR WSEL	Dist upstream Pioneer Culverts
E-1	1048.98	421	P-1	1049.1	207
E-2	1049.02	613	P-2	1049.13	750
E- 3	1049.36	1116	P-3	1049.2	1110
E- 4	1055.09	1969	P-4	1049.55	1469
E-5	1059.38	2631	P-5	1050.82	1697
E- 6	1064.93	3277	P-6	1054.85	1860
E- 7	1067.24	3628	P-7	1054.88	2175
West End of property			P-8	1056.17	2486
			P-9	1058.66	2796
Tumbledown Trails- North Swale			p-10	1062.46	2940
Existing Run- HEC-RAS			P-11	1063.58	3203
Dist upstream Pioneer Culverts			P-12	1065.21	3329
Sect			West End of property		
E-1	1050.15	1824			
E-2	1052.62	2226			
E- 3.4*	1055.94		Proposed Run- HEC-RAS		
E- 4	1056.28	2720	Sect		
E-5	1061.88	3381	P-1	1051.53	1438
			P-2	1051.55	1576
			P-3	1052.29	1973
			P-4	1054.26	2369
			North end of property		

*- Leaves Property at Section E-3.4 (Section E- 4 and E-5 are located on upstream landowners property)

The Existing Floodplain Elevation is greater than the Proposed Floodplain Elevation for both the Southwest and North swales as the swale leaves the property as follows:

- North Swale- Existing Elevation=1055.94; Proposed Elevation= 1054.26 resulting in a 1.68 ft decrease,
- Southwest Swale= Existing Elevation= 1067.24: Proposed Elevation=1065.21 resulting in a 2.03ft decrease.

The decrease in Proposed Condition floodplain elevations for the Southwest Swale and North Swale is explained as follows:

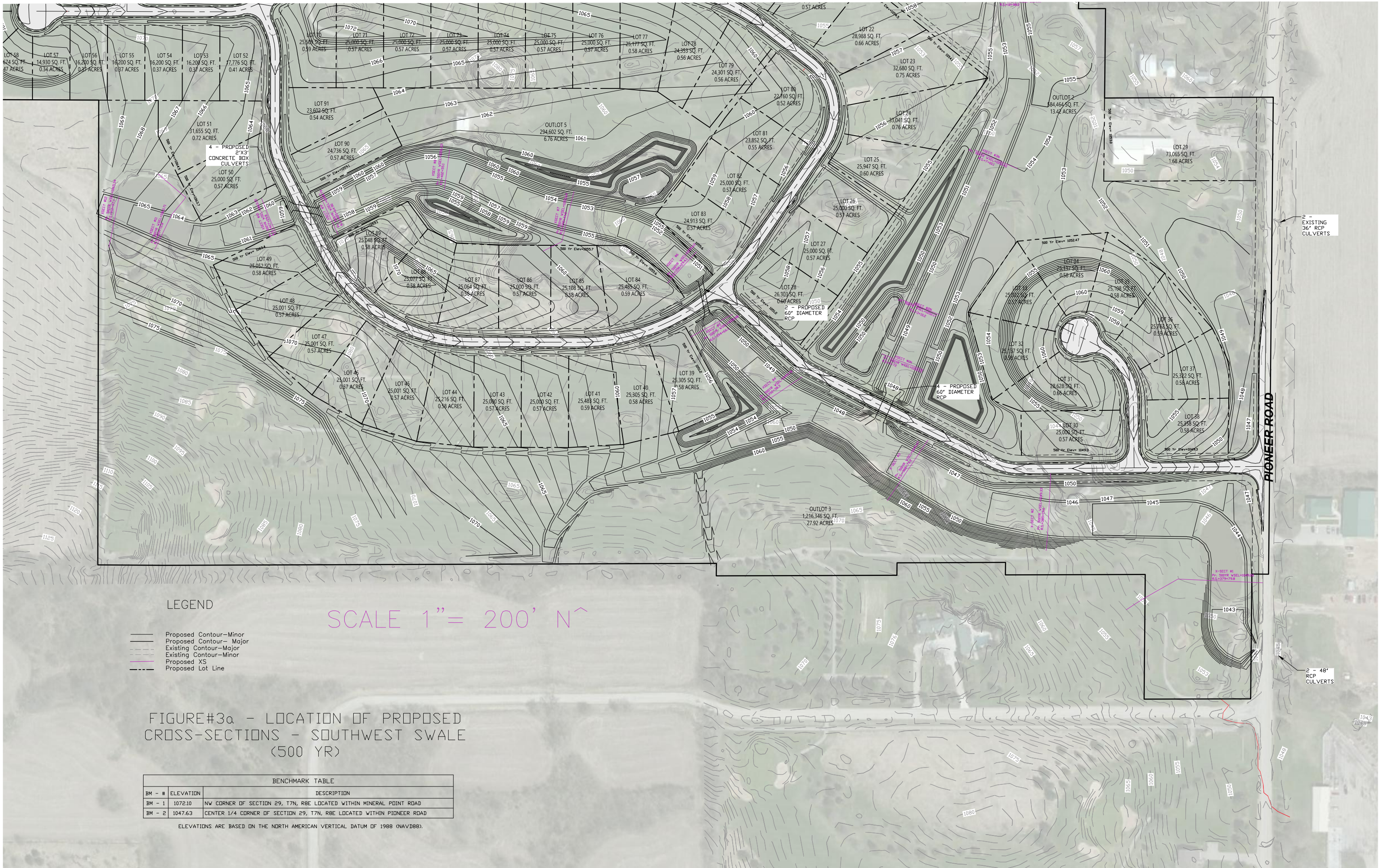
Southwest Swale- A steep slope channel at the west end will be created in the proposed condition as the swale leaves the property (longitudinal channel slope of 1.47%). This steep slope causes head losses further downstream to be negated at the west property line. In addition, the Proposed Swale geometry is modified to be a uniformly-sloped 50- foot wide bottom -width channel with 5(H):1(V) side slopes

creating minimal head loss as compared to the non-uniform, poorly defined waterway in the existing condition.

North Swale- In the existing case, two 36-inch Reinforced Concrete Pipes exist as the North Swale leaves the property just north of the entrance driveway. In the proposed case, these two 36-inch pipes and the corresponding head loss will be removed. As described above, the existing condition head loss created by the concrete floodgate dam just upstream of the two 36-inch RCPs is not modeled but will create additional head loss in the existing condition, As described above with the Southwest Swale, the proposed swale geometry is modified to be a uniformly-sloped 50- foot wide bottom-width channel with 5(H):1(V) side slopes creating minimal head loss as compared to the existing condition.

NR 116 requires backwater easements from upstream property owners if the backwater increases more than .01 foot. This development will not require any backwater easement since the proposed floodplain elevations do not increase at all. As described above, the backwater analysis is conservative in that the floodgate dam is not accounted for in the existing North Swale modeling.

500-year Floodplain Modeling - The City of Madison will require a 500-year floodplain elevation determination if public sanitary service is provided. The 500-year flows were determined by the drainage area transfer method as listed in Appendix G using FEMA-approved 500-year flows downstream. The starting water surface elevation was based on a normal depth calculation. The 500-year water surface elevations are shown in Figure #3a and #3b for the Southwest and North Swales respectively. The Proposed Conditions 500-year profile summary table is listed in Appendix H for both the Southwest and North Swales respectively. The 500-year elevations do exceed the road elevations at the proposed culvert locations.



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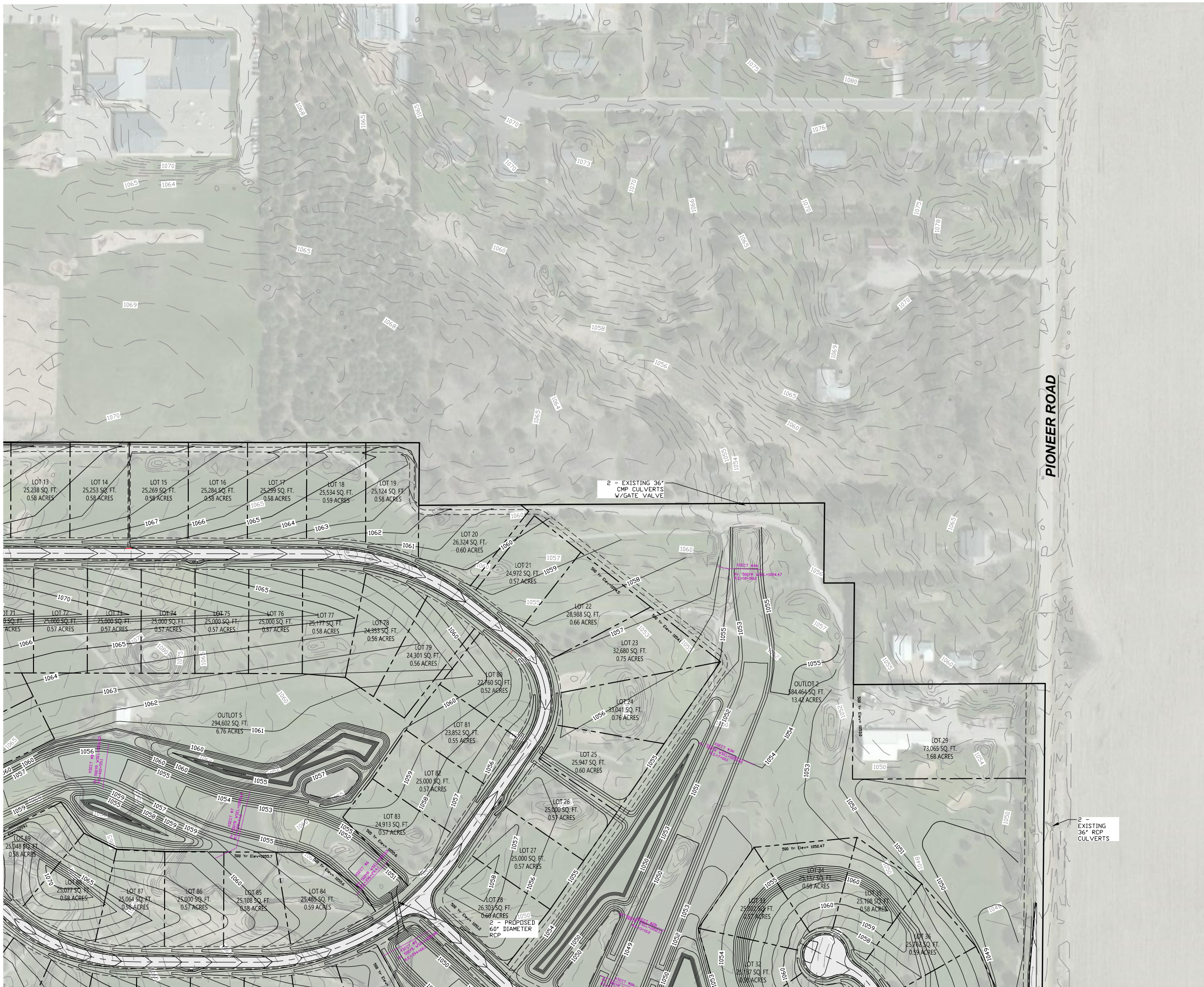
- Proposed Contour—Minor
- Proposed Contour—Major
- - - Existing Contour—Major
- - - Existing Contour—Minor
- Proposed XS
- - - Proposed Lot Line

SCALE 1" = 200' N[^]

FIGURE#3a - LOCATION OF PROPOSED CROSS-SECTIONS - SOUTHWEST SWALE (500 YR)

BENCHMARK TABLE		
BM - #	ELEVATION	DESCRIPTION
BM - 1	1072.10	NW CORNER OF SECTION 29, T7N, R8E LOCATED WITHIN MINERAL POINT ROAD
BM - 2	1047.63	CENTER 1/4 CORNER OF SECTION 29, T7N, R8E LOCATED WITHIN PIONEER ROAD

ELEVATIONS ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).



LEGEND

- Proposed Contour—Minor
- Proposed Contour—Major
- - - Existing Contour—Major
- - - Existing Contour—Minor
- Proposed XS
- Proposed Lot Line

SCALE 1" = 200' N[^]

FIGURE#3b - LOCATION OF PROPOSED CROSS-SECTIONS - NORTH SWALE (500 YR)

BENCHMARK TABLE		
BM - #	ELEVATION	DESCRIPTION
BM - 1	1072.10	NW CORNER OF SECTION 29, T7N, R8E LOCATED WITHIN MINERAL POINT ROAD
BM - 2	1047.63	CENTER 1/4 CORNER OF SECTION 29, T7N, R8E LOCATED WITHIN PIONEER ROAD

ELEVATIONS ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).

Appendix A-Badger Mill Creek Hydrologic Model

Badger Mill Creek Hydrologic Model

Results updated November 8, 2006 (removed 'Quarry-32' and 'Quarry-29' from analysis)

1.0 Watershed Description

Drainage area: 32.2 square miles

Landuse:

- Wisconsin Wetland Inventory Wetlands (0.3 square miles shown in light blue)

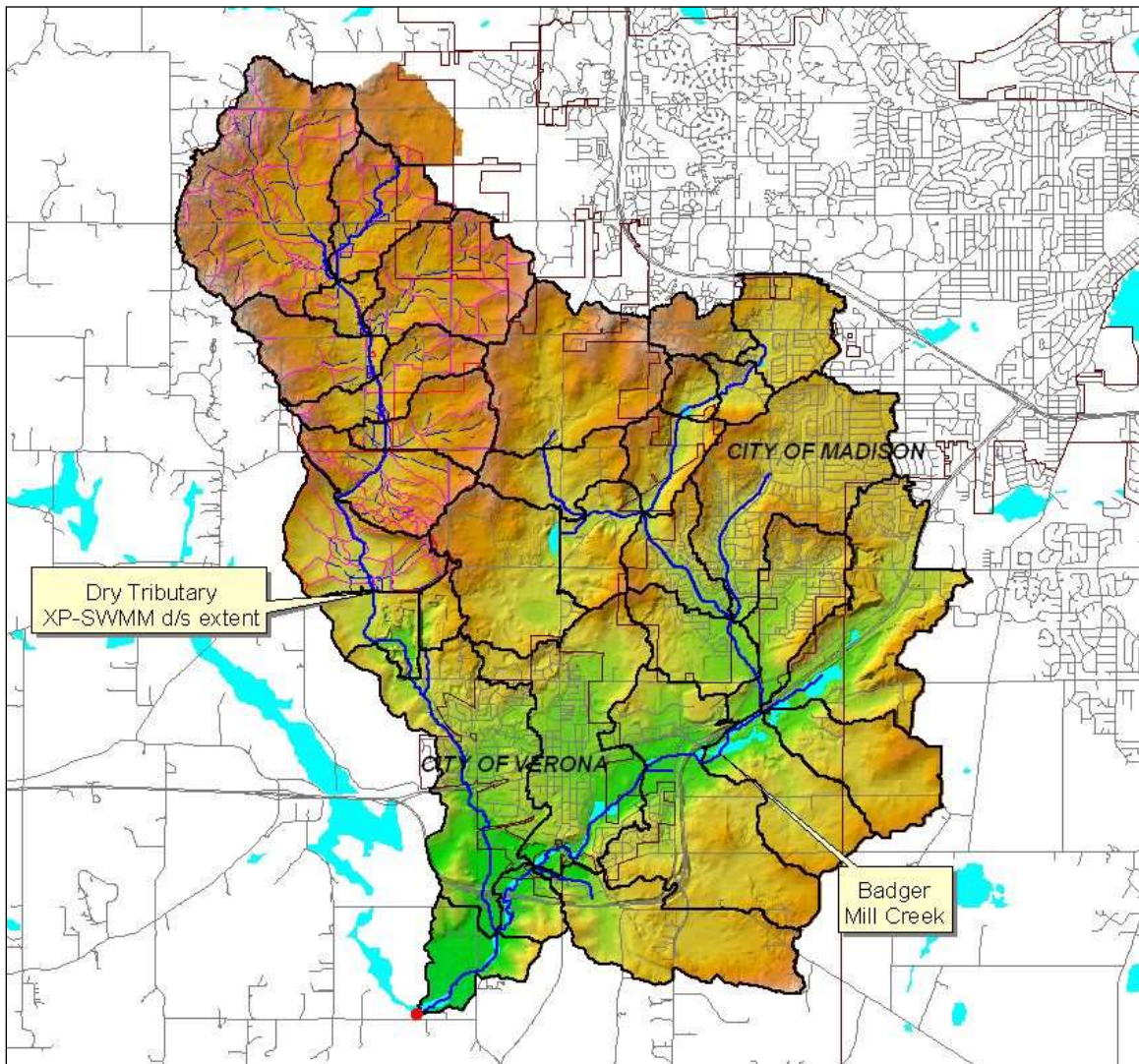


Figure 1. Project Area

2.0 Relevant Available Models

- 2003 Earth Tech XP-SWMM model on the Dry Tributary (u/s CTH PD – pink subbasins in Figure 1).
- FAD 5159 – 1996 USGS HEC-2 FIS model on the Dry Tributary.
- 1996 SEH Inc HEC-2 FIS model on Badger Mill Creek.

3.0 Model Description

The DEMs for this model have been processed at a 5-meter cell size to provide a high level of detail. Efforts were made to match the 2003 Earth Tech XP-SWMM model in as much as possible by using similar subbasin boundaries (although less subbasins), similar storage rating curves for local and regional detention ponds, similar Curve Numbers, and the same proposed future conditions (proposed detention ponds and grassed design waterways). A comparison of volumes and peak discharges between the HEC-HMS and XP-SWMM models is shown below.

Loss Rate Method / Abstraction: SCS CN. Curve Numbers were developed using the county's existing (2000) and future (2020) landuse data, and combining with NRCS SSURGO soils data. AMC II was assumed in assigning CNs. In the runs labeled 'ExistingLocalCN/Madison' and 'FutureLocalCN/Madison', composite CNs were determined from the XP-SWMM model on the Dry Tributary (see accompanying spreadsheet called 'ModelComparisons.xls' for details).

Transformation: SCS UH / TR-55 flow path segment method. Channel properties were estimated from the Dane County 2000 DTM. Manning's N values were estimated using the 2000 orthophoto.

Baseflow: None

Routing: Muskingum Cunge 8-point - Extracted cross sections from the 2000 DTM. Estimated Mannings N values from the 2000 orthophoto. For the Future run on the Dry Tributary upstream of CTH PD, routing reach cross sections and Mannings N values were taken from the XP-SWMM model, where design grassed greenways were proposed.

Meteorological Model: Both the SCS Type II and the custom Madison distribution were run. The Madison distribution gave the most reasonable results and was used this study. This distribution is based on storms 2" and larger at the Madison NWS gage for the period of 1975 to 2003. Storm depths were extracted from TP-40 (100-yr) at the centroid of each subbasin.

Non-contributing Areas: The upper portion of subbasin R20W20 (R540W410 for future condition) contains a sink in the landscape that was determined to be non-contributing by comparing the available storage volume to the runoff volume. This area was also not included in the Earth Tech study.

Reservoir: Storage was taken into account through significant Wisconsin Wetland Inventory wetlands, ponds, and man-made detention structures. This was done by creating HEC-RAS models using the 2000 DTM and determining the amount of storage at various discharges.

Using the 2000 terrain data, it appeared that the Dry Tributary flows down into the west side of Quarry-29, which contained about 700 acre-ft of storage. Examining the 2005 terrain data, it appears that much of the terrain has changed, and approximately 950 acre-ft of storage is available. It also appears that the outlet (or lowest exit point) of the quarry is in a new location, which changes the discharge rating curve. Therefore, a new rating curve was computed at this quarry in HEC-RAS using the 2005 terrain data. This updated rating curve resulted in a peak discharge of about 40 cfs lower than if using the 2000 rating curve.

Since the area within and surrounding the large quarry is in a state of flux, and since WDNR does not know when 'reclamation' of the site would be completed, it is impossible to know what the final state of this area will be. In the final analysis, it was determined that storage should not be taken into account as it cannot be guaranteed that any storage area will exist in the future. Over-predicting this storage would result in an under-prediction of flood hazards from this point down to the mouth of the Dry Tributary.

On the Dry Tributary upstream of CTH PD, there are three existing ponds labeled EP-1, EP-5, and EP-6. Under existing conditions, storage rating curves were developed for these three ponds using the 2000 DTM. These three locations are considered 'regional' detention ponds in the XP-SWMM model. There are a number of smaller man-made detention ponds throughout the watershed that are considered 'local' detention structures. For the basin models with 'w/ Local' in the title, local detention pond storage has been included by combining all of the local detention pond storage for each HEC-HMS subbasin. See accompanying spreadsheet called 'ModelComparisons.xls' for details.

Under future conditions, the Earth Tech study proposed redesigned regional detention ponds at EP-1, EP-5, and EP-6. It also proposed four new regional detention ponds at PP2, Pn1, EP-7, and EP-8. The proposed Earth Tech designs for all seven of these structures have been used in this model. Also, at EP-1, the Earth Tech report indicates that the "channel from the northeast will be routed around the pond on the east side to avoid the combination of peaks". This scenario has been modeled by adding a junction immediately downstream of the reservoir EP-1 and allowing basin R280W260 to bypass the reservoir.

Subbasin R270W250 contains a development called Hawk's Landing, which has three local detention ponds. Data for these three detention ponds was not available (XP-SWMM model uses an output hydrograph for the development). The storage at these three structures has not been accounted for in this model. Generally, local detention ponds are designed for 2-year and 10-year events and are much less significant than regional ponds during the 100-year event.

Richardson's Cave: There is a cave adjacent to the Dry Tributary stream channel in subbasin R260W240. A berm has been constructed to prevent low flows from entering the cave. According to the Earth Tech study, this berm may be overtopped during a 10-year event. However, the XP-SWMM does not account for any overflow loss into the cave. This model also does not account for any loss due to the cave.

4.0 Model Summary

The following two tables compare the peak discharges and total volumes of the HEC-HMS results to the Earth Tech XP-SWMM study on the Dry Tributary. In HMS, these are the runs labeled 'ExistingLocalCN/Mad' and 'FutureLocalCN/Mad'.

Comparison of Existing HEC-HMS results to XP-SWMM

Description	XP-SWMM			HEC-HMS		
	Location	Peak Q (cfs)	Volume (acre-ft)	Location	Peak Q (cfs)	Volume (acre-ft)
Pioneer Road West Crossing*	<i>Pn_Rd1_US to Pn_Rd1_DS</i>	79	95	---	---	---
Existing Tumbledown Golfcourse	<i>Z8_Weir</i>	502	389	<i>R10W10 Local</i>	436	340
Pioneer Road East Crossing	<i>L202</i>	511	478	<i>JR290</i>	570	443
Valley View Road	<i>VV_Rd1_US to T7</i>	862	691	<i>EP-1</i>	800	682
Midtown Road	<i>Mt_Rd2_US to Mt_Rd2_DS</i>	1047	959	<i>Mid-Town Road</i>	1016	935
Shady Oak Lane	<i>L211</i>	959	1049	<i>Shady Oak Lane</i>	1133	1033
CTH PD	<i>L173</i>	1008	1179	<i>CTH PD</i>	1283	1176

*Existing HMS model does not have a component at the Pioneer Road West crossing.

Comparison of Future HEC-HMS results to XP-SWMM

Description	XP-SWMM			HEC-HMS		
	Location	Peak Q (cfs)	Volume (acre-ft)	Location	Peak Q (cfs)	Volume (acre-ft)
Pioneer Road West Crossing	<i>Pn_Rd1_US to Pn1_out</i>	58	95	<i>Pn1</i>	154	119
Existing Tumbledown Golfcourse	<i>Z8_Weir</i>	340	253	<i>R10W10 Local</i>	390	356
Pioneer Road East Crossing*	<i>AA1 to Z7</i>	623	324	---	---	---
Valley View Road	<i>VV_Rd1_US to T7</i>	935	736	<i>Junction-DS EP-1</i>	844	814
Midtown Road	<i>Mt_Rd2_US to Mt_Rd2_DS</i>	1042	1017	<i>EP-7</i>	1098	1088
Shady Oak Lane	<i>L255</i>	1082	1116	<i>Shady Oak Lane</i>	1226	1205
CTH PD	<i>L313</i>	1008	1239	<i>CTH PD</i>	1317	1376

* No valid comparison in future conditions for Pioneer Rd East Crossing. HMS JR290 does not include XP-SWMM catchments DD, BB, and Z8.

In these two runs, attempts were made to mimic the XP-SWMM model in as much as possible by using similar Curve Numbers and storage due to detention ponds. The two models compare fairly well. The differences between the two answers can be attributed to different reach routing techniques (XP-SWMM uses a dynamic wave method), different rainfall distributions, and different subbasin configurations (which results in different lag times and combining of hydrographs).

The next table compares the HEC-HMS results to values computed using the 2003 USGS regression equations, and also to the published 2003 FIS values for Badger Mill Creek. The HMS results are based on the 'ExistingLocalCN/Mad' run.

Comparison of Existing HEC-HMS results to Regression / FIS

Description	HEC-HMS Component	DA (mi ²)*	Peak Q (cfs)	Regression (cfs)	FIS Q (cfs)
<i>Dry Tributary to Badger Mill Creek</i>					
At confluence with Badger Mill Creek	<i>Dry Tributary</i>	11.2	1701	836	1050
<i>Badger Mill Creek</i>					
At confluence with Sugar River	<i>Outlet</i>	32.2	4853	2048	---
At confluence of Dry Tributary (includes Dry Tributary)	<i>JR190</i>	31.7	4803	2098	2960
At Bruce Street	<i>JR170</i>	20.1	3073	1006	2280
At Divergence of Badger Mill Creek Diversion Channel	<i>Divergence Upstream</i>	14.4	2204	1005	1920
At Nesbitt Road	<i>UserPoint19</i>	9.7	1723	882	1920
At the confluence of East Branch Badger Mill Creek	<i>JR520</i>	6.9	1130	619	860

* Drainage areas based on HEC-HMS results

For a detailed comparison of all of these results, see the accompanying spreadsheet called 'ModelComparisons.xls' for details.

On Badger Mill Creek, The 2003 regression equations (region 1 values) appear to give discharges on the low side. This is probably due to the fact that much of this watershed is urbanized. In the 2003 FIS, it indicates that the 1991 urban regression equations were used (along with similar basin calculations).

Appendix B- Drainage Area Transfer Method to Generate 100-Year Flow

Q100= 623 c.f.s. for future conditions at Pioneer Road East Crossing using XP-SWMM results

Drainage area Ratio method- q100= 1133 c.f.s. for "Dry Tributary to Badger Mill Creek" at Shady Oak Lane- Source Table 10- FEMA 100year flows for Dane County

Q100= 1133 cfs *(3.5 sq miles/7.5 sq miles)= 529.4 c.f.s. at Pioneer road crossing

**** Use more conservative value of 623 c.f.s. at Pioneer Road East Crossing****

100 year Flow Change from Southwest to North Swale using Drainage Areas

DA Total= 2242.44 acres

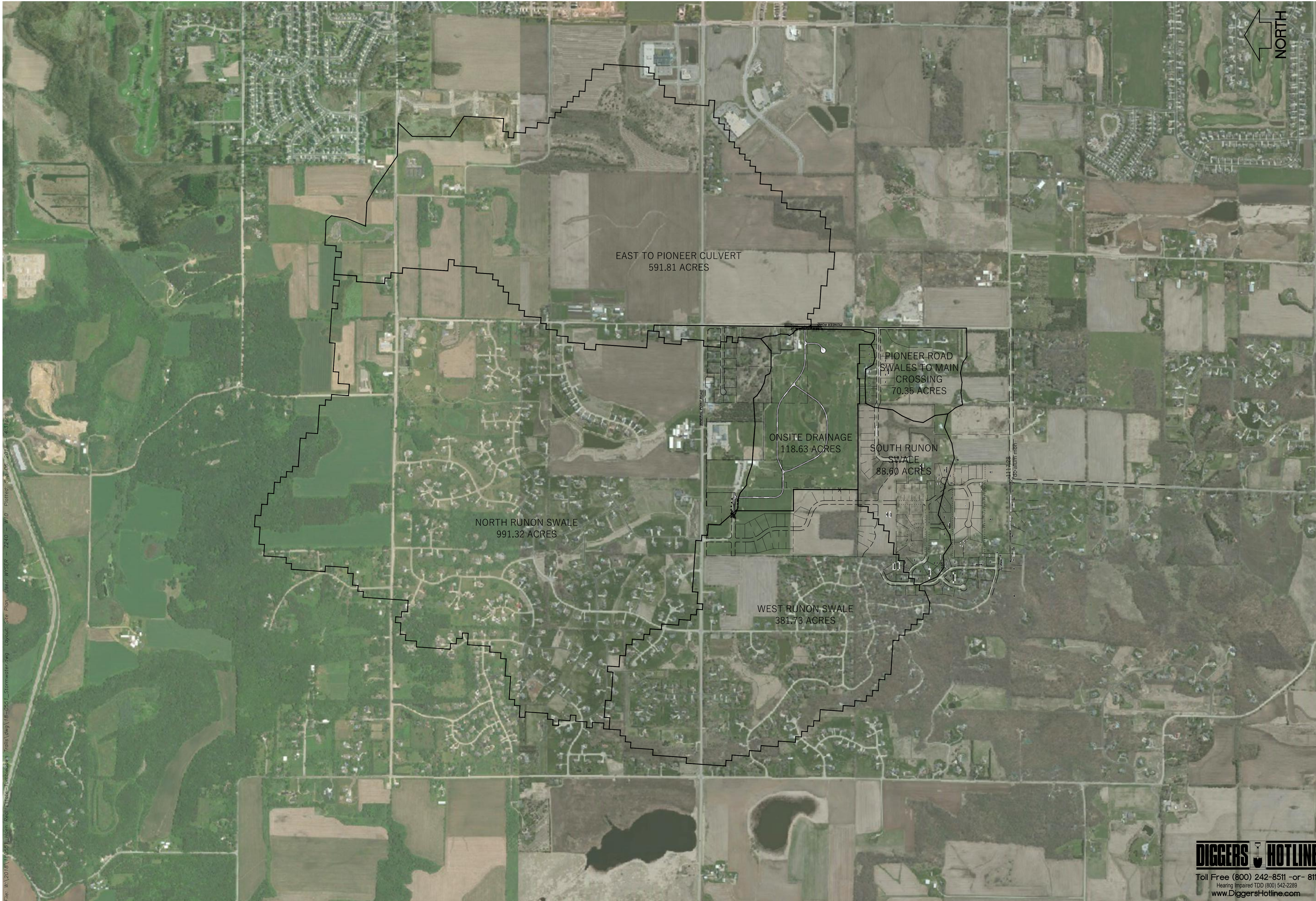
DA- north= 591.81 acres+991.32acres =1583.13 acres

Q100-north swale= $623 * (1583.13 / 2242.44) = 439.8$ say 440 c.f.s.

Q100-northswale (not including Pioneer Road East)= $623 * (991.32 / 2242.44) = 275$ c.f.s.

Q100-southwest swale= $623 * (658.87 / 2242.22) = 183$ c.f.s.

Appendix C- Map of Upstream Drainage Areas



**TUMBLEDOWN TRAILS
GOLF COURSE REDEVELOPMENT**

TOWN OF MIDDLETON, DANE COUNTY, WI

7701 W MINERAL POINT RD
VERONA, WI 53593

Sheet Title:
OVERALL WATERSHED MAP

Revisions:

No.	Date:	Description:

Graphic Scale 0' 375' 750' 1125'

Wyser Number 18-0551

Set Type SCHEMATIC

Date Issued 08/29/2018

Sheet Number SW1

File: W:\2018\18-0551_Plan_Red_Estate-Tumbledown_Trails\org\18-0551_Stormwatering_Layout_Site Plan User: WYSER - Z240 - W10 Plotted: Sep 05, 2018 4:03 PM

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Appendix D-Starting 100-Year Water Surface Elevation Calculation

Starting Water Surface Elevation downstream of Pioneer Road Culvert- Tumbledown Trails Flood Study

100 yr. WSEL of Dry Tributary to Badger Mill Creek at Mid-Town road bridge=1032.09 (FEMA Floodplain Map)

Upstream Invert at Midtown Road culvert=1028.9 (FEMA Floodplain map)

Downstream invert at fully expanded section 260 feet downstream of Pioneer Road=1042.42 (surveyed)

Approximate 100-year WSEL downstream of Pioneer Road= $1032.09+(1042.42-1028.9)=1045.61$

**Appendix E-Existing Conditions 100-Year Water Surface Elevations
(Southwest and North Swales)**

HEC-RAS Profile Summary Table- Plan 12- Southwest Swale Existing Conditions													
*-indicated interpolated cross-section at 25 feet intervals													
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude #	Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		
southwest swa	7	PF 1	183	1066	1067.24		1067.38	0.006368	3	61.04	92.36	0.65	
southwest swa	6.9286*	PF 1	183	1065.84	1067.08		1067.22	0.006286	3	61.09	91.66	0.65	
southwest swa	6.8571*	PF 1	183	1065.69	1066.92		1067.06	0.006342	3.02	60.65	90.63	0.65	
southwest swa	6.7857*	PF 1	183	1065.53	1066.76		1066.9	0.006311	3.02	60.53	89.83	0.65	
southwest swa	6.7143*	PF 1	183	1065.37	1066.6		1066.75	0.006411	3.05	60.02	88.99	0.65	
southwest swa	6.6429*	PF 1	183	1065.21	1066.45		1066.59	0.006227	3.03	60.45	88.65	0.65	
southwest swa	6.5714*	PF 1	183	1065.06	1066.28		1066.43	0.006377	3.06	59.75	87.66	0.65	
southwest swa	6.5000*	PF 1	183	1064.9	1066.13		1066.27	0.006388	3.07	59.58	87.13	0.65	
southwest swa	6.4286*	PF 1	183	1064.74	1065.97		1066.11	0.006284	3.06	59.86	87.1	0.65	
southwest swa	6.3571*	PF 1	183	1064.59	1065.81		1065.95	0.006407	3.06	59.75	87.96	0.66	
southwest swa	6.2857*	PF 1	183	1064.43	1065.65		1065.79	0.006479	3.06	59.75	88.71	0.66	
southwest swa	6.2143*	PF 1	183	1064.27	1065.48		1065.63	0.006602	3.07	59.59	89.36	0.66	
southwest swa	6.1429*	PF 1	183	1064.11	1065.32		1065.47	0.006645	3.07	59.59	89.8	0.66	
southwest swa	6.0714*	PF 1	183	1063.96	1065.15		1065.3	0.006833	3.11	58.87	88.94	0.67	
southwest swa	6	PF 1	183	1063.8	1064.93		1065.11	0.008428	3.37	54.35	85.27	0.74	
southwest swa	5.9630*	PF 1	183	1063.59	1064.72		1064.9	0.0084	3.35	54.55	85.83	0.74	
southwest swa	5.9259*	PF 1	183	1063.38	1064.52		1064.69	0.008436	3.36	54.45	85.73	0.74	
southwest swa	5.8889*	PF 1	183	1063.17	1064.31		1064.48	0.008493	3.36	54.44	86.12	0.75	
southwest swa	5.8519*	PF 1	183	1062.96	1064.1		1064.27	0.008489	3.36	54.42	85.99	0.75	
southwest swa	5.8148*	PF 1	183	1062.74	1063.89		1064.07	0.008327	3.33	54.89	86.61	0.74	
southwest swa	5.7778*	PF 1	183	1062.53	1063.68		1063.86	0.008497	3.36	54.5	86.39	0.75	
southwest swa	5.7407*	PF 1	183	1062.32	1063.48		1063.65	0.008413	3.34	54.78	86.83	0.74	
southwest swa	5.7037*	PF 1	183	1062.11	1063.27		1063.44	0.008478	3.35	54.63	86.75	0.74	
southwest swa	5.6667*	PF 1	183	1061.9	1063.06		1063.24	0.008326	3.32	55.06	87.29	0.74	
southwest swa	5.6296*	PF 1	183	1061.69	1062.86		1063.03	0.008424	3.34	54.84	87.19	0.74	
southwest swa	5.5926*	PF 1	183	1061.48	1062.65		1062.82	0.008543	3.35	54.66	87.35	0.75	
southwest swa	5.5556*	PF 1	183	1061.27	1062.44		1062.61	0.008355	3.32	55.06	87.51	0.74	
southwest swa	5.5185*	PF 1	183	1061.06	1062.23		1062.4	0.008534	3.34	54.74	87.64	0.75	
southwest swa	5.4815*	PF 1	183	1060.84	1062.02		1062.2	0.008345	3.32	55.11	87.64	0.74	
southwest swa	5.4444*	PF 1	183	1060.63	1061.82		1061.99	0.008396	3.32	55.1	87.98	0.74	

southwest swa	5.4074*	PF 1	183	1060.42	1061.61		1061.78	0.0085	3.34	54.83	87.73	0.74
southwest swa	5.3704*	PF 1	183	1060.21	1061.4		1061.57	0.00839	3.32	55.17	88.23	0.74
southwest swa	5.3333*	PF 1	183	1060	1061.2		1061.37	0.008417	3.32	55.09	88.13	0.74
southwest swa	5.2963*	PF 1	183	1059.79	1060.99		1061.16	0.008395	3.31	55.2	88.39	0.74
southwest swa	5.2593*	PF 1	183	1059.58	1060.78		1060.95	0.00842	3.32	55.13	88.27	0.74
southwest swa	5.2222*	PF 1	183	1059.37	1060.57		1060.74	0.008495	3.32	55.06	88.59	0.74
southwest swa	5.1852*	PF 1	183	1059.16	1060.36		1060.54	0.008498	3.33	54.99	88.35	0.74
southwest swa	5.1481*	PF 1	183	1058.94	1060.16		1060.33	0.008424	3.32	55.18	88.52	0.74
southwest swa	5.1111*	PF 1	183	1058.73	1059.95		1060.12	0.008465	3.32	55.05	88.31	0.74
southwest swa	5.0741*	PF 1	183	1058.52	1059.74		1059.91	0.008302	3.3	55.52	88.93	0.74
southwest swa	5.0370*	PF 1	183	1058.31	1059.54		1059.71	0.008052	3.26	56.17	89.46	0.72
southwest swa		5 PF 1	183	1058.1	1059.38		1059.52	0.006747	3.05	59.99	92.36	0.67
southwest swa	4.9630*	PF 1	183	1057.97	1059.22		1059.36	0.006722	3	61.08	96.34	0.66
southwest swa	4.9259*	PF 1	183	1057.83	1059.06		1059.19	0.006592	2.93	62.38	100.1	0.66
southwest swa	4.8889*	PF 1	183	1057.7	1058.9		1059.03	0.006664	2.9	63.16	104.09	0.66
southwest swa	4.8519*	PF 1	183	1057.57	1058.73		1058.86	0.006706	2.86	63.97	107.96	0.66
southwest swa	4.8148*	PF 1	183	1057.43	1058.58		1058.7	0.00651	2.79	65.65	112.7	0.64
southwest swa	4.7778*	PF 1	183	1057.3	1058.42		1058.54	0.006568	2.75	66.43	116.84	0.64
southwest swa	4.7407*	PF 1	183	1057.17	1058.26		1058.37	0.006551	2.71	67.6	121.83	0.64
southwest swa	4.7037*	PF 1	183	1057.03	1058.1		1058.21	0.006451	2.66	68.92	126.37	0.63
southwest swa	4.6667*	PF 1	183	1056.9	1057.95		1058.05	0.006521	2.62	69.82	131.6	0.63
southwest swa	4.6296*	PF 1	183	1056.77	1057.79		1057.89	0.00658	2.59	70.65	136.44	0.63
southwest swa	4.5926*	PF 1	183	1056.63	1057.63		1057.73	0.00632	2.51	72.84	142.91	0.62
southwest swa	4.5556*	PF 1	183	1056.5	1057.48		1057.57	0.006504	2.5	73.22	147.93	0.63
southwest swa	4.5185*	PF 1	183	1056.37	1057.32		1057.41	0.006577	2.47	74.23	154.35	0.63
southwest swa	4.4815*	PF 1	183	1056.23	1057.16		1057.25	0.006471	2.42	75.74	160.35	0.62
southwest swa	4.4444*	PF 1	183	1056.1	1057.01		1057.09	0.006383	2.36	77.54	168.34	0.61
southwest swa	4.4074*	PF 1	183	1055.97	1056.85		1056.93	0.006495	2.34	78.34	174.97	0.62
southwest swa	4.3704*	PF 1	183	1055.83	1056.69		1056.77	0.006469	2.29	79.92	183.4	0.61
southwest swa	4.3333*	PF 1	183	1055.7	1056.54		1056.62	0.006417	2.24	81.53	191.59	0.61
southwest swa	4.2963*	PF 1	183	1055.57	1056.38		1056.46	0.00656	2.21	82.63	201.47	0.61
southwest swa	4.2593*	PF 1	183	1055.43	1056.22		1056.29	0.006527	2.17	84.14	209.96	0.61
southwest swa	4.2222*	PF 1	183	1055.3	1056.07		1056.14	0.006313	2.1	87.12	223.42	0.59
southwest swa	4.1852*	PF 1	183	1055.17	1055.91		1055.98	0.006725	2.1	86.97	233.27	0.61

southwest swa	4.1481*	PF 1	183	1055.03	1055.75		1055.81	0.006609	2.05	89.14	245.73	0.6
southwest swa	4.1111*	PF 1	183	1054.9	1055.58		1055.65	0.00672	2.05	89.42	252.55	0.6
southwest swa	4.0741*	PF 1	183	1054.77	1055.42		1055.49	0.006604	2.02	90.7	261.14	0.6
southwest swa	4.0370*	PF 1	183	1054.63	1055.26		1055.32	0.006656	2.01	91.3	268.85	0.6
southwest swa		4 PF 1	183	1054.5	1055.09		1055.15	0.007234	2.05	89.91	277.08	0.62
southwest swa	3.9706*	PF 1	183	1054.29	1054.91		1054.98	0.007059	2.03	90.53	274.42	0.61
southwest swa	3.9412*	PF 1	183	1054.09	1054.73		1054.79	0.007631	2.07	88.44	269.37	0.63
southwest swa	3.9118*	PF 1	183	1053.88	1054.54		1054.6	0.00735	2.07	88.57	260.95	0.63
southwest swa	3.8824*	PF 1	183	1053.68	1054.35		1054.42	0.007538	2.12	86.47	250.5	0.63
southwest swa	3.8529*	PF 1	183	1053.47	1054.16		1054.23	0.007576	2.15	85.04	241.14	0.64
southwest swa	3.8235*	PF 1	183	1053.26	1053.97		1054.04	0.007529	2.18	83.87	231.82	0.64
southwest swa	3.7941*	PF 1	183	1053.06	1053.78		1053.86	0.007653	2.22	82.45	224.88	0.65
southwest swa	3.7647*	PF 1	183	1052.85	1053.59		1053.67	0.007677	2.24	81.55	219.34	0.65
southwest swa	3.7353*	PF 1	183	1052.65	1053.4		1053.48	0.007518	2.25	81.41	214.96	0.64
southwest swa	3.7059*	PF 1	183	1052.44	1053.21		1053.29	0.007681	2.28	80.21	210.49	0.65
southwest swa	3.6765*	PF 1	183	1052.24	1053.02		1053.1	0.007644	2.3	79.7	206.41	0.65
southwest swa	3.6471*	PF 1	183	1052.03	1052.83		1052.91	0.007569	2.3	79.4	202.98	0.65
southwest swa	3.6176*	PF 1	183	1051.82	1052.64		1052.72	0.007661	2.32	78.74	200.6	0.65
southwest swa	3.5882*	PF 1	183	1051.62	1052.45		1052.53	0.007622	2.33	78.61	199.02	0.65
southwest swa	3.5588*	PF 1	183	1051.41	1052.25		1052.34	0.007704	2.35	77.84	195.76	0.66
southwest swa	3.5294*	PF 1	183	1051.21	1052.06		1052.15	0.007694	2.37	77.23	191.75	0.66
southwest swa	3.5000*	PF 1	183	1051	1051.87		1051.96	0.007588	2.37	77.09	188.89	0.66
southwest swa	3.4706*	PF 1	183	1050.79	1051.68		1051.77	0.007575	2.39	76.62	185.78	0.66
southwest swa	3.4412*	PF 1	183	1050.59	1051.49		1051.58	0.007938	2.45	74.79	181.11	0.67
southwest swa	3.4118*	PF 1	183	1050.38	1051.3		1051.39	0.007549	2.42	75.74	180.05	0.66
southwest swa	3.3824*	PF 1	183	1050.18	1051.11		1051.2	0.007685	2.45	74.85	177.11	0.66
southwest swa	3.3529*	PF 1	183	1049.97	1050.91		1051.01	0.007666	2.46	74.46	174.5	0.66
southwest swa	3.3235*	PF 1	183	1049.76	1050.72		1050.82	0.007735	2.48	73.73	171.38	0.67
southwest swa	3.2941*	PF 1	183	1049.56	1050.53		1050.63	0.007674	2.49	73.5	169.05	0.67
southwest swa	3.2647*	PF 1	183	1049.35	1050.34		1050.44	0.007666	2.5	73.08	166.51	0.67
southwest swa	3.2353*	PF 1	183	1049.15	1050.15		1050.25	0.007599	2.5	73.12	165.69	0.66
southwest swa	3.2059*	PF 1	183	1048.94	1049.96		1050.06	0.007775	2.54	72.15	163	0.67
southwest swa	3.1765*	PF 1	183	1048.74	1049.77		1049.87	0.007347	2.5	73.28	162.4	0.66
southwest swa	3.1471*	PF 1	183	1048.53	1049.61		1049.7	0.006011	2.33	78.66	166.81	0.6

southwest swa	3.1176*	PF 1	183	1048.32	1049.52		1049.58	0.003707	1.94	94.11	181.72	0.48
southwest swa	3.0882*	PF 1	183	1048.12	1049.47		1049.5	0.001899	1.51	120.79	205.39	0.35
southwest swa	3.0588*	PF 1	183	1047.91	1049.45		1049.47	0.000879	1.15	158.47	227.25	0.24
southwest swa	3.0294*	PF 1	183	1047.71	1049.44		1049.45	0.000451	0.92	199.39	244.53	0.18
southwest swa		3 PF 1	440	1047.5	1049.36		1049.42	0.001806	1.95	226.21	254.62	0.36
southwest swa	2.9524*	PF 1	440	1047.45	1049.32		1049.38	0.001652	1.89	233.23	257.09	0.35
southwest swa	2.9048*	PF 1	440	1047.4	1049.29		1049.34	0.001507	1.83	240.62	259.46	0.33
southwest swa	2.8571*	PF 1	440	1047.36	1049.25		1049.3	0.001386	1.77	247.99	262.67	0.32
southwest swa	2.8095*	PF 1	440	1047.31	1049.22		1049.27	0.001249	1.71	256.97	265.55	0.31
southwest swa	2.7619*	PF 1	440	1047.26	1049.2		1049.24	0.001124	1.65	266.6	269.06	0.29
southwest swa	2.7143*	PF 1	440	1047.21	1049.17		1049.21	0.001006	1.59	277.09	272.53	0.28
southwest swa	2.6667*	PF 1	440	1047.17	1049.15		1049.19	0.000897	1.52	288.68	277.11	0.26
southwest swa	2.6190*	PF 1	440	1047.12	1049.13		1049.17	0.0008	1.46	300.44	281.06	0.25
southwest swa	2.5714*	PF 1	440	1047.07	1049.12		1049.15	0.000712	1.4	313.39	286.26	0.24
southwest swa	2.5238*	PF 1	440	1047.02	1049.1		1049.13	0.000619	1.35	326.46	289.23	0.22
southwest swa	2.4762*	PF 1	440	1046.98	1049.09		1049.12	0.000531	1.29	340.82	293.17	0.21
southwest swa	2.4286*	PF 1	440	1046.93	1049.08		1049.1	0.00046	1.24	355.26	298.17	0.19
southwest swa	2.3810*	PF 1	440	1046.88	1049.07		1049.09	0.0004	1.2	370.89	305.85	0.18
southwest swa	2.3333*	PF 1	440	1046.83	1049.06		1049.08	0.000349	1.16	387.48	313.82	0.17
southwest swa	2.2857*	PF 1	440	1046.79	1049.06		1049.08	0.000306	1.11	404.97	319.05	0.16
southwest swa	2.2381*	PF 1	440	1046.74	1049.05		1049.07	0.000269	1.07	423.47	325.06	0.15
southwest swa	2.1905*	PF 1	440	1046.69	1049.05		1049.06	0.000235	1.03	444.36	332.6	0.14
southwest swa	2.1429*	PF 1	440	1046.64	1049.04		1049.06	0.000208	1	465.35	341.44	0.14
southwest swa	2.0952*	PF 1	440	1046.6	1049.04		1049.05	0.000183	0.96	489.34	351.93	0.13
southwest swa	2.0476*	PF 1	440	1046.55	1049.03		1049.05	0.000162	0.93	514.74	364.62	0.12
southwest swa		2 PF 1	623	1046.5	1049.02		1049.04	0.000294	1.27	538.25	378.2	0.17
southwest swa	1.9474*	PF 1	623	1046.46	1049.01		1049.03	0.000257	1.2	566.75	396.91	0.16
southwest swa	1.8947*	PF 1	623	1046.43	1049.01		1049.03	0.000226	1.14	596.81	417.38	0.15
southwest swa	1.8421*	PF 1	623	1046.39	1049		1049.02	0.000197	1.08	631.58	440.48	0.14
southwest swa	1.7895*	PF 1	623	1046.35	1049		1049.02	0.000172	1.02	668.16	466.1	0.13
southwest swa	1.7368*	PF 1	623	1046.32	1049		1049.01	0.00015	0.96	708.02	495.32	0.12
southwest swa	1.6842*	PF 1	623	1046.28	1049		1049.01	0.000131	0.91	752.91	530.37	0.11
southwest swa	1.6316*	PF 1	623	1046.24	1048.99		1049	0.000113	0.86	802.55	568.72	0.1
southwest swa	1.5789*	PF 1	623	1046.21	1048.99		1049	0.000099	0.81	854.84	616.05	0.1

southwest swa	1.5263*	PF 1	623	1046.17	1048.99		1049	0.000086	0.76	912.88	653.57	0.09
southwest swa	1.4737*	PF 1	623	1046.13	1048.99		1049	0.000074	0.72	976.78	682.19	0.09
southwest swa	1.4211*	PF 1	623	1046.09	1048.99		1048.99	0.000064	0.68	1042.77	711.13	0.08
southwest swa	1.3684*	PF 1	623	1046.06	1048.99		1048.99	0.000056	0.64	1112.25	740.42	0.07
southwest swa	1.3158*	PF 1	623	1046.02	1048.99		1048.99	0.000049	0.6	1184.21	770.38	0.07
southwest swa	1.2632*	PF 1	623	1045.98	1048.99		1048.99	0.000042	0.57	1261.91	800.45	0.07
southwest swa	1.2105*	PF 1	623	1045.95	1048.99		1048.99	0.000037	0.54	1341.4	830.92	0.06
southwest swa	1.1579*	PF 1	623	1045.91	1048.98		1048.99	0.000032	0.51	1425.64	861.61	0.06
southwest swa	1.1053*	PF 1	623	1045.87	1048.98		1048.99	0.000028	0.48	1510.31	892.22	0.05
southwest swa	1.0526*	PF 1	623	1045.84	1048.98		1048.99	0.000025	0.45	1601.58	923.22	0.05
southwest swa	1	PF 1	623	1045.8	1048.98		1048.99	0.000022	0.43	1694.02	954.23	0.05
southwest swa	0.98421*	PF 1	623	1045.63	1048.98		1048.99	0.000017	0.39	1856.5	957.95	0.04
southwest swa	0.96842*	PF 1	623	1045.47	1048.98		1048.98	0.000013	0.37	2009.75	961.43	0.04
southwest swa	0.95263*	PF 1	623	1045.3	1048.98		1048.98	0.00001	0.34	2173.53	965.14	0.03
southwest swa	0.93684*	PF 1	623	1045.13	1048.98		1048.98	0.000008	0.31	2337.55	968.82	0.03
southwest swa	0.92105*	PF 1	623	1044.97	1048.98		1048.98	0.000007	0.29	2492.95	972.34	0.03
southwest swa	0.90526*	PF 1	623	1044.8	1048.98		1048.98	0.000006	0.28	2658.48	976.04	0.03
southwest swa	0.88947*	PF 1	623	1044.64	1048.98		1048.98	0.000005	0.26	2815.4	985.75	0.02
southwest swa	0.87368*	PF 1	623	1044.47	1048.98		1048.98	0.000004	0.25	2983.86	996.87	0.02
southwest swa	0.85789*	PF 1	623	1044.3	1048.98		1048.98	0.000003	0.23	3154.18	1008	0.02
southwest swa	0.84211*	PF 1	623	1044.14	1048.98		1048.98	0.000003	0.22	3316.33	1018.48	0.02
southwest swa	0.82632*	PF 1	623	1043.97	1048.98		1048.98	0.000003	0.21	3490.23	1029.6	0.02
southwest swa	0.81053*	PF 1	623	1043.8	1048.98		1048.98	0.000002	0.2	3666.05	1040.73	0.02
southwest swa	0.79474*	PF 1	623	1043.64	1048.98		1048.98	0.000002	0.19	3833.5	1051.2	0.02
southwest swa	0.77895*	PF 1	623	1043.47	1048.98		1048.98	0.000002	0.18	4012.95	1062.32	0.01
southwest swa	0.76316*	PF 1	623	1043.31	1048.98		1048.98	0.000001	0.18	4183.91	1072.8	0.01
southwest swa	0.74737*	PF 1	623	1043.14	1048.98		1048.98	0.000001	0.17	4367.28	1083.94	0.01
southwest swa	0.73158*	PF 1	623	1042.97	1048.98		1048.98	0.000001	0.16	4552.43	1095.06	0.01
southwest swa	0.71579*	PF 1	623	1042.81	1048.98		1048.98	0.000001	0.16	4728.5	1105.54	0.01
southwest swa	0.7	PF 1	623	1042.64	1048.98	1045.06	1048.98	0.000001	0.15	4916.89	1107.38	0.01
southwest swa	0.65		Culvert									
southwest swa	0.6	PF 1	623	1041.31	1046.82	1044.86	1047.08	0.001955	4.28	153.25	369.37	0.37
southwest swa	0.59000*	PF 1	623	1041.42	1046.91		1046.95	0.000451	1.97	546.9	384.45	0.17
southwest swa	0.58000*	PF 1	623	1041.53	1046.9		1046.94	0.000504	2.09	535.63	383	0.18

southwest swa	0.57000*	PF 1	623	1041.64	1046.88		1046.92	0.000537	2.16	523.38	374.13	0.19	
southwest swa	0.56000*	PF 1	623	1041.75	1046.87		1046.91	0.000557	2.19	503.82	342.81	0.19	
southwest swa	0.55000*	PF 1	623	1041.86	1046.85		1046.89	0.000598	2.25	475.38	306.79	0.2	
southwest swa	0.54000*	PF 1	623	1041.98	1046.82		1046.88	0.000676	2.36	435.69	266.55	0.21	
southwest swa	0.53000*	PF 1	623	1042.09	1046.79		1046.85	0.000828	2.56	383	222.52	0.23	
southwest swa	0.52000*	PF 1	623	1042.2	1046.74		1046.82	0.001132	2.91	317.34	174.9	0.27	
southwest swa	0.51000*	PF 1	623	1042.31	1046.62		1046.77	0.001908	3.61	235.15	122.77	0.35	
southwest swa	0.5	PF 1	623	1042.42	1045.68	1045.68	1046.48	0.013855	7.49	96.12	63.72	0.88	

HEC-RAS Profile Summary Table- Plan 08- North Swale Proposed Conditions												
*-indicated interpolated cross-section at 25 feet intervals												
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # C
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
north trib	4	PF 1	275	1053.3	1055.7		1055.75	0.000447	1.8	178.85	141.69	0.21
north trib	3.8462*	PF 1	275	1053.2	1055.7		1055.73	0.000325	1.58	213.17	164.38	0.18
north trib	3.6923*	PF 1	275	1053.11	1055.7		1055.72	0.000239	1.39	251.26	187.19	0.16
north trib	3.5385*	PF 1	275	1053.01	1055.7		1055.72	0.000173	1.21	292.59	197.83	0.13
north trib	3.3846*	PF 1	275	1052.92	1055.7		1055.71	0.000128	1.07	335.98	208.49	0.12
north trib	3.2308*	PF 1	275	1052.82	1055.7		1055.71	0.000096	0.94	381	219.13	0.1
north trib	3.0769*	PF 1	275	1052.72	1055.7		1055.71	0.000073	0.84	428.53	229.78	0.09
north trib	2.9231*	PF 1	275	1052.63	1055.7		1055.7	0.000056	0.75	478.21	240.42	0.08
north trib	2.7692*	PF 1	275	1052.53	1055.7		1055.7	0.000044	0.67	530.15	251.07	0.07
north trib	2.6154*	PF 1	275	1052.43	1055.7		1055.7	0.000034	0.61	583.61	261.71	0.06
north trib	2.4615*	PF 1	275	1052.34	1055.7		1055.7	0.000027	0.55	639.79	272.37	0.06
north trib	2.3077*	PF 1	275	1052.24	1055.7		1055.7	0.000022	0.5	697.45	283.01	0.05
north trib	2.1538*	PF 1	275	1052.15	1055.7		1055.7	0.000018	0.46	757.17	293.66	0.04
north trib	2	PF 1	275	1052.05	1055.7		1055.7	0.000015	0.42	819.36	304.3	0.04
north trib	1.8500*	PF 1	275	1051.95	1055.7		1055.7	0.000016	0.45	831.92	347.25	0.04
north trib	1.7000*	PF 1	275	1051.85	1055.69		1055.7	0.000018	0.49	814.58	390.2	0.05
north trib	1.5500*	PF 1	275	1051.76	1055.69		1055.7	0.000023	0.55	768.02	429.5	0.05
north trib	1.4	PF 1	275	1051.66	1055.69		1055.7	0.000028	0.62	696.71	449.17	0.06
north trib	1.3	PF 1	275	1051.57	1055.58	1052.98	1055.67	0.000353	2.35	117.05	448.15	0.21
north trib	1.25		Culvert									
north trib	1.2	PF 1	275	1051.22	1052.63	1052.63	1053.33	0.011515	6.69	41.13	64.11	0.99
north trib	1.1	PF 1	275	1051.12	1052.54		1052.72	0.00342	3.38	81.35	64.24	0.53
north trib	1.0833*	PF 1	275	1051.02	1052.46		1052.63	0.003769	3.35	82.2	64.37	0.52
north trib	1.0667*	PF 1	275	1050.91	1052.37		1052.54	0.003833	3.3	83.41	64.56	0.51
north trib	1.0500*	PF 1	275	1050.81	1052.26		1052.43	0.004339	3.3	83.24	64.53	0.51
north trib	1.0333*	PF 1	275	1050.71	1052.14		1052.32	0.005144	3.37	81.65	64.29	0.53
north trib	1.0167*	PF 1	275	1050.6	1051.99	1051.55	1052.18	0.00599	3.48	79.06	63.88	0.55
north trib	1	PF 1	275	1050.5	1051.45	1051.45	1051.88	0.024795	5.32	51.7	59.45	1.01

**Appendix F-Proposed Conditions 100-Year Water Surface Elevations
(Southwest and North Swales)**

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # C
southwest	12	PF 1	183	1064.45	1065.21	1065.17	1065.52	0.012665	4.43	41.32	58.22	0.93
southwest	11.800*	PF 1	183	1064.13	1064.87	1064.85	1065.19	0.013713	4.53	40.38	58.33	0.96
southwest	11.600*	PF 1	183	1063.8	1064.56	1064.52	1064.86	0.01276	4.42	41.39	58.78	0.93
southwest	11.400*	PF 1	183	1063.48	1064.23	1064.2	1064.54	0.013612	4.5	40.63	58.94	0.96
southwest	11.200*	PF 1	183	1063.15	1063.9	1063.87	1064.21	0.013167	4.45	41.16	59.36	0.94
southwest	11	PF 1	183	1062.83	1063.58	1063.55	1063.89	0.013127	4.43	41.35	59.91	0.94
southwest	10.909*	PF 1	183	1062.52	1063.27	1063.24	1063.58	0.013255	4.45	41.13	59.57	0.94
southwest	10.818*	PF 1	183	1062.21	1062.96	1062.93	1063.27	0.013111	4.44	41.21	59.36	0.94
southwest	10.727*	PF 1	183	1061.9	1062.65	1062.62	1062.96	0.013461	4.48	40.82	59.12	0.95
southwest	10.636*	PF 1	183	1061.59	1062.51		1062.71	0.006509	3.56	51.38	60.91	0.68
southwest	10.545*	PF 1	183	1061.28	1062.48		1062.59	0.002662	2.67	68.46	63.78	0.45
southwest	10.455*	PF 1	183	1060.96	1062.47		1062.54	0.001209	2.07	88.37	66.76	0.32
southwest	10.364*	PF 1	183	1060.65	1062.47		1062.51	0.000623	1.68	109	70.52	0.23
southwest	10.273*	PF 1	183	1060.34	1062.47		1062.5	0.000352	1.42	130.91	74.13	0.18
southwest	10.182*	PF 1	183	1060.03	1062.47		1062.49	0.000215	1.22	153.73	79.51	0.15
southwest	10.091*	PF 1	183	1059.72	1062.47		1062.48	0.00014	1.08	176.67	83.66	0.12
southwest	10	PF 1	183	1059.41	1062.46		1062.48	0.000097	0.97	198.57	83.65	0.1
southwest	9.7333*	PF 1	183	1059.22	1062.46		1062.48	0.000077	0.9	214.74	87.13	0.09
southwest	9.4667*	PF 1	183	1059.04	1062.46	1059.77	1062.47	0.000067	0.9	205.64	90.41	0.09
southwest	9.2	PF 1	183	1058.85	1062.43	1059.8	1062.47	0.000158	1.46	125.4	93.38	0.14
southwest	9.15		Culvert									
southwest	9.1	PF 1	183	1057.97	1058.91	1058.91	1059.39	0.013687	5.56	32.91	64.02	1.01
southwest	9	PF 1	183	1057.83	1058.66	1058.56	1058.94	0.00948	4.24	43.19	62.48	0.82
southwest	8.9231*	PF 1	183	1057.63	1058.48		1058.72	0.007952	3.94	47.89	61.92	0.76
southwest	8.8462*	PF 1	183	1057.44	1058.28		1058.53	0.00819	3.97	47.31	61.34	0.77
southwest	8.7692*	PF 1	183	1057.24	1058.09		1058.33	0.007985	3.94	47.51	60.85	0.76
southwest	8.6923*	PF 1	183	1057.05	1057.9		1058.14	0.008219	3.97	47	60.48	0.77
southwest	8.6154*	PF 1	183	1056.85	1057.71		1057.95	0.007972	3.93	47.33	60.14	0.76
southwest	8.5385*	PF 1	183	1056.66	1057.51		1057.75	0.008294	3.98	46.68	59.76	0.77
southwest	8.4615*	PF 1	183	1056.46	1057.32		1057.56	0.007976	3.92	47.21	59.62	0.76
southwest	8.3846*	PF 1	183	1056.27	1057.12		1057.37	0.008257	3.96	46.67	59.32	0.77
southwest	8.3077*	PF 1	183	1056.07	1056.93		1057.17	0.008007	3.92	47.07	59.12	0.76

southwest	5.1	PF 1	183	1050	1051.02	1051.02	1051.54	0.013128	5.77	31.74	57.79	1
southwest	5	PF 1	183	1049.85	1050.82	1050.63	1051.04	0.006252	3.81	49.93	57.19	0.69
southwest	4.9000*	PF 1	183	1049.71	1050.68		1050.9	0.006128	3.77	50.31	57.52	0.68
southwest	4.8000*	PF 1	183	1049.58	1050.54		1050.76	0.00628	3.78	50.04	57.82	0.69
southwest	4.7000*	PF 1	183	1049.44	1050.4		1050.61	0.006141	3.73	50.48	58.17	0.68
southwest	4.6000*	PF 1	183	1049.31	1050.26		1050.47	0.006319	3.75	50.16	58.49	0.69
southwest	4.5000*	PF 1	183	1049.17	1050.12		1050.33	0.006194	3.7	50.59	58.86	0.68
southwest	4.4000*	PF 1	183	1049.03	1049.98		1050.19	0.005946	3.64	51.37	59.31	0.66
southwest	4.3000*	PF 1	183	1048.9	1049.85		1050.05	0.005845	3.6	51.82	59.79	0.66
southwest	4.2000*	PF 1	183	1048.76	1049.73		1049.92	0.005287	3.47	53.64	60.42	0.63
southwest	4.1000*	PF 1	183	1048.63	1049.63		1049.8	0.004729	3.33	55.75	61.18	0.6
southwest	4	PF 1	183	1048.49	1049.55		1049.7	0.003778	3.1	60	62.18	0.54
southwest	3.9333*	PF 1	183	1048.38	1049.48		1049.61	0.003137	2.88	64.26	64.02	0.49
southwest	3.8667*	PF 1	183	1048.27	1049.43		1049.54	0.002505	2.65	69.71	66.09	0.44
southwest	3.8000*	PF 1	183	1048.16	1049.39		1049.48	0.001948	2.41	76.26	68.31	0.39
southwest	3.7333*	PF 1	183	1048.05	1049.36		1049.43	0.001491	2.19	83.84	70.64	0.35
southwest	3.6667*	PF 1	183	1047.94	1049.34		1049.4	0.001131	1.99	92.41	73.08	0.31
southwest	3.6000*	PF 1	183	1047.83	1049.32		1049.37	0.000861	1.81	101.7	75.56	0.27
southwest	3.5333*	PF 1	183	1047.72	1049.31		1049.35	0.00066	1.64	111.72	78.08	0.24
southwest	3.4667*	PF 1	183	1047.61	1049.3		1049.33	0.000509	1.5	122.4	80.65	0.21
southwest	3.4000*	PF 1	183	1047.5	1049.29		1049.32	0.000396	1.37	133.76	83.22	0.19
southwest	3.3333*	PF 1	183	1047.39	1049.29		1049.31	0.000311	1.26	145.61	85.81	0.17
southwest	3.2667*	PF 1	183	1047.28	1049.28		1049.31	0.000247	1.16	158.04	88.44	0.15
southwest	3.2000*	PF 1	183	1047.17	1049.28		1049.3	0.000198	1.07	170.98	91.05	0.14
southwest	3.1333*	PF 1	183	1047.06	1049.28		1049.29	0.000159	0.99	184.55	93.67	0.12
southwest	3.0667*	PF 1	183	1046.95	1049.28		1049.29	0.00013	0.92	198.57	96.31	0.11
southwest	3	PF 1	440	1046.84	1049.2		1049.28	0.000686	2.14	206.1	98.44	0.26
southwest	2.9333*	PF 1	440	1046.75	1049.19		1049.26	0.000605	2.04	215.61	100.66	0.24
southwest	2.8667*	PF 1	440	1046.65	1049.18		1049.24	0.000529	1.95	226.17	102.81	0.23
southwest	2.8000*	PF 1	440	1046.56	1049.18		1049.23	0.000468	1.87	236.33	105.06	0.22
southwest	2.7333*	PF 1	440	1046.46	1049.17		1049.22	0.000412	1.78	247.49	107.31	0.2
southwest	2.6667*	PF 1	440	1046.37	1049.16		1049.21	0.000367	1.71	258	109.51	0.19
southwest	2.6000*	PF 1	440	1046.28	1049.16		1049.2	0.000328	1.64	268.9	111.78	0.18
southwest	2.5333*	PF 1	440	1046.18	1049.15		1049.19	0.000291	1.57	280.84	114.07	0.17

southwest	2.4667*	PF 1	440	1046.09	1049.15		1049.18	0.000261	1.51	292.14	116.29	0.17
southwest	2.4000*	PF 1	440	1045.99	1049.14		1049.17	0.000233	1.45	304.46	118.59	0.16
southwest	2.3333*	PF 1	440	1045.9	1049.14		1049.17	0.00021	1.4	316.45	120.92	0.15
southwest	2.2667*	PF 1	440	1045.81	1049.14		1049.16	0.00019	1.35	328.34	123.17	0.14
southwest	2.2000*	PF 1	440	1045.71	1049.13		1049.16	0.000171	1.3	341.37	125.49	0.14
southwest	2.1333*	PF 1	440	1045.62	1049.13		1049.15	0.000155	1.25	353.96	127.82	0.13
southwest	2.0667*	PF 1	440	1045.52	1049.13		1049.15	0.00014	1.21	367.24	130.1	0.12
southwest		2 PF 1	440	1045.43	1049.13		1049.15	0.000127	1.17	380.26	132.45	0.12
southwest	1.9545*	PF 1	440	1045.34	1049.12		1049.14	0.000116	1.14	391.32	133.45	0.11
southwest	1.9091*	PF 1	440	1045.25	1049.12		1049.14	0.000106	1.11	402.24	134.58	0.11
southwest	1.8636*	PF 1	440	1045.16	1049.12		1049.14	0.000096	1.08	413.45	135.99	0.1
southwest	1.8182*	PF 1	440	1045.06	1049.12		1049.13	0.000088	1.05	425.33	137.54	0.1
southwest	1.7727*	PF 1	440	1044.97	1049.12		1049.13	0.000081	1.03	436.56	139.36	0.1
southwest	1.7273*	PF 1	440	1044.88	1049.11		1049.13	0.000075	1.01	447.97	141.48	0.09
southwest	1.6818*	PF 1	440	1044.79	1049.11		1049.13	0.000069	0.99	459.61	143.92	0.09
southwest	1.6364*	PF 1	440	1044.7	1049.11		1049.13	0.000064	0.96	471.4	146.82	0.09
southwest	1.5909*	PF 1	440	1044.61	1049.11		1049.12	0.000059	0.94	483.66	150.07	0.08
southwest	1.5455*	PF 1	440	1044.52	1049.11		1049.12	0.000055	0.93	495.94	153.82	0.08
southwest	1.5000*	PF 1	440	1044.43	1049.11		1049.12	0.000051	0.91	509.15	158.31	0.08
southwest	1.4545*	PF 1	440	1044.33	1049.11		1049.12	0.000047	0.89	523.6	163.43	0.08
southwest	1.4091*	PF 1	440	1044.24	1049.11		1049.12	0.000044	0.87	537.75	169.67	0.07
southwest	1.3636*	PF 1	440	1044.15	1049.11		1049.12	0.000041	0.85	553.29	177.05	0.07
southwest	1.3182*	PF 1	440	1044.06	1049.11		1049.12	0.000039	0.84	569.57	185.63	0.07
southwest	1.2727*	PF 1	440	1043.97	1049.11		1049.12	0.000036	0.82	588.01	195.99	0.07
southwest	1.2273*	PF 1	440	1043.88	1049.11		1049.11	0.000034	0.81	608.09	208.41	0.07
southwest	1.1818*	PF 1	440	1043.79	1049.1		1049.11	0.000031	0.79	631.11	222.91	0.06
southwest	1.1364*	PF 1	440	1043.69	1049.1		1049.11	0.000029	0.77	657.6	231.45	0.06
southwest	1.0909*	PF 1	440	1043.6	1049.1		1049.11	0.000027	0.75	684.49	241.17	0.06
southwest	1.0455*	PF 1	440	1043.51	1049.1		1049.11	0.000025	0.73	713.59	252.62	0.06
southwest		1 PF 1	623	1043.42	1049.1		1049.11	0.000046	1.01	742.55	264.23	0.08
southwest	0.95000*	PF 1	623	1043.29	1049.1		1049.1	0.000019	0.63	1216.37	407.38	0.05
southwest	0.90000*	PF 1	623	1043.16	1049.1		1049.1	0.000009	0.43	1787.52	550.16	0.03
southwest	0.85000*	PF 1	623	1043.03	1049.1		1049.1	0.000004	0.31	2456.72	692.39	0.02
southwest	0.80000*	PF 1	623	1042.9	1049.1		1049.1	0.000002	0.23	3223.14	834.18	0.02

southwest	0.75000*	PF 1	623	1042.77	1049.1		1049.1	0.000001	0.18	4086.99	973.26	0.01
southwest	0.7	PF 1	623	1042.64	1049.1	1045.06	1049.1	0.000001	0.15	5048.42	1107.38	0.01
southwest	0.65		Culvert									
southwest	0.6	PF 1	623	1041.31	1046.89	1044.86	1047.14	0.001853	4.21	155.76	379.83	0.36
southwest	0.59000*	PF 1	623	1041.42	1046.98		1047.01	0.000421	1.93	572.1	398.92	0.17
southwest	0.58000*	PF 1	623	1041.53	1046.96		1047	0.00046	2.02	561.44	397.07	0.18
southwest	0.57000*	PF 1	623	1041.64	1046.95		1046.99	0.000478	2.06	549.38	381.08	0.18
southwest	0.56000*	PF 1	623	1041.75	1046.94		1046.97	0.000496	2.09	528.18	348.72	0.18
southwest	0.55000*	PF 1	623	1041.86	1046.92		1046.96	0.000533	2.15	497.69	311.84	0.19
southwest	0.54000*	PF 1	623	1041.98	1046.9		1046.95	0.000604	2.26	455.64	270.83	0.2
southwest	0.53000*	PF 1	623	1042.09	1046.87		1046.93	0.000739	2.45	400.3	226.06	0.22
southwest	0.52000*	PF 1	623	1042.2	1046.82		1046.9	0.001007	2.79	331.85	177.68	0.26
southwest	0.51000*	PF 1	623	1042.31	1046.72		1046.85	0.001678	3.45	246.78	124.73	0.33
southwest	0.5	PF 1	623	1042.42	1046.33	1045.68	1046.71	0.005007	5.32	138.67	67.67	0.55

North Tributary Proposed Conditions Profile summary Table - June 13, 2019												
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # C
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
revised	4	PF 1	275	1053	1054.26		1054.5	0.00495	3.88	71.12	62.63	0.63
revised	3.9375*	PF 1	275	1052.88	1054.14		1054.37	0.005066	3.91	70.61	62.56	0.64
revised	3.8750*	PF 1	275	1052.75	1054.01		1054.25	0.004991	3.89	70.94	62.61	0.63
revised	3.8125*	PF 1	275	1052.62	1053.89		1054.12	0.004878	3.86	71.44	62.67	0.63
revised	3.7500*	PF 1	275	1052.5	1053.76		1054	0.00495	3.88	71.12	62.63	0.63
revised	3.6875*	PF 1	275	1052.38	1053.64		1053.87	0.005065	3.91	70.62	62.56	0.64
revised	3.6250*	PF 1	275	1052.25	1053.51		1053.75	0.004989	3.89	70.95	62.61	0.63
revised	3.5625*	PF 1	275	1052.12	1053.39		1053.62	0.004876	3.86	71.45	62.66	0.63
revised	3.5000*	PF 1	275	1052	1053.26		1053.5	0.004944	3.88	71.14	62.63	0.63
revised	3.4375*	PF 1	275	1051.88	1053.14		1053.37	0.005057	3.91	70.65	62.57	0.64
revised	3.3750*	PF 1	275	1051.75	1053.01		1053.25	0.004979	3.89	70.99	62.61	0.63
revised	3.3125*	PF 1	275	1051.62	1052.89		1053.12	0.00486	3.86	71.53	62.69	0.62
revised	3.2500*	PF 1	275	1051.5	1052.77		1053	0.00491	3.87	71.3	62.65	0.63
revised	3.1875*	PF 1	275	1051.38	1052.64		1052.88	0.004993	3.89	70.93	62.62	0.63
revised	3.1250*	PF 1	275	1051.25	1052.52		1052.75	0.00488	3.87	71.44	62.71	0.63
revised	3.0625*	PF 1	275	1051.12	1052.4		1052.63	0.004699	3.82	72.28	62.91	0.62
revised	3	PF 1	275	1051	1052.29		1052.51	0.004649	3.81	72.52	62.85	0.61
revised	2.9375*	PF 1	275	1050.88	1052.17		1052.39	0.004568	3.79	72.92	62.93	0.61
revised	2.8750*	PF 1	275	1050.75	1052.07		1052.28	0.004254	3.71	74.55	63.17	0.59
revised	2.8125*	PF 1	275	1050.62	1051.98		1052.18	0.003834	3.59	77	63.55	0.56
revised	2.7500*	PF 1	275	1050.5	1051.89		1052.08	0.00348	3.49	79.37	63.93	0.54
revised	2.6875*	PF 1	275	1050.38	1051.82		1052	0.003083	3.37	82.45	64.42	0.51
revised	2.6250*	PF 1	275	1050.25	1051.76		1051.92	0.002588	3.19	87.13	65.14	0.47
revised	2.5625*	PF 1	275	1050.12	1051.72		1051.86	0.002133	3.01	92.63	65.96	0.43
revised	2.5000*	PF 1	275	1050	1051.68		1051.81	0.001784	2.85	98.07	66.79	0.4
revised	2.4375*	PF 1	275	1049.88	1051.65		1051.76	0.001483	2.69	104.06	67.7	0.37
revised	2.3750*	PF 1	275	1049.75	1051.63		1051.72	0.001203	2.53	111.31	68.75	0.33
revised	2.3125*	PF 1	275	1049.62	1051.61		1051.69	0.000979	2.37	119.02	69.84	0.3
revised	2.2500*	PF 1	275	1049.5	1051.59		1051.67	0.000814	2.24	126.37	70.9	0.28
revised	2.1875*	PF 1	275	1049.38	1051.58		1051.65	0.000681	2.12	134.04	71.99	0.26
revised	2.1250*	PF 1	275	1049.25	1051.57		1051.63	0.000562	2	142.75	73.18	0.24

revised	2.0625*	PF 1	275	1049.12	1051.56		1051.61	0.000467	1.89	151.73	74.38	0.22
revised	2	PF 1	275	1049	1051.55		1051.6	0.000397	1.8	160.22	75.53	0.2
revised	1.8333*	PF 1	275	1048.89	1051.55		1051.59	0.000344	1.72	167.98	76.21	0.19
revised	1.6667*	PF 1	275	1048.77	1051.54		1051.58	0.000296	1.65	176.29	76.9	0.18
revised	1.5000*	PF 1	275	1048.66	1051.54		1051.58	0.000259	1.59	184.3	77.61	0.17
revised	1.3333*	PF 1	275	1048.55	1051.54		1051.57	0.000228	1.53	192.41	78.33	0.16
revised	1.1667*	PF 1	275	1048.43	1051.53		1051.56	0.0002	1.47	201.01	79.04	0.15
revised	1	PF 1	275	1048.32	1051.53		1051.56	0.000177	1.42	209.33	79.76	0.14
revised	0.92500*	PF 1	275	1048.21	1051.53		1051.56	0.000157	1.37	218.02	80.74	0.13
revised	0.85000*	PF 1	275	1048.1	1051.53		1051.55	0.00014	1.32	226.84	81.71	0.13
revised	0.77500*	PF 1	275	1047.99	1051.52	1048.94	1051.55	0.000128	1.29	221.08	82.68	0.12
revised	0.7	PF 1	275	1047.88	1051.48	1049.04	1051.54	0.000285	1.96	140.2	83.23	0.18
revised	0.5		Culvert									
revised	0.25	PF 1	275	1047.36	1049.23	1048.51	1049.45	0.00252	3.77	72.89	67.7	0.49
revised	0.2	PF 1	275	1047.3	1049.28	1048.24	1049.37	0.000992	2.42	118.08	68.7	0.31

Appendix G- - Drainage Area Transfer Method to Generate 500-Year Flow

Drainage area Ratio method- Q500= 1730 c.f.s. for “Dry Tributary to Badger Mill Creek” at Shady Oak Lane- Source Table 10- “Summary of Discharges”, FEMA Flood Insurance Study for Dane County, page 36, Volume 1 of 4, 06/16/2016

Q500= 1730 cfs *(3.5 sq miles/7.5 sq miles) = 807.3 c.f.s. at Pioneer road crossing

**** Use more 807.3 c.f.s. for 500-year flow at Pioneer Road East Crossing****

Calculate 500-year Flow Change from Southwest to North Swale using Drainage Areas

DA Total= 2242.44 acres

DA- north= 591.81 acres+991.32acres =1583.13 acres

Q500-north swale= $807.3 * (1583.13 / 2242.44) = 569.95$ cfs say 570 c.f.s.

Q500-northswale (not including Pioneer Road East) = $807.3 * (991.32 / 2242.44) = 356.89$ c.f.s. say 360

Q500-southwest swale= $807.3 * (658.87 / 2242.22) = 237.2$ c.f.s. say 240

**Appendix H- Proposed Conditions 500-Year Water Surface Elevations
(Southwest and North Swales)**

Southwest Tributary 500 year Profile Summary Table- June 13,2019												
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # C
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
southwest	12	PF 1	240	1064.45	1065.34	1065.32	1065.72	0.012913	4.92	48.78	59.53	0.96
southwest	11.800*	PF 1	240	1064.13	1065	1064.99	1065.39	0.013662	5	48.02	59.72	0.98
southwest	11.600*	PF 1	240	1063.8	1064.69	1064.66	1065.06	0.012865	4.89	49.06	60.21	0.96
southwest	11.400*	PF 1	240	1063.48	1064.35	1064.34	1064.74	0.013579	4.97	48.34	60.43	0.98
southwest	11.200*	PF 1	240	1063.15	1064.03	1064.01	1064.41	0.013189	4.91	48.92	60.93	0.97
southwest	11	PF 1	240	1062.83	1063.71	1063.69	1064.08	0.013031	4.87	49.3	61.59	0.96
southwest	10.909*	PF 1	240	1062.52	1063.39	1063.38	1063.77	0.013573	4.94	48.55	61.09	0.98
southwest	10.818*	PF 1	240	1062.21	1063.23		1063.5	0.008065	4.19	57.29	62.53	0.77
southwest	10.727*	PF 1	240	1061.9	1063.18		1063.34	0.003668	3.25	73.88	65.35	0.54
southwest	10.636*	PF 1	240	1061.59	1063.16		1063.27	0.001794	2.57	93.24	68.34	0.39
southwest	10.545*	PF 1	240	1061.28	1063.16		1063.23	0.000965	2.1	114.18	74.47	0.29
southwest	10.455*	PF 1	240	1060.96	1063.15		1063.2	0.000532	1.76	138.14	86.47	0.22
southwest	10.364*	PF 1	240	1060.65	1063.15		1063.19	0.000321	1.52	164.05	96.21	0.18
southwest	10.273*	PF 1	240	1060.34	1063.15		1063.18	0.000208	1.33	190.86	102.7	0.15
southwest	10.182*	PF 1	240	1060.03	1063.15		1063.17	0.000142	1.19	217.2	104.98	0.12
southwest	10.091*	PF 1	240	1059.72	1063.15		1063.17	0.000102	1.08	241.03	103.4	0.11
southwest	10	PF 1	240	1059.41	1063.15		1063.17	0.000076	0.99	260.32	93.51	0.09
southwest	9.7333*	PF 1	240	1059.22	1063.15		1063.17	0.000063	0.93	278.03	93.51	0.09
southwest	9.4667*	PF 1	240	1059.04	1063.15	1059.89	1063.16	0.000053	0.88	294.82	93.51	0.08
southwest	9.2	PF 1	240	1058.85	1063.15	1059.99	1063.16	0.000044	0.84	312.57	93.51	0.07
southwest	9.15		Culvert									
southwest	9.1	PF 1	240	1057.97	1059.11	1059.11	1059.67	0.012571	6.04	39.72	66.65	1
southwest	9	PF 1	240	1057.83	1058.79	1058.7	1059.15	0.009949	4.79	50.09	64.26	0.86
southwest	8.9231*	PF 1	240	1057.63	1058.62		1058.91	0.007943	4.37	56.97	63.77	0.78
southwest	8.8462*	PF 1	240	1057.44	1058.43		1058.72	0.008127	4.4	56.35	63.11	0.78
southwest	8.7692*	PF 1	240	1057.24	1058.24		1058.53	0.007987	4.38	56.42	62.54	0.78
southwest	8.6923*	PF 1	240	1057.05	1058.04		1058.34	0.008163	4.41	55.92	62.12	0.79
southwest	8.6154*	PF 1	240	1056.85	1057.85		1058.15	0.007983	4.38	56.14	61.73	0.78
southwest	8.5385*	PF 1	240	1056.66	1057.65		1057.95	0.008227	4.41	55.51	61.33	0.79
southwest	8.4615*	PF 1	240	1056.46	1057.46		1057.76	0.007988	4.37	55.95	61.14	0.78
southwest	8.3846*	PF 1	240	1056.27	1057.27		1057.57	0.008212	4.4	55.4	60.82	0.79

southwest	8.3077*	PF 1	240	1056.07	1057.08		1057.37	0.008027	4.36	55.72	60.58	0.78
southwest	8.2308*	PF 1	240	1055.88	1056.88		1057.18	0.008203	4.39	55.33	60.41	0.79
southwest	8.1538*	PF 1	240	1055.68	1056.69		1056.98	0.007993	4.35	55.74	60.22	0.78
southwest	8.0769*	PF 1	240	1055.49	1056.5		1056.79	0.008017	4.34	55.7	60.14	0.78
southwest		8 PF 1	240	1055.29	1056.33		1056.6	0.007375	4.23	57.14	60.14	0.75
southwest	7.9231*	PF 1	240	1055.11	1056.17		1056.43	0.00712	4.09	58.96	62.17	0.73
southwest	7.8462*	PF 1	240	1054.93	1056.01		1056.26	0.006389	3.97	60.79	61.95	0.7
southwest	7.7692*	PF 1	240	1054.75	1055.9		1056.11	0.005274	3.73	64.74	62.86	0.64
southwest	7.6923*	PF 1	240	1054.57	1055.81		1055.99	0.003989	3.42	70.89	64.03	0.56
southwest	7.6154*	PF 1	240	1054.39	1055.75		1055.9	0.002862	3.08	79.04	65.54	0.48
southwest	7.5385*	PF 1	240	1054.21	1055.72		1055.83	0.002026	2.75	88.56	67.18	0.41
southwest	7.4615*	PF 1	240	1054.03	1055.69		1055.79	0.001436	2.46	99.3	69.02	0.35
southwest	7.3846*	PF 1	240	1053.85	1055.68		1055.75	0.001033	2.21	110.89	70.96	0.3
southwest	7.3077*	PF 1	240	1053.67	1055.67		1055.73	0.000759	2	123.02	72.89	0.26
southwest	7.2308*	PF 1	240	1053.49	1055.66		1055.71	0.000567	1.82	135.83	74.9	0.23
southwest	7.1538*	PF 1	240	1053.31	1055.65		1055.69	0.000431	1.66	149.16	76.93	0.2
southwest	7.0769*	PF 1	240	1053.13	1055.65		1055.68	0.000334	1.52	162.85	78.97	0.18
southwest		7 PF 1	240	1052.95	1055.64		1055.67	0.000262	1.41	177.09	81.03	0.16
southwest	6.9286*	PF 1	240	1052.79	1055.64		1055.67	0.000214	1.31	189.87	82.77	0.15
southwest	6.8571*	PF 1	240	1052.63	1055.64		1055.66	0.000176	1.23	203.07	84.55	0.14
southwest	6.7857*	PF 1	240	1052.47	1055.64		1055.66	0.000146	1.15	216.54	86.27	0.12
southwest	6.7143*	PF 1	240	1052.32	1055.64		1055.65	0.000123	1.09	229.75	88.03	0.11
southwest	6.6429*	PF 1	240	1052.16	1055.63		1055.65	0.000108	1.02	243.97	92.57	0.11
southwest	6.5714*	PF 1	240	1052	1055.63		1055.65	0.000097	0.95	261.78	101.37	0.1
southwest	6.5000*	PF 1	240	1051.84	1055.63		1055.65	0.000074	0.9	280.55	102.62	0.09
southwest	6.4286*	PF 1	240	1051.68	1055.63		1055.64	0.000059	0.85	298.35	102.88	0.08
southwest	6.3571*	PF 1	240	1051.52	1055.63		1055.64	0.000048	0.82	314.43	102.49	0.08
southwest	6.2857*	PF 1	240	1051.36	1055.63		1055.64	0.000041	0.8	328.06	101.47	0.07
southwest	6.2143*	PF 1	240	1051.21	1055.63		1055.64	0.000037	0.78	338.9	100.1	0.07
southwest	6.1429*	PF 1	240	1051.05	1055.63		1055.64	0.000033	0.77	347.14	98.28	0.06
southwest	6.0714*	PF 1	240	1050.89	1055.63		1055.64	0.000031	0.77	352.81	96.26	0.06
southwest		6 PF 1	240	1050.73	1055.63		1055.64	0.00003	0.78	355.09	93.92	0.06
southwest	5.6000*	PF 1	240	1050.64	1055.62	1051.51	1055.64	0.000035	0.86	283.16	94.66	0.07
southwest		5.2 PF 1	240	1050.54	1055.59	1051.77	1055.63	0.000111	1.53	156.54	95.24	0.12

southwest	5.15		Culvert									
southwest	5.1	PF 1	240	1050	1051.24	1051.24	1051.85	0.012034	6.26	38.34	60.17	0.99
southwest	5	PF 1	240	1049.85	1050.98	1050.77	1051.25	0.006284	4.24	59.33	59.01	0.71
southwest	4.9000*	PF 1	240	1049.71	1050.84		1051.11	0.006176	4.2	59.71	59.29	0.7
southwest	4.8000*	PF 1	240	1049.58	1050.7		1050.97	0.0063	4.2	59.45	59.56	0.7
southwest	4.7000*	PF 1	240	1049.44	1050.56		1050.82	0.006163	4.15	59.95	59.88	0.7
southwest	4.6000*	PF 1	240	1049.31	1050.42		1050.68	0.006255	4.15	59.8	60.19	0.7
southwest	4.5000*	PF 1	240	1049.17	1050.28		1050.54	0.006066	4.09	60.5	60.58	0.69
southwest	4.4000*	PF 1	240	1049.03	1050.16		1050.4	0.005714	3.99	61.78	61.06	0.67
southwest	4.3000*	PF 1	240	1048.9	1050.03		1050.27	0.005445	3.91	62.92	61.62	0.66
southwest	4.2000*	PF 1	240	1048.76	1049.93		1050.15	0.004745	3.73	65.88	62.38	0.61
southwest	4.1000*	PF 1	240	1048.63	1049.85		1050.04	0.004071	3.54	69.37	63.29	0.57
southwest	4	PF 1	240	1048.49	1049.78		1049.95	0.003221	3.28	74.9	64.4	0.51
southwest	3.9333*	PF 1	240	1048.38	1049.73		1049.87	0.002627	3.04	80.59	66.29	0.47
southwest	3.8667*	PF 1	240	1048.27	1049.69		1049.81	0.002095	2.79	87.39	68.4	0.42
southwest	3.8000*	PF 1	240	1048.16	1049.66		1049.76	0.00165	2.56	95.15	70.63	0.38
southwest	3.7333*	PF 1	240	1048.05	1049.64		1049.72	0.001291	2.34	103.82	72.95	0.34
southwest	3.6667*	PF 1	240	1047.94	1049.62		1049.69	0.001008	2.14	113.37	75.38	0.3
southwest	3.6000*	PF 1	240	1047.83	1049.61		1049.67	0.000791	1.96	123.57	77.83	0.27
southwest	3.5333*	PF 1	240	1047.72	1049.6		1049.65	0.000624	1.8	134.42	80.32	0.24
southwest	3.4667*	PF 1	240	1047.61	1049.59		1049.63	0.000496	1.66	145.92	82.87	0.21
southwest	3.4000*	PF 1	240	1047.5	1049.58		1049.62	0.000396	1.53	158.05	85.41	0.19
southwest	3.3333*	PF 1	240	1047.39	1049.58		1049.61	0.00032	1.41	170.69	87.98	0.18
southwest	3.2667*	PF 1	240	1047.28	1049.57		1049.6	0.00026	1.31	183.87	90.57	0.16
southwest	3.2000*	PF 1	240	1047.17	1049.57		1049.59	0.000212	1.22	197.57	93.16	0.14
southwest	3.1333*	PF 1	240	1047.06	1049.57		1049.59	0.000175	1.14	211.88	95.75	0.13
southwest	3.0667*	PF 1	240	1046.95	1049.57		1049.58	0.000145	1.06	226.66	98.37	0.12
southwest	3	PF 1	570	1046.84	1049.47		1049.57	0.000774	2.46	232.65	100.33	0.28
southwest	2.9333*	PF 1	570	1046.75	1049.46		1049.55	0.000691	2.36	242.65	102.54	0.27
southwest	2.8667*	PF 1	570	1046.65	1049.45		1049.53	0.000611	2.26	253.68	104.71	0.25
southwest	2.8000*	PF 1	570	1046.56	1049.44		1049.51	0.000547	2.17	264.32	106.96	0.24
southwest	2.7333*	PF 1	570	1046.46	1049.43		1049.5	0.000486	2.08	275.97	109.22	0.23
southwest	2.6667*	PF 1	570	1046.37	1049.42		1049.49	0.000437	2	286.95	111.42	0.21
southwest	2.6000*	PF 1	570	1046.28	1049.42		1049.47	0.000394	1.92	298.33	113.69	0.2

southwest	2.5333*	PF 1	570	1046.18	1049.41	1049.46	0.000352	1.85	310.79	115.98	0.19
southwest	2.4667*	PF 1	570	1046.09	1049.41	1049.45	0.000318	1.78	322.56	118.21	0.19
southwest	2.4000*	PF 1	570	1045.99	1049.4	1049.45	0.000286	1.71	335.39	120.52	0.18
southwest	2.3333*	PF 1	570	1045.9	1049.4	1049.44	0.00026	1.65	347.88	122.85	0.17
southwest	2.2667*	PF 1	570	1045.81	1049.39	1049.43	0.000237	1.6	360.27	125.1	0.16
southwest	2.2000*	PF 1	570	1045.71	1049.39	1049.43	0.000214	1.54	373.83	127.43	0.15
southwest	2.1333*	PF 1	570	1045.62	1049.39	1049.42	0.000195	1.49	386.94	129.77	0.15
southwest	2.0667*	PF 1	570	1045.52	1049.38	1049.41	0.000178	1.44	400.73	132.06	0.14
southwest	2	PF 1	870	1045.43	1049.33	1049.4	0.000398	2.16	407.83	134.04	0.21
southwest	1.9545*	PF 1	870	1045.34	1049.33	1049.39	0.000366	2.11	418.48	135.25	0.2
southwest	1.9091*	PF 1	870	1045.25	1049.32	1049.38	0.000337	2.06	429.06	136.59	0.2
southwest	1.8636*	PF 1	870	1045.16	1049.31	1049.38	0.000311	2.02	440	138.22	0.19
southwest	1.8182*	PF 1	870	1045.06	1049.31	1049.37	0.000286	1.97	451.69	140	0.18
southwest	1.7727*	PF 1	870	1044.97	1049.3	1049.36	0.000265	1.93	462.83	142.08	0.18
southwest	1.7273*	PF 1	870	1044.88	1049.3	1049.35	0.000246	1.89	474.18	144.53	0.17
southwest	1.6818*	PF 1	870	1044.79	1049.29	1049.35	0.000229	1.85	485.88	147.34	0.17
southwest	1.6364*	PF 1	870	1044.7	1049.29	1049.34	0.000213	1.82	497.83	150.58	0.16
southwest	1.5909*	PF 1	870	1044.61	1049.29	1049.33	0.000198	1.78	510.33	154.2	0.16
southwest	1.5455*	PF 1	870	1044.52	1049.28	1049.33	0.000185	1.75	522.92	158.36	0.15
southwest	1.5000*	PF 1	870	1044.43	1049.28	1049.32	0.000173	1.72	536.63	163.37	0.15
southwest	1.4545*	PF 1	870	1044.33	1049.28	1049.32	0.000161	1.68	551.68	169.22	0.14
southwest	1.4091*	PF 1	870	1044.24	1049.27	1049.32	0.000151	1.65	566.61	176.06	0.14
southwest	1.3636*	PF 1	870	1044.15	1049.27	1049.31	0.000141	1.62	583.15	184.07	0.13
southwest	1.3182*	PF 1	870	1044.06	1049.27	1049.31	0.000132	1.59	600.64	193.4	0.13
southwest	1.2727*	PF 1	870	1043.97	1049.27	1049.3	0.000124	1.56	620.58	204.59	0.13
southwest	1.2273*	PF 1	870	1043.88	1049.27	1049.3	0.000116	1.53	642.47	218.06	0.12
southwest	1.1818*	PF 1	870	1043.79	1049.26	1049.3	0.000108	1.49	667.3	228.63	0.12
southwest	1.1364*	PF 1	870	1043.69	1049.26	1049.29	0.0001	1.45	695.04	237.81	0.11
southwest	1.0909*	PF 1	870	1043.6	1049.26	1049.29	0.000092	1.42	723.33	248.32	0.11
southwest	1.0455*	PF 1	870	1043.51	1049.26	1049.29	0.000086	1.38	754.11	259.53	0.11
southwest	1	PF 1	870	1043.42	1049.26	1049.29	0.000079	1.34	786.9	271.27	0.1
southwest	0.95000*	PF 1	870	1043.29	1049.27	1049.28	0.000032	0.83	1285.58	414.35	0.07
southwest	0.90000*	PF 1	870	1043.16	1049.27	1049.27	0.000015	0.57	1881.25	557.06	0.04
southwest	0.85000*	PF 1	870	1043.03	1049.27	1049.27	0.000008	0.41	2574.77	699.1	0.03

southwest	0.80000*	PF 1	870	1042.9	1049.27		1049.27	0.000004	0.31	3365.4	839.16	0.02
southwest	0.75000*	PF 1	870	1042.77	1049.27		1049.27	0.000002	0.25	4252.25	973.26	0.02
southwest	0.7	PF 1	870	1042.64	1049.27	1045.64	1049.27	0.000001	0.2	5236.59	1107.38	0.01
southwest	0.65		Culvert									
southwest	0.6	PF 1	870	1041.31	1047.43	1045.38	1047.82	0.002399	5.18	176.32	497.59	0.41
southwest	0.59000*	PF 1	870	1041.42	1047.59		1047.62	0.000354	1.94	855.08	516.41	0.16
southwest	0.58000*	PF 1	870	1041.53	1047.58		1047.61	0.000355	1.95	834.89	482.35	0.16
southwest	0.57000*	PF 1	870	1041.64	1047.57		1047.6	0.000363	1.97	804.93	443.61	0.16
southwest	0.56000*	PF 1	870	1041.75	1047.56		1047.59	0.000387	2.03	760.96	400.86	0.17
southwest	0.55000*	PF 1	870	1041.86	1047.54		1047.58	0.000428	2.12	705.26	355.36	0.17
southwest	0.54000*	PF 1	870	1041.98	1047.52		1047.57	0.0005	2.27	635.59	306.72	0.19
southwest	0.53000*	PF 1	870	1042.09	1047.49		1047.55	0.000632	2.51	550.08	254.64	0.21
southwest	0.52000*	PF 1	870	1042.2	1047.44		1047.52	0.000888	2.91	448.84	198.68	0.25
southwest	0.51000*	PF 1	870	1042.31	1047.33		1047.47	0.001536	3.68	327.11	137.53	0.32
southwest	0.5	PF 1	870	1042.42	1046.86	1046.1	1047.32	0.005002	5.94	175.15	70.89	0.57

North Tributary 500 year Profile Summary Table- 6-13-19												
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # C
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
revised	4	PF 1	360	1053	1054.47		1054.76	0.00495	4.32	84.16	64.68	0.65
revised	3.9375*	PF 1	360	1052.88	1054.34		1054.63	0.005045	4.34	83.66	64.62	0.65
revised	3.8750*	PF 1	360	1052.75	1054.22		1054.51	0.004978	4.33	84.01	64.66	0.65
revised	3.8125*	PF 1	360	1052.62	1054.09		1054.38	0.004883	4.3	84.52	64.71	0.64
revised	3.7500*	PF 1	360	1052.5	1053.97		1054.26	0.004942	4.32	84.2	64.68	0.65
revised	3.6875*	PF 1	360	1052.38	1053.84		1054.13	0.005032	4.34	83.73	64.63	0.65
revised	3.6250*	PF 1	360	1052.25	1053.72		1054.01	0.004957	4.32	84.12	64.69	0.65
revised	3.5625*	PF 1	360	1052.12	1053.6		1053.88	0.004854	4.29	84.67	64.72	0.64
revised	3.5000*	PF 1	360	1052	1053.47		1053.76	0.004891	4.3	84.47	64.72	0.64
revised	3.4375*	PF 1	360	1051.88	1053.35		1053.64	0.004944	4.32	84.2	64.71	0.65
revised	3.3750*	PF 1	360	1051.75	1053.23		1053.51	0.004837	4.29	84.78	64.84	0.64
revised	3.3125*	PF 1	360	1051.62	1053.11		1053.39	0.004671	4.24	85.73	65.36	0.63
revised	3.2500*	PF 1	360	1051.5	1053		1053.27	0.004622	4.23	86.04	65.61	0.63
revised	3.1875*	PF 1	360	1051.38	1052.88		1053.16	0.004553	4.21	86.49	65.84	0.62
revised	3.1250*	PF 1	360	1051.25	1052.78		1053.04	0.00429	4.14	88.14	66.04	0.61
revised	3.0625*	PF 1	360	1051.12	1052.68		1052.94	0.003941	4.03	90.53	66.14	0.58
revised	3	PF 1	360	1051	1052.6		1052.84	0.003659	3.94	92.61	65.97	0.56
revised	2.9375*	PF 1	360	1050.88	1052.52		1052.75	0.00333	3.83	95.44	66.42	0.54
revised	2.8750*	PF 1	360	1050.75	1052.46		1052.66	0.002891	3.67	99.84	67.06	0.51
revised	2.8125*	PF 1	360	1050.62	1052.4		1052.59	0.002468	3.5	105.03	67.81	0.47
revised	2.7500*	PF 1	360	1050.5	1052.36		1052.53	0.002132	3.34	110.12	68.57	0.44
revised	2.6875*	PF 1	360	1050.38	1052.32		1052.48	0.001826	3.19	115.79	69.42	0.41
revised	2.6250*	PF 1	360	1050.25	1052.29		1052.43	0.001524	3.02	122.79	70.4	0.38
revised	2.5625*	PF 1	360	1050.12	1052.27		1052.39	0.001271	2.86	130.28	71.43	0.35
revised	2.5000*	PF 1	360	1050	1052.25		1052.36	0.00108	2.72	137.45	72.45	0.33
revised	2.4375*	PF 1	360	1049.88	1052.23		1052.33	0.000919	2.58	144.97	73.5	0.3
revised	2.3750*	PF 1	360	1049.75	1052.21		1052.31	0.000772	2.45	153.58	74.64	0.28
revised	2.3125*	PF 1	360	1049.62	1052.2		1052.29	0.000652	2.32	162.51	75.81	0.26
revised	2.2500*	PF 1	360	1049.5	1052.19		1052.27	0.00056	2.22	170.96	76.94	0.24
revised	2.1875*	PF 1	360	1049.38	1052.19		1052.25	0.000483	2.12	179.64	78.08	0.23
revised	2.1250*	PF 1	360	1049.25	1052.18		1052.24	0.000414	2.02	189.32	79.29	0.21

revised	2.0625*	PF 1	360	1049.12	1052.17		1052.23	0.000356	1.93	199.23	80.5	0.2
revised	2	PF 1	360	1049	1052.17		1052.22	0.000311	1.85	208.59	81.68	0.19
revised	1.8333*	PF 1	360	1048.89	1052.16		1052.21	0.000276	1.78	216.84	82.22	0.18
revised	1.6667*	PF 1	360	1048.77	1052.16		1052.2	0.000245	1.72	225.62	82.81	0.17
revised	1.5000*	PF 1	360	1048.66	1052.16		1052.2	0.000219	1.67	234.09	83.41	0.16
revised	1.3333*	PF 1	360	1048.55	1052.15		1052.19	0.000197	1.62	242.67	84.03	0.15
revised	1.1667*	PF 1	360	1048.43	1052.15		1052.19	0.000177	1.57	251.75	84.69	0.14
revised	1	PF 1	360	1048.32	1052.15		1052.18	0.00016	1.52	260.52	85.34	0.14
revised	0.92500*	PF 1	360	1048.21	1052.15		1052.18	0.000144	1.47	269.85	86.32	0.13
revised	0.85000*	PF 1	360	1048.1	1052.15		1052.18	0.000131	1.43	279.28	87.3	0.13
revised	0.77500*	PF 1	360	1047.99	1052.14	1049.12	1052.17	0.000125	1.42	262.26	88.26	0.12
revised	0.7	PF 1	360	1047.88	1052.08	1049.25	1052.16	0.00029	2.2	163.85	88.69	0.19
revised	0.5		Culvert									
revised	0.25	PF 1	360	1047.36	1049.51	1048.73	1049.8	0.002716	4.3	83.77	70.21	0.52
revised	0.2	PF 1	360	1047.3	1049.58	1048.42	1049.69	0.001031	2.72	139.09	71.4	0.32