DETROIT EDISON OFFSITE MITIGATION AREA

HYDROLOGY REPORT

July 2012

TETRA TECH

200-01278-11007

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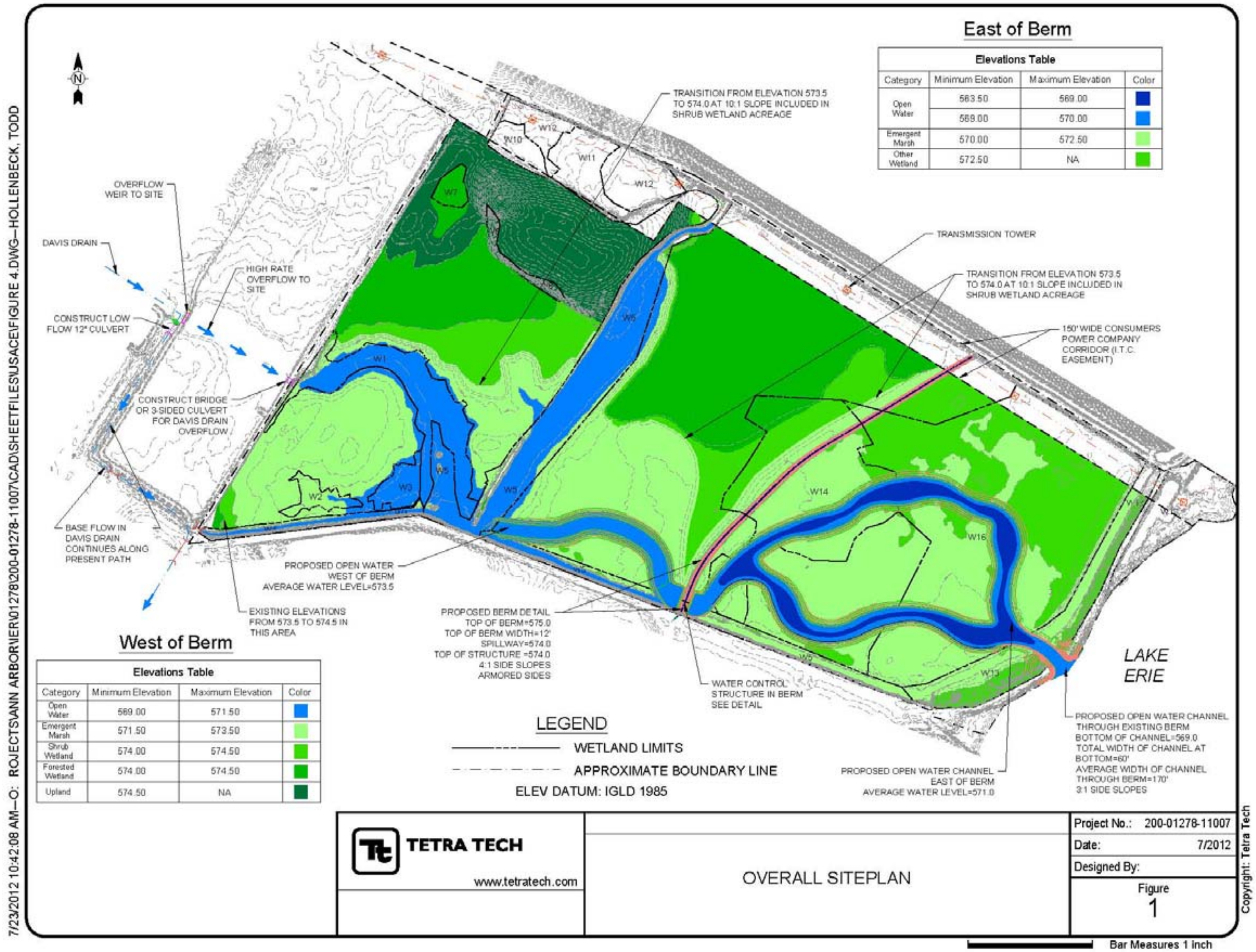
SECTION 1
INTRODUCTION

Detroit Edison has proposed a mitigation strategy to compensate for proposed impacts to aquatic resources associated with construction of Fermi 3 at the Enrico Fermi Atomic Power Plant. The proposed offsite mitigation area, referred to as the Monroe site, is east of Interstate 75, north of La Plaisance Creek, and immediately adjacent to Lake Erie. The Monroe site is owned and managed by Detroit Edison as part of the Monroe Power Plant. The proposed mitigation wetland would be constructed using an approximately 173-acre agricultural field. This area will be restored to two separate but hydrologically connected wetland units as shown on **Figure 1**. The eastern unit will be directly connected to Lake Erie and water levels in this unit will fluctuate with Lake Erie water levels. The western unit will be partially connected to Lake Erie. A low berm will be constructed between the eastern and western units. This berm will be constructed to an elevation that will help to ensure successful restoration of proposed habitat types and acreages in the western unit. A spillway will be constructed in the berm to allow excess water to spill over and enter the eastern unit waterway and eventually flow into Lake Erie.

Located to the west and adjacent to the mitigation site is a U.S. Fish and Wildlife Service (USFWS) conservation area. The combined area of the mitigation site and conservation area is approximately 210 acres. Along this conservation area lies a small, shallow ditch that supplies water for the USFWS wetland. Site topography suggests this ditch may have originally traversed the Monroe site and had its own outlet to Lake Erie but was rerouted around the Detroit Edison property. This ditch is named the Davis Drain and falls under the jurisdiction of the Monroe County Drain Commissioner. Drain Commissioner records show the drainage district consists of 641 acres at the Drain's outlet to La Plaisance Creek immediately south of the Monroe site. The watershed is very flat making defining this watershed's size difficult from USGS 5-foot contour maps. **Figure 2** depicts the drain location, approximate watershed area, and proposed mitigation area. Detroit Edison proposes to reroute flow from Davis Drain into the western unit. This design feature will increase water flow into the wetland and also slow floodwater and reduce sediment loading and pollutants from runoff water before it reaches Lake Erie.

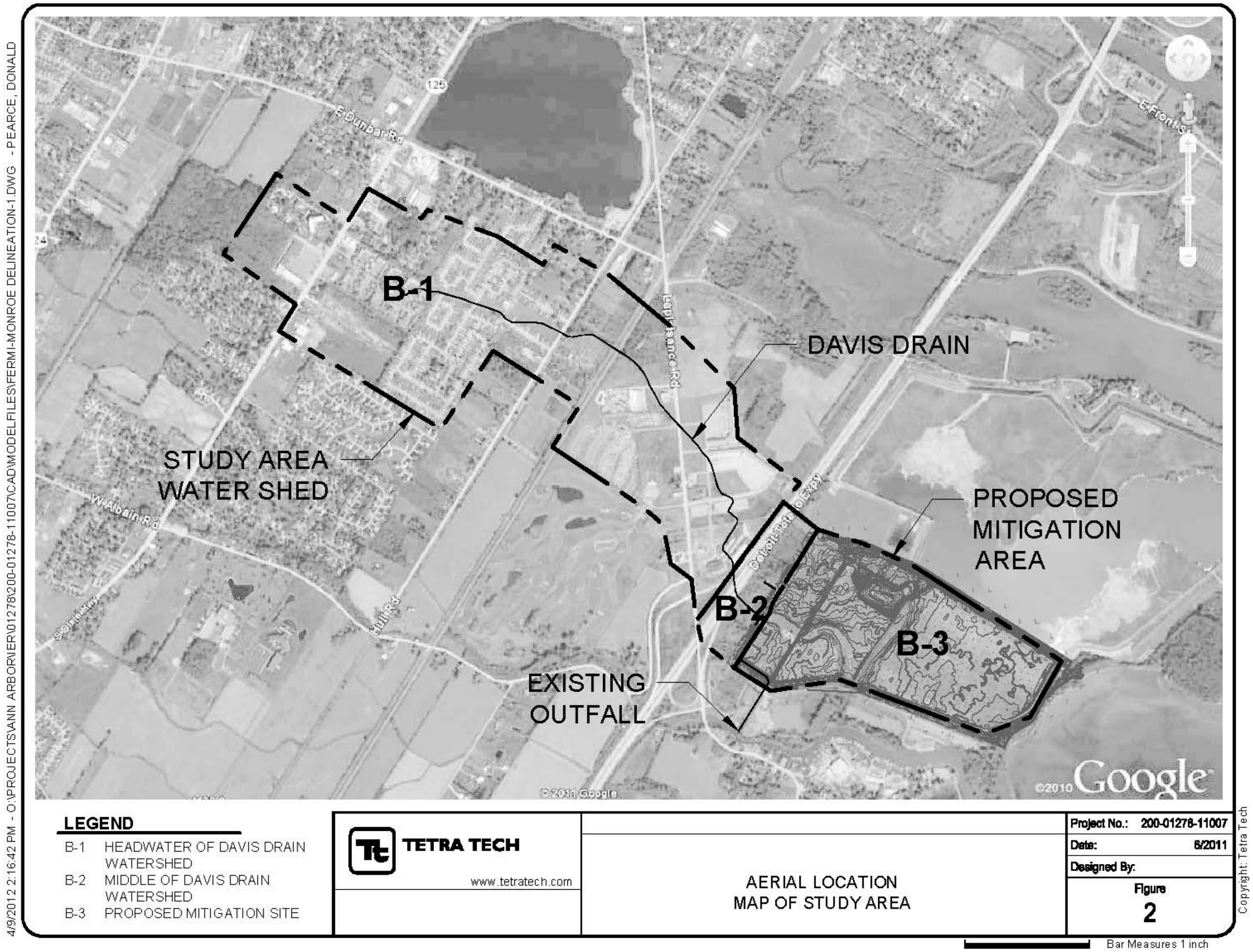


East of Berm — Elevations Table

Category	Minimum Elevation	Maximum Elevation	Color
Open Water	563.50	569.00	
	569.00	570.00	
Emergent Marsh	570.00	572.50	
Other Wetland	572.50	NA	

West of Berm — Elevations Table

Category	Minimum Elevation	Maximum Elevation	Color
Open Water	569.00	571.50	
Emergent Marsh	571.50	573.50	
Shrub Wetland	574.00	574.50	
Forested Wetland	574.00	574.50	
Upland	574.50	NA	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B-1
B-2
B-3
DAVIS DRAIN
STUDY AREA
WATER SHED
PROPOSED
MITIGATION
AREA
EXISTING
OUTFALL
Google
LEGEND
B-1 HEADWATER OF DAVIS DRAIN WATERSHED
B-2 MIDDLE OF DAVIS DRAIN WATERSHED
B-3 PROPOSED MITIGATION SITE
TETRA TECH
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AERIAL LOCATION
MAP OF STUDY AREA
Project No.: 200-01278-11007
Date: 6/2011
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Figure
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This report summarizes hydrologic parameters, including estimates of peak flows and average rainfall volume, of the Davis Drain that affect the design of the mitigation wetland. The report also completes water balance calculations for the proposed wetland so its sustainability can be better understood.

SECTION 2
EXISTING CONDITIONS AND STUDY AREA

2.1 EXISTING STUDY AREA

The Monroe site is approximately 210 acres located on Lake Erie. The study area includes the watershed that drains to that property. This report utilizes aerial photography, National Cooperative Soil Survey Soil Maps, as-built drawings for I-75, USGS 5-foot Quadrangle Maps, Monroe County Drain Commissioner records, and field surveys to run hydraulic/hydrologic models to estimate the existing peak flows and average annual volumes. **Figure 2** illustrates the limits of the study.

The Monroe site receives runoff from the Davis Drain watershed. The Davis Drain watershed is 641 acres according to Drain Commissioner records. The watershed is approximately 0.92 square miles, or 584 acres, in size at the western edge of the Monroe site. (Subareas B-1 and B-2) The drain is conveyed under I-75 via a 48-inch culvert as shown in the as-built drawings in **Appendix A**.

2.1.1 Location

The Monroe site is located at the intersection of I-75 and La Plaisance Road approximately 36 miles south of Detroit, Michigan and 17 miles north of Toledo, Ohio. **Figure 3** represents the survey of the Monroe site.

2.1.2 Topography

General land contours were obtained from the USGS Monroe Quadrangle Map and are shown on **Figure 4**. The contours depict Davis Drain, the general slope, and low-lying areas. The topography of the study area is very flat. In general, the elevations of the watershed vary from 600 to 580. The drainage area is difficult to determine due to development and the flat topography. The drainage area depicted in **Figure 4** was compiled in part from the Monroe County Drain Commissioner records.


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SURVEY OF PROPOSED
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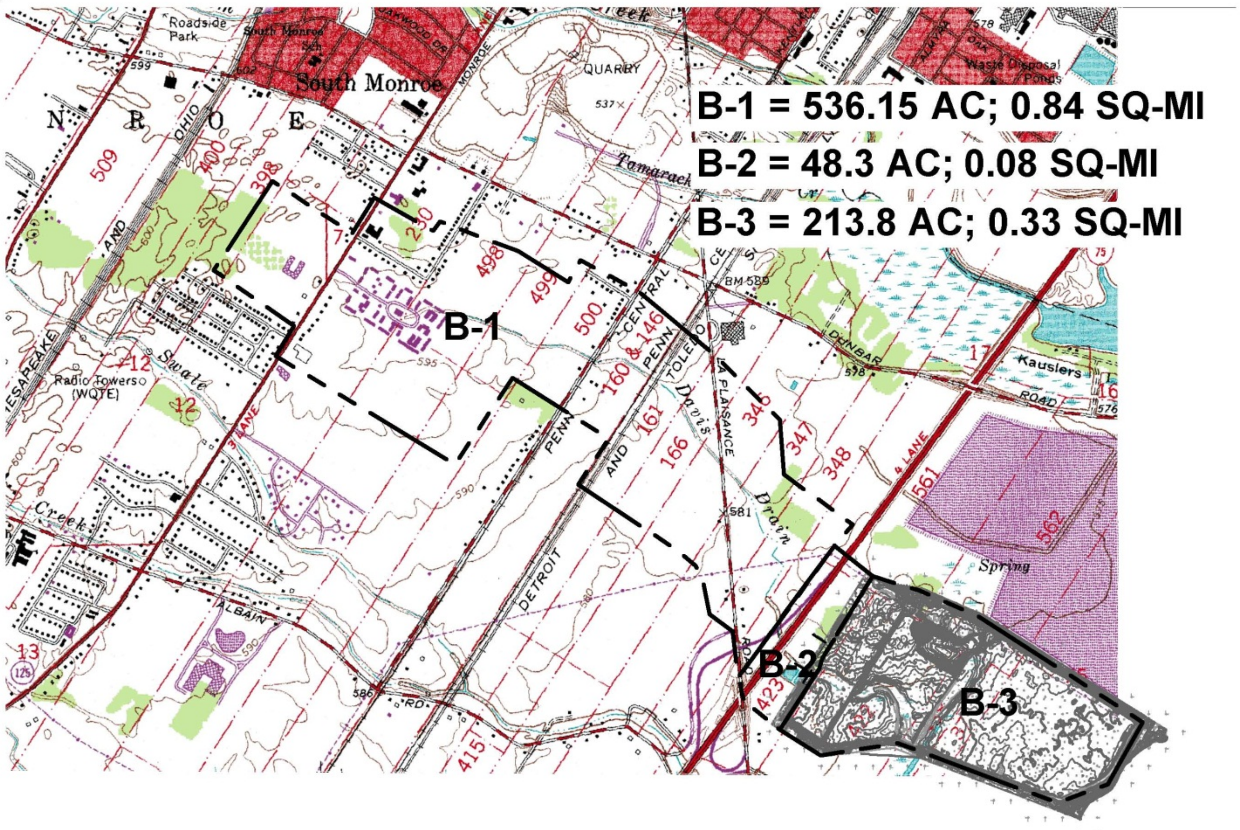

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LEGEND

B-1 HEADWATER OF DAVIS DRAIN WATERSHED
B-2 MIDDLE OF DAVIS DRAIN WATERSHED
B-3 PROPOSED MITIGATION SITE

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USGS CONTOUR MAP

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The datum referenced in the USGS Quadrangle Map is the National Geodetic Vertical Datum of 1929 (NGVD 29).

2.1.3 Land Use

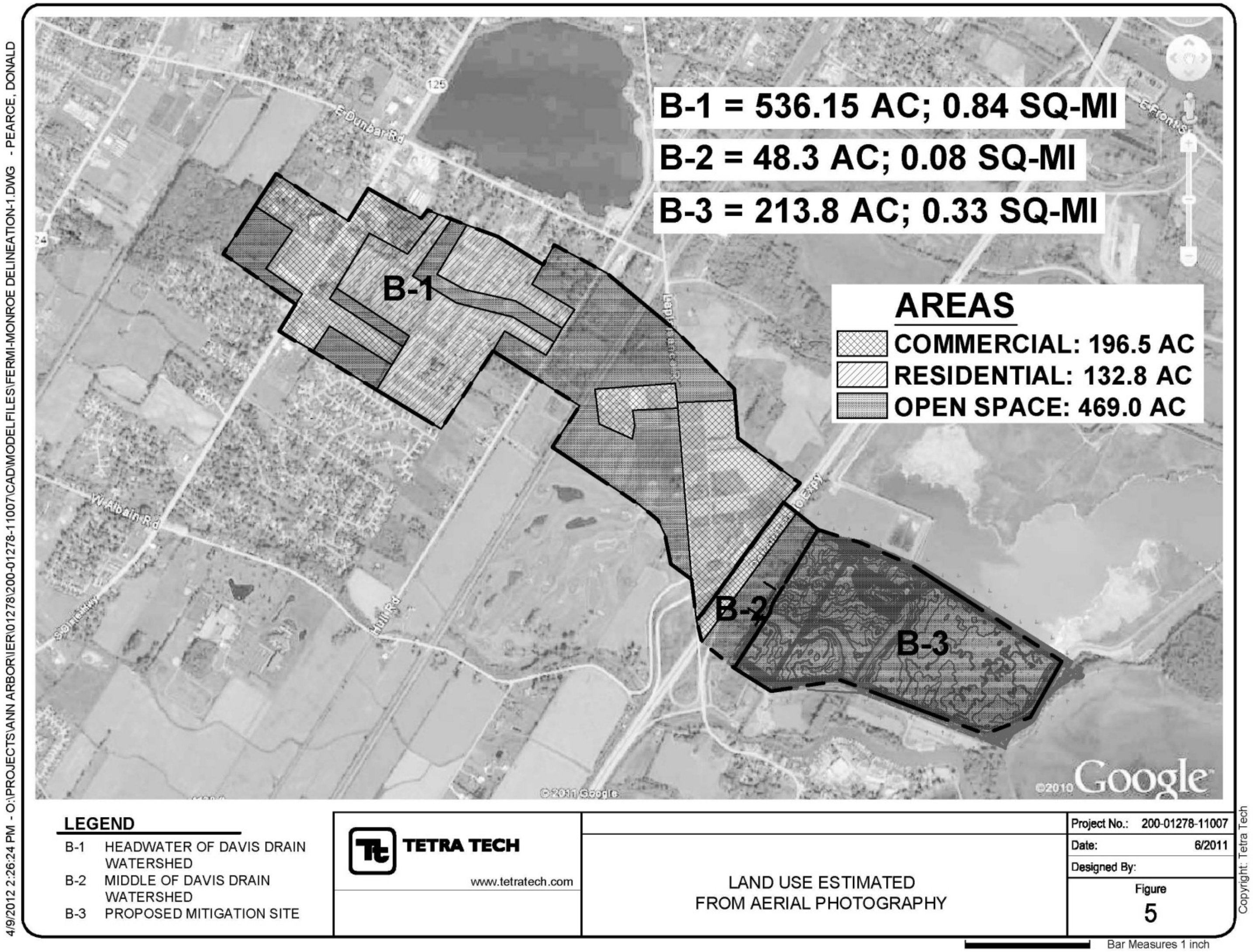
The existing land uses in the study area are approximated from aerial photography and are shown on **Figure 5**. The study area is a combination of residential, commercial and open space.

2.1.4 Soils

The soils within the watershed are grouped into hydrologic soil groups based on runoff potential. Group A soils have a high infiltration rate, Group B soils have a moderate infiltration rate, Group C soils have a slow infiltration rate, and Group D soils have a very slow infiltration rate. The study area is comprised of B, B/D, C, and C/D soil groups. Approximately 51% is Lenawee silty clay loam, B/D, and 25% is Blount loam, C. These soils can expect moderate to low infiltration rates into the soil during a storm event. The summary of soil types is shown in **Appendix B**.

2.1.5 Rainfall

A design storm is a one that is equaled or exceeded, on average, once in a prescribed duration of time. Thus, a 10-year storm is equaled or exceeded, on average, once every 10 years. The design storm can also be expressed as a probability of occurring in any one year. Therefore, a 2-year storm has a 50 percent probability of being equaled or exceeded in a given year and a 5-year storm has a 20 percent probability. A summary of design rainfalls for this area is included as **Table 2.1** and is derived from *Rainfall Frequency Atlas of the Midwest* (Huff and Angel 1992).


B-1 = 536.15 AC; 0.84 SQ-MI
B-2 = 48.3 AC; 0.08 SQ-MI
B-3 = 213.8 AC; 0.33 SQ-MI
AREAS
COMMERCIAL: 196.5 AC
RESIDENTIAL: 132.8 AC
OPEN SPACE: 469.0 AC
B-1
B-2
B-3
E Dunbar Rd
W Albain Rd
Hull Rd
E Front St
©2010 Google
LEGEND
B-1 HEADWATER OF DAVIS DRAIN WATERSHED
B-2 MIDDLE OF DAVIS DRAIN WATERSHED
B-3 PROPOSED MITIGATION SITE
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LAND USE ESTIMATED FROM AERIAL PHOTOGRAPHY
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Table 2.1 Rainfall Depth for Design Storm Event

Storm Event	Rainfall (in)
2-year/24-hour	2.26
5-year/24-hour	2.75
10-year/24-hour	3.13
25-year/24-hour	3.60
50-year/24-hour	3.98
100-year/24-hour	4.36

These large storms are not directly relevant for the long-term conditions most relevant for a water balance calculation. However, they are useful for estimating peak flows needed to size design features.

Hydrology can also be estimated for a continuous period of time using historical records. The closest rain gauge with continuous rainfall monitoring is located at Detroit Metropolitan Airport. A 47-year rainfall period of record, from 1959 through 2006, was used to estimate the volume of runoff that should be anticipated within the study area for average conditions.

SECTION 3.0
HYDROLOGIC AND HYDRAULIC MODELING

3.1 OVERVIEW

Tetra Tech developed two models for the study area. The first Hydrologic and Hydraulic (H&H) model is created with the MWH Soft InfoSWMM 10.0 program to estimate the average annual volume that could potentially enter the proposed mitigation site. This model utilizes the EPA runoff method to develop rainfall runoff for the drainage subbasins which is then routed through the model components to estimate the volume. The second model, used to estimate runoff generated from the wetland itself, will be discussed in Section 4.0.

3.2 InfoSWMM 10.0 Model Methodology

The InfoSWMM 10.0 H&H model was used in the analysis. This model was derived from EPA's SWMM (Stormwater Management Model) Version 5.0.22. InfoSWMM utilizes a dynamic wave solution to simulate runoff and flow routing through the system during a rainfall event. The model simulates such things as infiltration, runoff, hydraulic grade lines, pipe storage, weirs, pump stations, tidal fluctuations, and drainage wells. InfoSWMM is a powerful modeling platform that works within Arc-GIS allowing simplified editing and the ability to present illustrative results.

A model was developed by manually compiling data. The subcatchments were delineated from the USGS topography and a total of three subcatchments were delineated, as shown on **Figure 2**. The culvert information was gathered from the historic construction drawings of I-75, as shown in **Appendix A**. More detailed field survey was conducted of the proposed mitigation site and is shown on **Figure 3**.

Each of the subcatchments estimates runoff using the overland flow method. This method describes the tendency of water to flow across land surfaces when rainfall has exceeded the infiltration capacity into the upper zone of the pervious area; impervious areas do not infiltrate. Impervious and pervious areas used in the model were chosen from typical values for land uses estimated from aerial photography. Assumed land uses are shown on **Figure 5.** Impervious areas include driveways, streets, parking areas, and roofs that are directly connected to the storm sewer system. Pervious areas

include lawns, parks, and other grassy or wooded areas. Other watershed data used in the model include ground slope and the shape (width) of subcatchment areas. Slope and width were estimated from the USGS topography based on the specific characteristics of each individual subcatchment. Each subcatchment has a discharge outlet point for the rainfall excess, or runoff, not infiltrated into the soil. In the model these discharge outlet points are represented as nodes. The model does not account for any existing stormwater detention facilities.

The purpose of this model is to assess the runoff, flows, storage, and hydraulic data within the Davis Drain watershed.

3.2.1 Physical Features

The input parameters for the system include subcatchments that represent B-1 and B-2 drainage basins, which discharge through a downstream area that represents B-3 (see **Figure 5** for locations and details of the drainage areas). The Davis Drain drainage area at the edge of the Monroe site is approximately 584 acres of predominantly residential and open space land use. The model includes a rain gauge with approximately 47 years of historic rainfall (1959-2006) collected from the Detroit Metro Airport rain gauge. A continuous simulation was run for the entire 47 years of record. In addition the 2-, 5-, 10-, 25-, 50-, and 100-year, 24-hour discrete design storm events were run. A summary of the results is presented in **Tables 3.1 and 3.2**.

3.2.2 Model Results and Flows Defined by Model for Design Storms

The model provides peak discharges for the Davis Drain watershed upstream of the proposed mitigation site at the western boundary of the adjacent conservation area. These values aid in the design of overflow weirs into and out of the site. For values of peak flows and total runoff volume refer to **Table 3.1**.

Table 3.1

Design Storm Peak Flow in Davis Drain

Design Storm	Peak Flow (cfs)	Volume (ft^3)
2-year/24-hour	90	1,575,000
5-year/24-hour	120	1,937,000
10-year/24-hour	145	2,223,000
25-year/24-hour	175	2,589,000
50-year/24-hour	200	2,891,000
100-year/24-hour	230	3,193,000

3.3.3 Model Results and Flows Defined by Model for Continuous Simulation

The continuous simulation model calculated flow volumes for the Davis Drain watershed using rainfall from a period of record from 1959 through 2006. The results are tabulated for the Davis Drain watershed upstream of the proposed mitigation site at the western edge of the adjacent conservation area and are presented in **Table 3.2**.

Table 3.2

Continuous Simulation Statistics for Davis Drain

Month	Minimum (ft^3)	Maximum (ft^3)	Average (ft^3)
January	138,000	2,767,000	1,312,000
February	122,000	3,513,000	1,228,000
March	368,000	3,073,000	1,616,000
April	426,000	3,701,000	2,059,000
May	616,000	5,708,000	2,152,000
June	642,000	4,993,000	2,440,000
July	444,000	4,282,000	2,192,000
August	97,000	5,501,000	2,262,000
September	294,000	5,207,000	1,960,000
October	89,000	4,346,000	1,538,000
November	560,000	4,110,000	1,803,000
December	293,000	4,173,000	1,705,000
		Total	**22,267,000**

The proposed concept of interconnecting the Davis Drain to the wetland involves allowing a small base flow to continue to Lake Erie and the larger storm overflow to the wetland. This is based on allowing a 12-inch culvert to convey base flow to Lake Erie and flow depths above approximately 2 feet of depth to overflow into the proposed wetland. Because most storms are small, the majority of the annual volume will continue to flow to Lake Erie. **Table 3.3** shows model output for that scenario.

Table 3.3

Davis Drain Runoff Volumes Diverted to the Proposed Wetland

Month	Min (ft^3)	Max (ft^3)	Average (ft^3)	Average (ac-ft)
January	5,000	475,000	178,000	4.1
February	5,000	1,074,000	228,000	5.2
March	18,000	744,000	210,000	4.8
April	1,000	1,429,000	362,000	8.3
May	10,000	1,986,000	486,000	11.2
June	26,000	2,385,000	771,000	17.7
July	100	2,358,000	701,000	16.1
August	17,000	2,721,000	745,000	17.1
September	2,000	2,156,000	573,000	13.2
October	1,000	1,275,000	354,000	8.1
November	2,000	1,151,000	290,000	6.7
December	1,000	2,149,000	253,000	5.8

SECTION 4.0
ONSITE HYDROLOGY OF PROPOSED WETLAND MITIGATION SITE

4.1 OVERVIEW

Tetra Tech developed two models for the study area. The second Hydrologic and Hydraulic (H&H) model is also created with the MWH Soft InfoSWMM 10.0 program to estimate the average annual volume, and the peak flows during the design storms, that fall directly on the proposed mitigation site. This model utilizes the EPA runoff method to develop rainfall runoff volume and flow rates for the drainage subbasins.

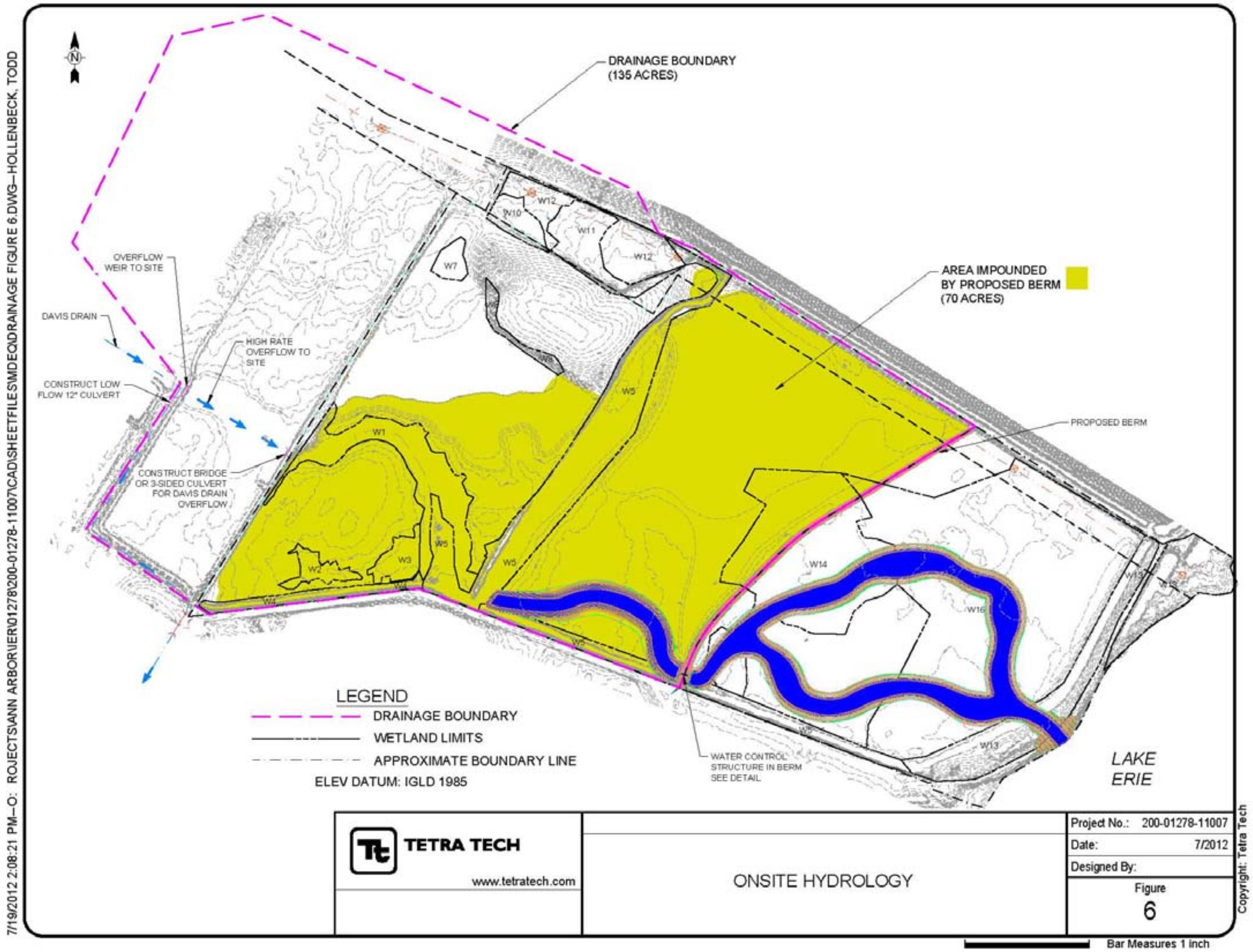
The proposed mitigation site plan is shown on **Figures 1** and **6**. The eastern unit will be under the influence of Lake Erie. The long term monthly mean water levels for Lake Erie are shown in **Figure 7**. The western unit will have stormwater impounded by a constructed berm bisecting the site. The analysis in Section 4 will consider the hydrology of the western unit.

4.2 Physical Features

The input parameters for the system are the 65 acres directly contributing to the impoundment created by the proposed berm (see **Figure 6** for locations and details of the drainage areas).

4.3 Model Results and Flows Defined by Model for Continuous Simulation

The continuous simulation model calculated flow volumes for the 65 acres tributary to the 70 acre proposed impoundment. The results are tabulated and are presented in **Table 4.1**.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(135 ACRES)
AREA IMPOUNDED
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HIGH RATE
OVERFLOW TO
SITE
CONSTRUCT LOW
FLOW 12" CULVERT
CONSTRUCT BRIDGE
OR 3-SIDED CULVERT
FOR DAVIS DRAIN
OVERFLOW
PROPOSED BERM
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APPROXIMATE BOUNDARY LINE
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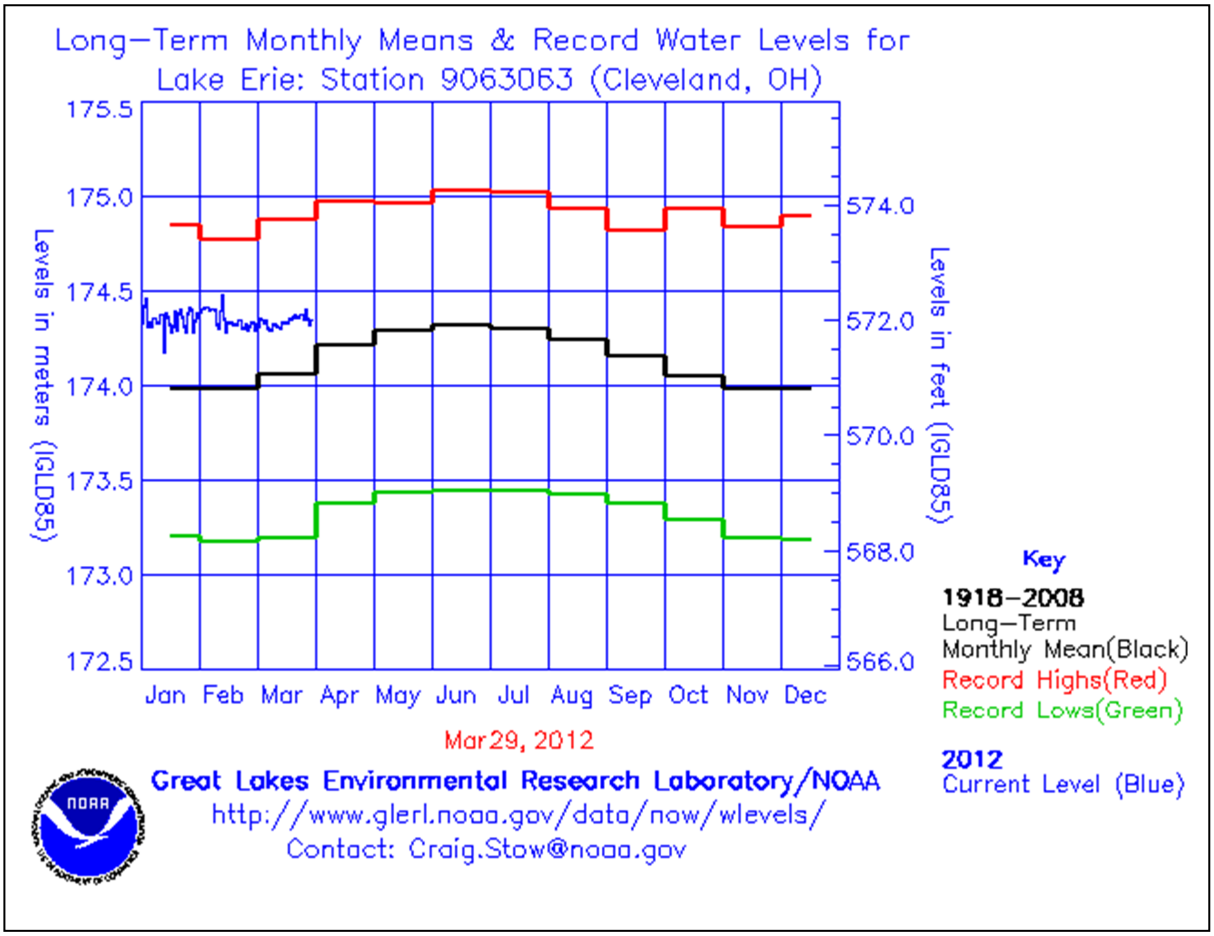

Figure 7. Long Term Lake Erie Water Levels

Table 4.1

Site Runoff

Month	Average (ft^3)	Average (ac-ft)	Month	Average (ft^3)	Average (ac-ft)
January	43,000	1.0	August	185,000	4.2
February	54,000	1.2	September	140,000	3.2
March	52,000	1.2	October	83,000	1.9
April	88,000	2.0	November	70,000	1.6
May	126,000	2.9	December	72,000	1.6
June	194,000	4.4			
July	184,000	4.2	**Total**	**1,291,000**	**29.4**

SECTION 5
WATER BUDGET

5.1 Overview

With the hydrology of the Davis Drain and site watersheds characterized, a water budget for the constructed wetland can be calculated. The calculations assume an impoundment of approximately 70 acres will be created in the western unit behind the proposed berm. The average depth of this impoundment is approximately 2 feet and the storage approximately 140 acre-ft.

5.2 Water Budget Methodology

The water budget was prepared following the guidelines in the Michigan Department of Transportation Drainage Manual (MDOT 2006) and MDEQ "General Guidelines for Calculating a Water Budget" (MDEQ 2010).

Input factors are described below and calculations are summarized in Appendix C:

Precipitation – Based on the monthly average precipitation falling on the 70 acre impoundment.

Infiltration – Soil borings taken onsite were shown to have uniform classifications of clay. Two of these borings were analyzed in the laboratory for hydraulic conductivity. The tests confirmed that a negligible amount of infiltration will be expected from the site. See Appendix D for the laboratory test results.

Site Runoff – Based on results of SWMM.

Davis Drain Overflow – Based on results of SWMM.

Potential Evapotranspiration (PET) – Based on calculations described in Appendix C.

Ground Water Flow – Piezometer readings show the groundwater below the ground elevations. Given the impervious clay on the site, there is not expected to be any gain or loss of water to groundwater flow. This is assumed to be negligible for the water balance calculation.

Table 5.1 demonstrates the composite input into the wetland with the Davis Drain overflow included.

Table 5.1

Calculation of Hydrology Input for Average Year

Month	Davis Drain Overflow (ac-ft)[a]	Site Runoff (ac-ft)[b]	Precipitation (ac-ft)[c]	Total Input (ac-ft)
January	4.1	1.0	12.4	17.5
February	5.2	1.2	10.9	17.3
March	4.8	1.2	13.8	19.8
April	8.3	2.0	18.7	29.0
May	11.2	2.9	20.7	34.8
June	17.7	4.4	18.7	40.8
July	16.1	4.2	20.3	40.6
August	17.1	4.2	22.1	43.4
September	13.2	3.2	16.9	33.3
October	8.1	1.9	15.5	25.5
November	6.7	1.6	17.8	26.1
December	5.8	1.6	15.2	22.6

a. From Table 3.3.
b. From Table 4.1.
c. From Table C.3 in Appendix C.

5.3 Results

5.3.1 Hydrology with Davis Drain Overflow

Table 5.2 is the water balance with this scenario for an average year. The inflows to the western unit of the site greatly exceed the outflows. In this calculation, the wetland will begin to overflow to the eastern unit in the tenth month. In each month, inflows exceed outflows, so the wetland will be stable during the typical year.

Table 5.2

Water Budget for Average Year with Davis Drain Overflow

Month	Input (ac-ft)[a]	Inflow Depth (ft)[b]	PET (ft)[c]	Ground Water Loss (ft)	Wetland Depth (ft)[d]	Total Storage (ac-ft)	Overflow to Lake (ac-ft)
January	17.5	0.25	0	0	0.25	17.5	0
February	17.3	0.25	0	0	0.50	34.9	0
March	19.8	0.28	0.02	0	0.76	52.9	0
April	29.0	0.41	0.1	0	1.0	72.9	0
May	34.8	0.50	0.3	0	1.3	88.5	0
June	40.8	0.58	0.4	0	1.4	99.6	0
July	40.6	0.58	0.5	0	1.5	106.9	0
August	43.4	0.62	0.4	0	1.7	121.1	0
September	33.3	0.48	0.3	0	1.9	134.5	0
October	25.5	0.36	0.1	0	2.0	140	10.0
November	26.1	0.37	0.05	0	2.0	140	22.9
December	22.6	0.32	0	0	2.0	140	22.6

a. Total input from Table 5.1.
b. Inflow depth estimated for 70-acre impoundment.
c. PET from Table C.2 in Appendix C.
d. Wetland depth = Inflow depth – PET – GW.

Note: Inflows always exceed outflows.

5.3.2 Hydrology with Site Only

Table 5.3 is the water balance with this scenario for an average year. Table 5.3 shows that while inflows have decreased without Davis Drain input, the inflows still exceed outflows over the course of the average year. Under this scenario, it will be the second year until the wetland completely fills. However, the wetland will have inflows meeting outflows in summer months. In winter months, inflows will exceed outflows (with the excess spilling to the eastern unit of the mitigation wetland next to Lake Erie).

Table 5.3

Water Budget for Average Year for Wetland Site Only

Month	Input (ac-ft)[a]	Inflow Depth (ft)[b]	PET (ft)[c]	Ground Water Loss (ft)	Wetland Depth (ft)[d]	Total Storage (ac-ft)	Overflow to Lake (ac-ft)
Jan	13.4	0.19	0	0	0.19	13.4	0
Feb	12.1	0.17	0	0	0.37	25.6	0
Mar	15.0	0.21	0.02	0	0.55	38.8	0
Apr	20.7	0.30	0.1	0	0.72	50.5	0
May	23.6	0.34	0.3	0	0.78	54.9	0
Jun	23.1	0.33	0.4	0	0.69	48.3	0
Jul	24.5	0.35	0.5	0	0.56	39.5	0
Aug	26.3	0.38	0.4	0	0.52	36.6	0
Sep	20.1	0.29	0.3	0	0.53	36.8	0
Oct	17.4	0.25	0.1	0	0.63	44.2	0
Nov	19.4	0.28	0.05	0	0.86	60.4	0
Dec	16.8	0.24	0	0	1.10	77.2	0

a. Input equal to sum of Site Runoff and Precipitation from Table 5.1.
b. Inflow depth estimated for 70-acre impoundment.
c. PET from Table C.2 in Appendix C.
d. Wetland depth = Inflow depth – PET – GW.

Note: Inflow for year exceeds outflows. Wetland fills in second year.

SECTION 6
CONCLUSIONS

We conclude that the constructed wetland will have a stable hydrology to support a permanent pool behind the proposed berm. The Davis Drain overflow is desired and will ensure that there are fewer fluctuations in water levels from droughts. The proposed wetland will also serve to remove sediments and improve water quality of the Davis Drain before it enters Lake Erie. The calculations also demonstrate that the wetland will have ample inflows to maintain a stable elevation even without the Davis Drain contribution.

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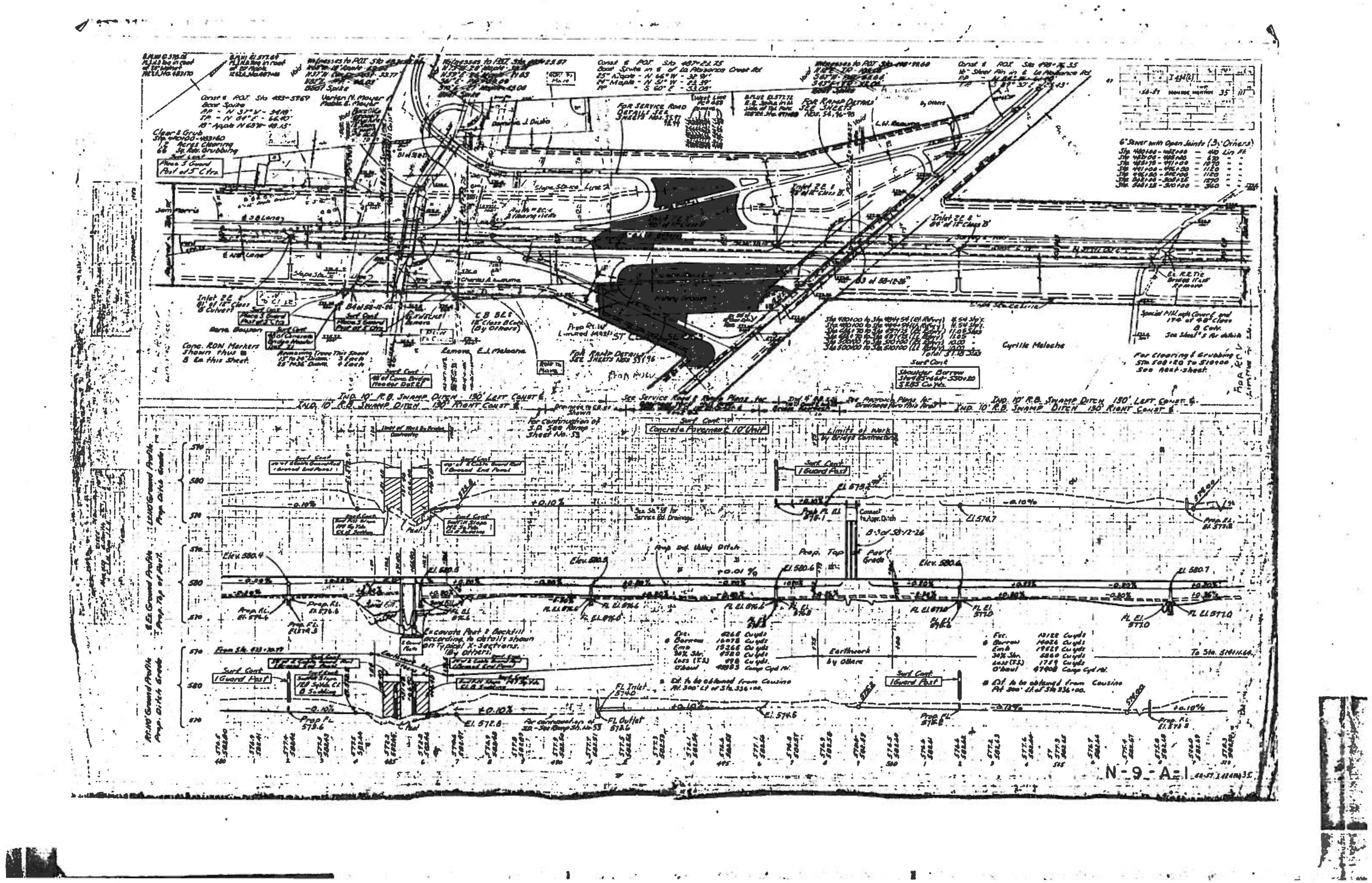
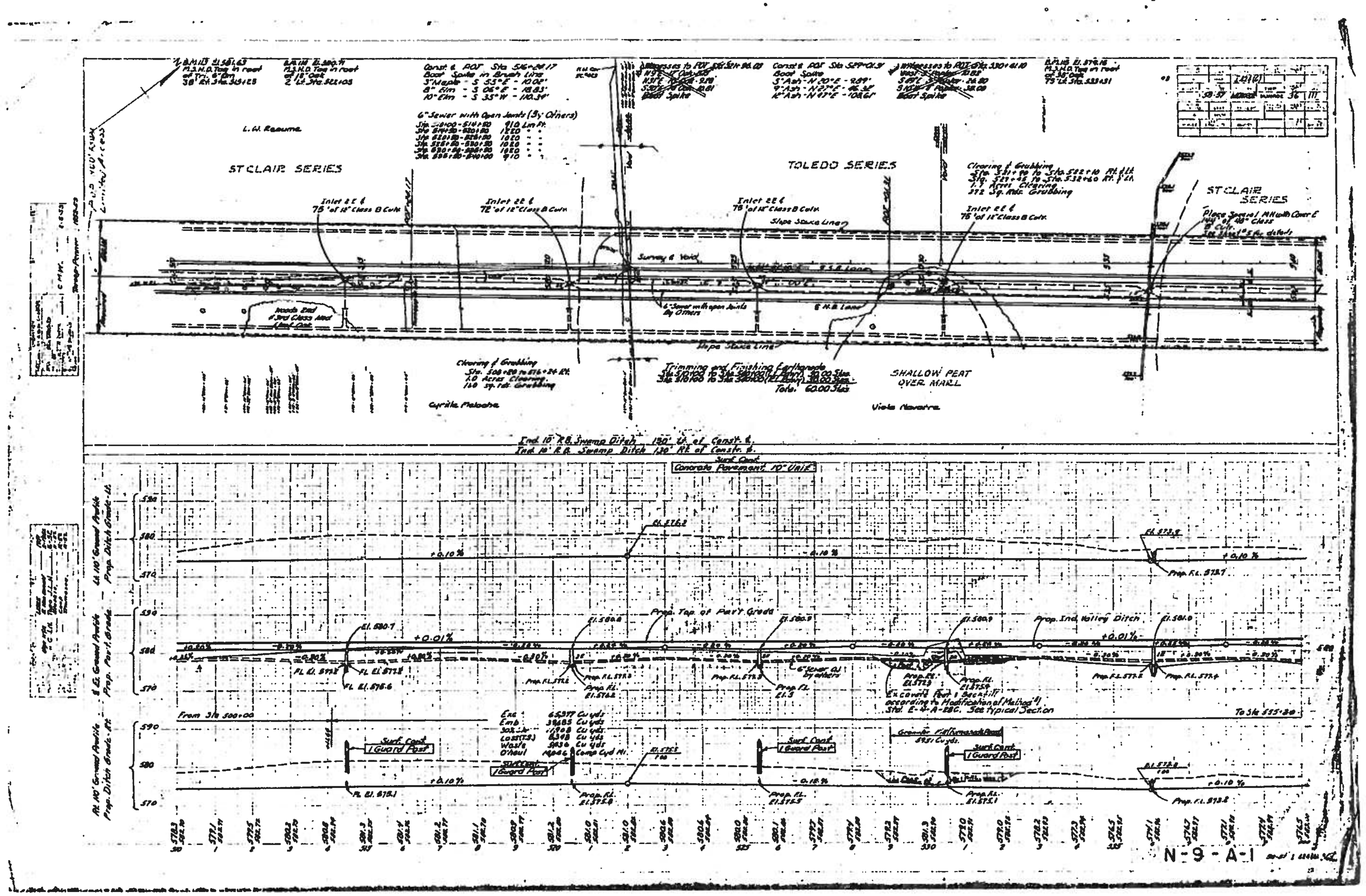
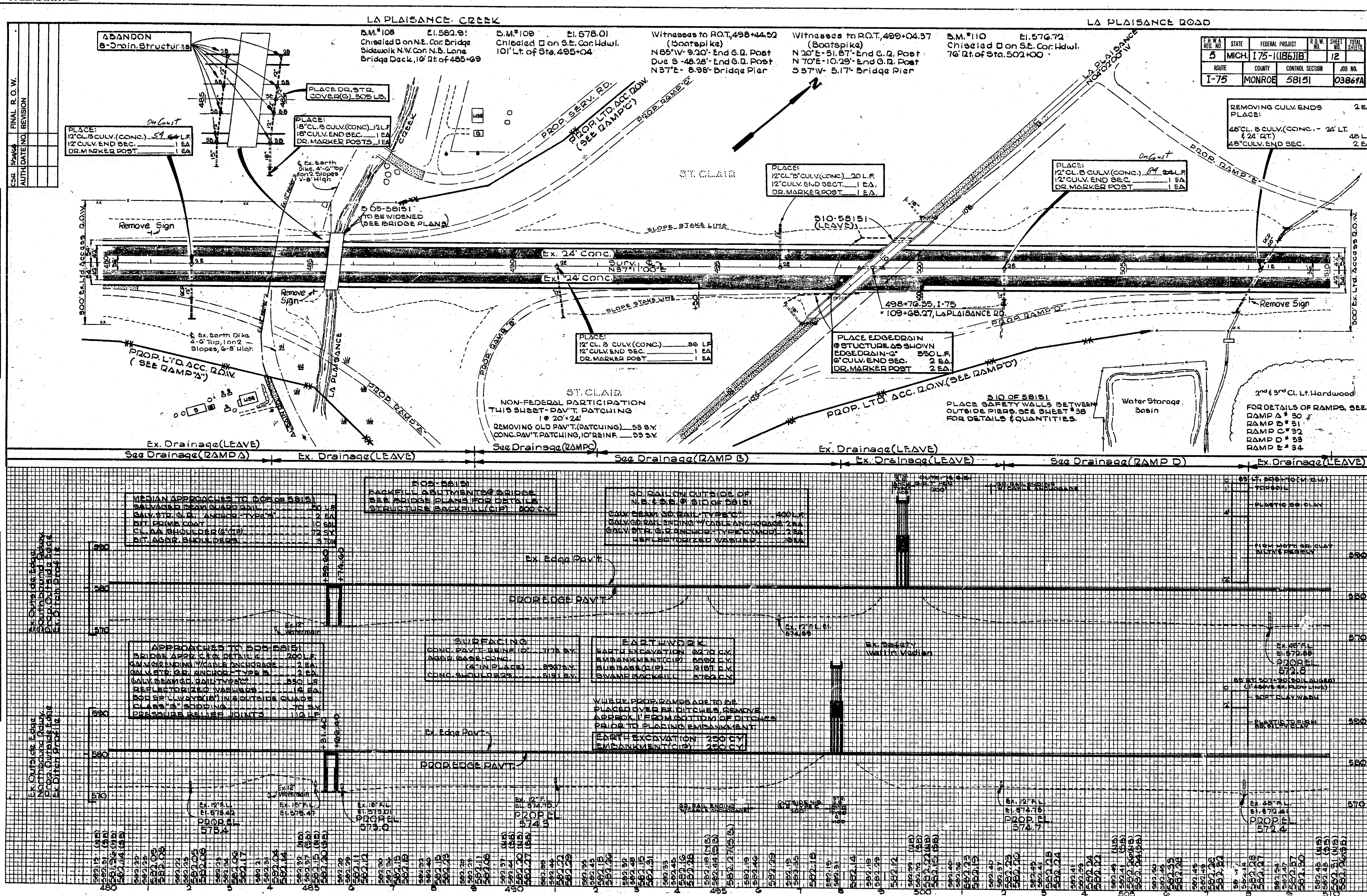
APPENDIX A
I-75 As-Built Drawings

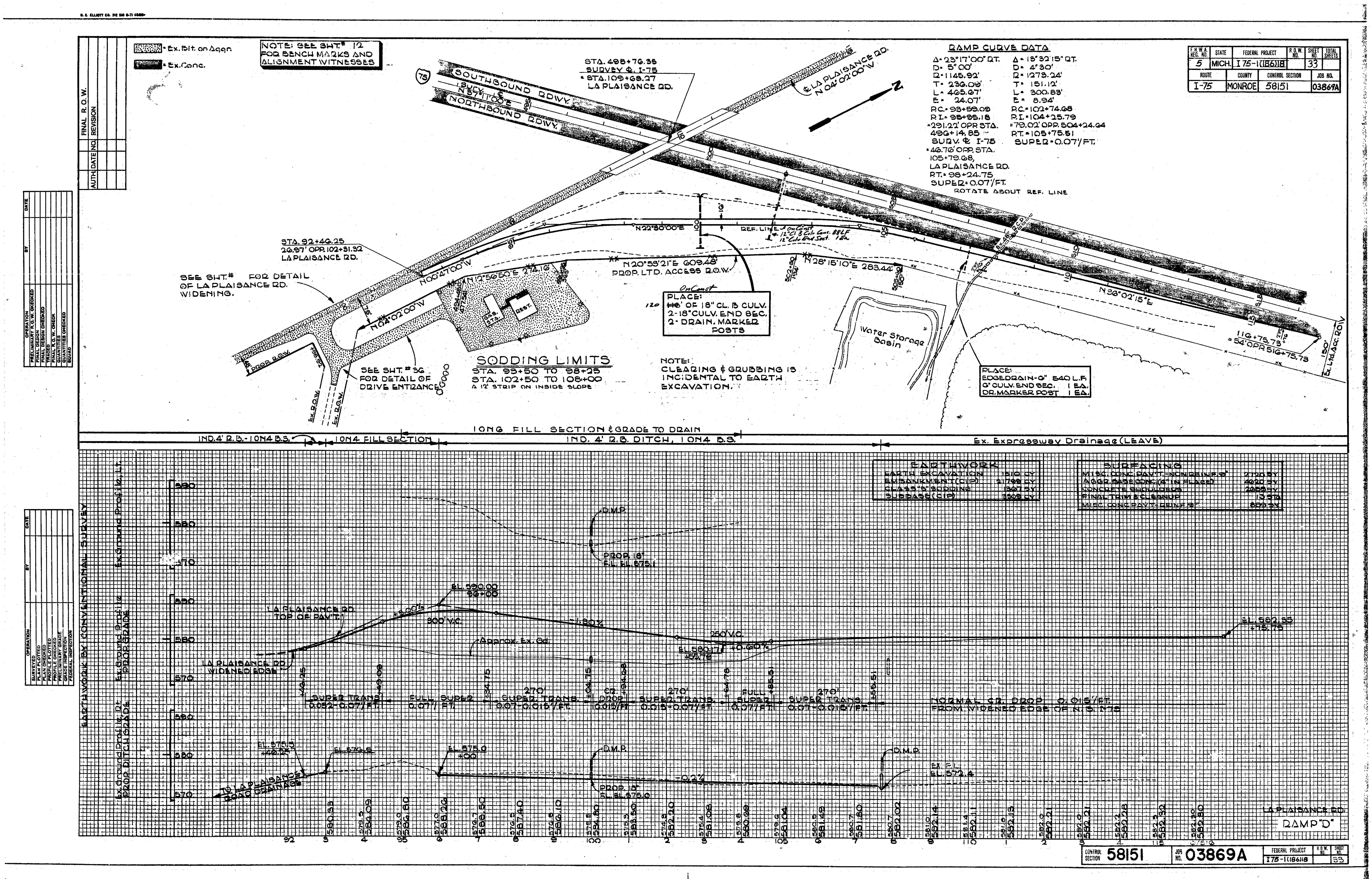

N-9-A-1


ST CLAIR SERIES
TOLEDO SERIES
SHALLOW PEAT OVER MARL
Concrete Pavement 10" Unif.
N-9-A-1

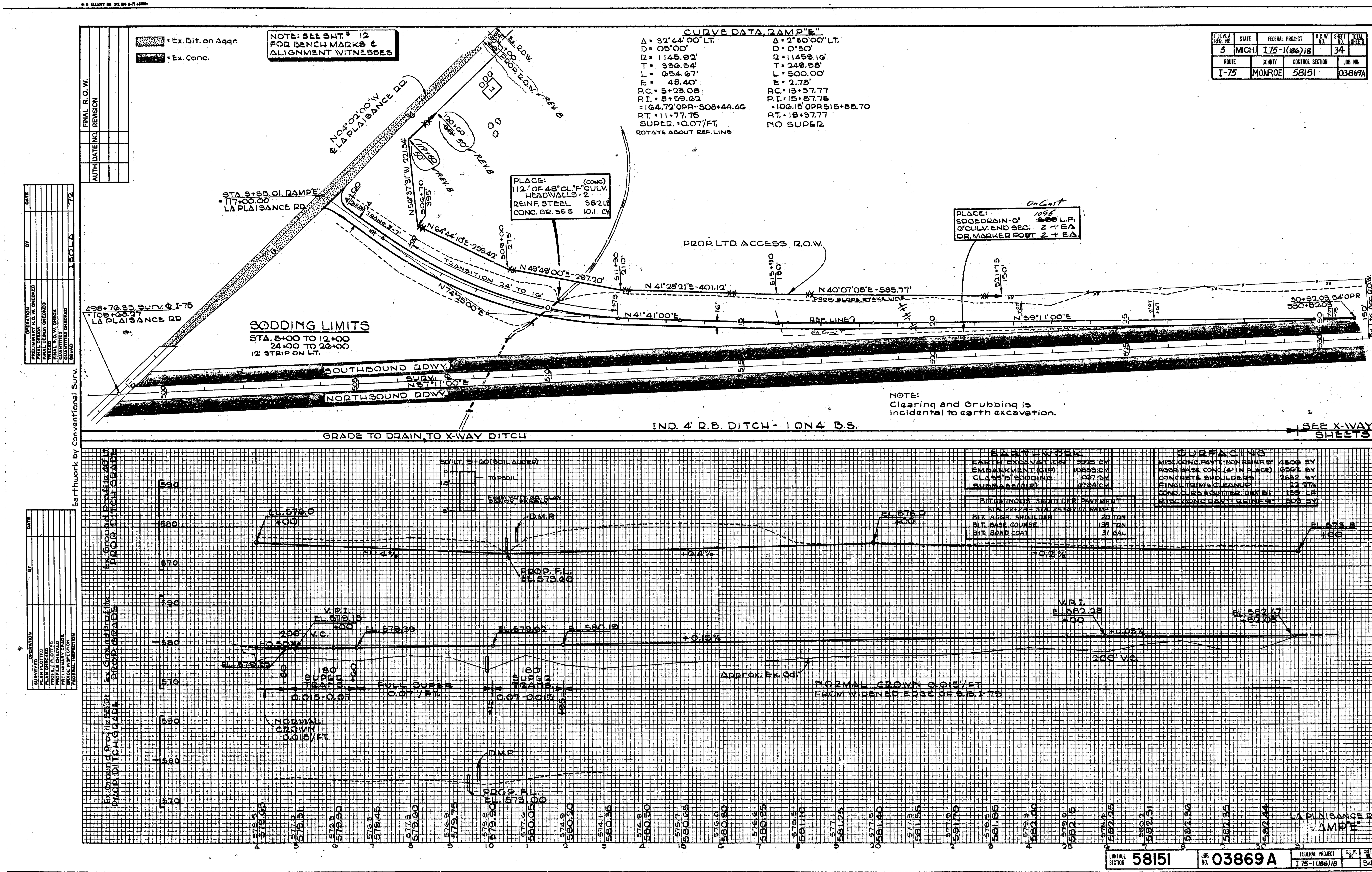


CONTROL SECTION	JOB NO.	FEDERAL PROJECT	R.O.W. NO.	SHEET NO.
58151	03869A	I75-1(186)18		12

A-4

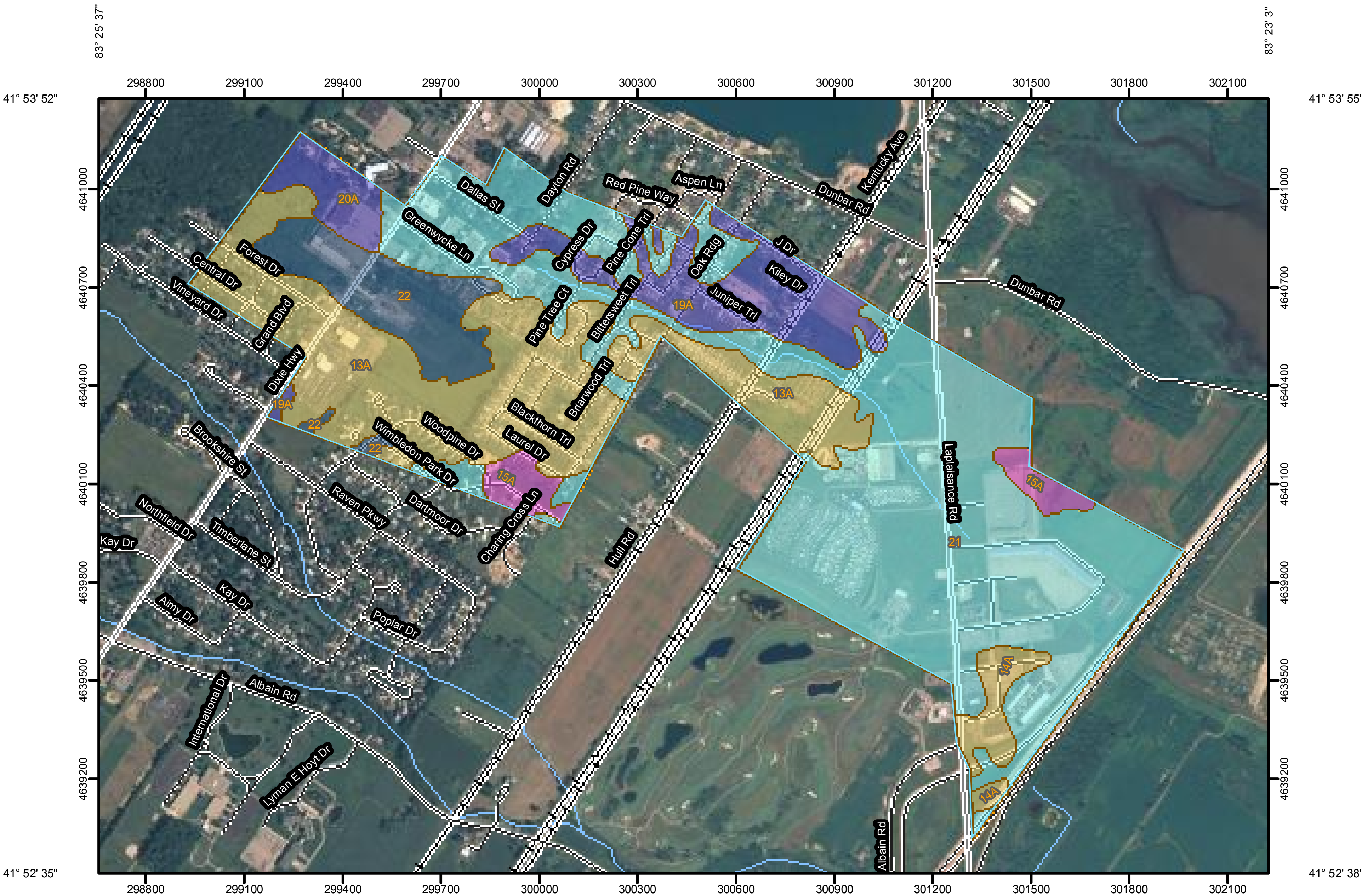


F.H.W.A. REG. NO. 5 | STATE MICH. | FEDERAL PROJECT I 75-1(186)18 | R.O.W. NO. | SHEET NO. 33 | TOTAL SHEETS
ROUTE I-75 | COUNTY MONROE | CONTROL SECTION 58151 | JOB NO. 03869A
Ex. Bit. on Aggr.
Ex. Conc.
NOTE: SEE SHT.# 12 FOR BENCH MARKS AND ALIGNMENT WITNESSES
FINAL R.O.W. REVISION
SOUTHBOUND RDWY.
NORTHBOUND RDWY.
STA. 498+76.35 SURVEY ℄ I-75 = STA. 109+68.27 LA PLAISANCE RD.
℄ LA PLAISANCE RD. N 04°02'00"W
RAMP CURVE DATA
Δ=23°17'00" RT. D=5°00' R=1145.92' T=236.08' L=465.67' E=24.07' P.C.=93+59.09 P.I.=95+95.18 =291.22' OPP. STA. 496+14.85 SURV. ℄ I-75 =46.76' OPP. STA. 105+79.98, LA PLAISANCE RD. P.T.=98+24.75 SUPER=0.07'/FT.
Δ=13°32'15" RT. D=4°30' R=1273.24' T=151.12' L=300.83' E=8.94' P.C.=102+74.68 P.I.=104+25.79 =79.02' OPP. 504+24.64 P.T.=105+75.51 SUPER=0.07'/FT.
ROTATE ABOUT REF. LINE
STA. 92+46.25 26.97' OPP. 102+51.32 LA PLAISANCE RD.
SEE SHT.# FOR DETAIL OF LA PLAISANCE RD. WIDENING.
N00°47'00"W
N12°56'50"E 274.16'
N22°30'00"E
REF. LINE
N20°55'21"E 609.48' PROP. LTD. ACCESS R.O.W.
N28°15'10"E 283.44'
N36°02'15"E
N04°02'00"W
PLACE: 16' OF 18" CL. B CULV. 2-18" CULV. END SEC. 2-DRAIN. MARKER POSTS
Water Storage Basin
116+75.73 = 54' OPP. 516+75.73
150' Ex. Ltd. Acc. R.O.W.
PLACE: EDGE DRAIN-6" 540 L.F. 6" CULV. END SEC. 1 EA. DR. MARKER POST 1 EA.
SEE SHT.# 36 FOR DETAIL OF DRIVE ENTRANCE
SODDING LIMITS
STA. 95+50 TO 98+25
STA. 102+50 TO 108+00
A 12' STRIP ON INSIDE SLOPE
NOTE: CLEARING & GRUBBING IS INCIDENTAL TO EARTH EXCAVATION.
PROP. R.O.W.
Ex. R.O.W.
1 ON 6 FILL SECTION & GRADE TO DRAIN
IND. 4' R.B.-1 ON 4 B.S.
1 ON 4 FILL SECTION
IND. 4' R.B. DITCH, 1 ON 4 B.S.
Ex. Expressway Drainage (LEAVE)
EARTHWORK
EARTH EXCAVATION 1510 CY
EMBANKMENT (CIP) 21799 CY
CLASS "B" SODDING 1367 SY
SUBBASE (CIP) 3309 CY
SURFACING
MISC. CONC. PAV'T.-NONREINF. 9" 2720 SY
AGGR. BASE CONC. (4" IN PLACE) 4020 SY
CONCRETE SHOULDERS 2635 SY
FINAL TRIM & CLEANUP 13 STA
MISC. CONC. PAV'T.-REINF. 9" 689 SY
EARTHWORK BY CONVENTIONAL SURVEY
Ex. Ground Profile Lt.
Ex. Ground Profile Rt. PROP. GRADE
Ex. Ground Prof. Lt. Rt. PROP. DITCH GRADE
D.M.P.
PROP. 18" F.L. EL. 575.1
EL. 590.00 96+00
LA PLAISANCE RD. TOP OF PAV'T.
+3.00%
300' V.C.
-1.30%
250' V.C.
+0.60%
Approx. Ex. Gd.
LA PLAISANCE RD. WIDENED EDGE
EL. 582.35 +75.73
SUPER TRANS. 0.052-0.07'/FT.
FULL SUPER 0.07'/FT.
270' SUPER. TRANS. 0.07-0.015'/FT.
CR. DROP 0.015'/FT.
270' SUPER. TRANS. 0.015-0.07'/FT.
FULL SUPER 0.07'/FT.
270' SUPER. TRANS. 0.07-0.015'/FT.
NORMAL CR. DROP 0.015'/FT. FROM WIDENED EDGE OF N.B. RDWY.
EL. 575.3 +42.2
EL. 579.5
EL. 575.0 +00
-0.2%
EX. EL. 572.4
PROP. 18" F.L. EL. 575.0
TO LA PLAISANCE ROAD DRAINAGE
590 580 570
92 3 4 5 6 7 8 9 100 1 2 3 4 105 6 7 8 9 110 1 2 3
LA PLAISANCE RD. RAMP "D"
CONTROL SECTION 58151 JOB NO. 03869A FEDERAL PROJECT I75-1(186)18 SHEET NO. 33


= Ex. Bit. on Aggr.
= Ex. Conc.
NOTE: SEE SHT.# 12 FOR BENCH MARKS & ALIGNMENT WITNESSES
CURVE DATA, RAMP "E"
Δ = 32°44'00" LT.
D = 05°00'
R = 1145.92'
T = 336.54'
L = 654.67'
E = 48.40'
P.C. = 5+23.08
P.I. = 8+59.62
= 164.72' OPR-508+44.46
P.T. = 11+77.75
SUPER. = 0.07/FT.
ROTATE ABOUT REF. LINE
Δ = 2°30'00" LT.
D = 0°30'
R = 11459.16'
T = 249.98'
L = 500.00'
E = 2.73'
P.C. = 13+37.77
P.I. = 15+87.75
= 106.15' OPR 515+88.70
P.T. = 18+37.77
NO SUPER
F.H.W.A. REG. NO. 5
STATE MICH.
FEDERAL PROJECT I 75-1(186)18
SHEET NO. 34
ROUTE I-75
COUNTY MONROE
CONTROL SECTION 58151
JOB NO. 03869A
FINAL R.O.W.
AUTH. DATE NO. REVISION
N04°02'00"W
℄ LA PLAISANCE RD.
PLACE: 112' OF 48" CL."F" CULV. (CONC) HEADWALLS - 2
REINF. STEEL 382 LB
CONC. GR. 35 S 10.1 C.Y.
PLACE: EDGEDRAIN-6" 1096 L.F. (On Const)
6" CULV. END SEC. 2 EA
DR. MARKER POST 2 EA
PROP. LTD. ACCESS R.O.W.
STA. 9+85.01, RAMP "E" = 117+00.00 LA PLAISANCE RD.
N 64°44'10"E - 259.42'
N 49°49'00"E - 297.20'
N 41°28'21"E - 401.12'
N 40°07'08"E - 585.77'
N 74°25'00"E
N 41°41'00"E
N 39°11'00"E
TRANSITION 24' TO 16'
REF. LINE
PROP. SLOPE STAKE LINE
498+76.85 Surv. ℄ I-75 = 109+68.47 LA PLAISANCE RD.
SODDING LIMITS
STA. 5+00 TO 12+00
24+00 TO 26+00
12' STRIP ON LT.
SOUTHBOUND RDWY.
SURV. ℄
N37°11'00"E
NORTHBOUND RDWY.
NOTE: Clearing and Grubbing is incidental to earth excavation.
IND. 4' R.B. DITCH - 1 ON 4 B.S.
GRADE TO DRAIN TO X-WAY DITCH
SEE X-WAY SHEETS
Earthwork by Conventional Surv.
EARTHWORK
EARTH EXCAVATION 3375 CY
EMBANKMENT (C.I.P.) 10895 CY
CLASS "B" SODDING 1027 SY
SUBBASE (C.I.P.) 4734 CY
BITUMINOUS SHOULDER PAVEMENT
BIT. AGGR. SHOULDER 20 TON
BIT. BASE COURSE 139 TON
BIT. BOND COAT 31 GAL
SURFACING
MISC. CONC. PAVT. NON REINF. 9" 4506 SY
AGGR. BASE CONC. (4" IN PLACE) 5062 SY
CONCRETE SHOULDERS 2682 SY
FINAL TRIM & CLEANUP 23 STA.
CONC. CURB & GUTTER, DET. B1 153 L.F.
MISC. CONC. PAVT. REINF. 9" 509 SY
Ex. Ground Profile 60' Lt.
PROP. DITCH GRADE
EL. 576.0 +00
-0.4%
D.M.P.
PROP. FL. EL. 573.20
+0.4%
EL. 576.0 +00
+0.2%
EL. 573.8 +00
TOPSOIL
Ex. Ground Profile
PROP. GRADE
V.P.I. EL. 579.15 +00
200' V.C.
-0.30%
EL. 579.39
EL. 579.92
EL. 580.19
+0.15%
V.P.I. EL. 582.28 +00
+0.08%
EL. 582.47 +52.05
200' V.C.
EL. 579.55
Approx. Ex. Gd.
FULL SUPER 0.07'/FT.
0.015-0.07
0.07-0.015
NORMAL CROWN 0.015'/FT.
NORMAL CROWN 0.015'/FT. FROM WIDENED EDGE OF S.B. I-75
Ex. Ground Profile 55' Rt.
PROP. DITCH GRADE
D.M.P.
PROP. F.L. EL. 578.00
LA PLAISANCE RD. RAMP "E"
CONTROL SECTION 58151
JOB NO. 03869 A
FEDERAL PROJECT I 75-1(186)18
SHEET NO. 34

APPENDIX B
National Cooperative Soil Survey Soils Map

Hydrologic Soil Group—Monroe County, Michigan
(Fermi B-1 Subcatchment)



Map Scale: 1:16,900 if printed on A size (8.5" x 11") sheet.

N

Meters: 0, 200, 400, 800, 1,200

Feet: 0, 500, 1,000, 2,000, 3,000

Note: Area defined for soil characterization differs slightly from the subbasins shown on Figure 4 of the Report. The difference does not materially affect the soil data that was applied to the modeling of flows in the drainage subbasins.

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Soil Ratings

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Political Features

- Cities

Water Features

- Oceans
- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:16,900 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:15,840.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 17N NAD83

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

Soil Survey Area: Monroe County, Michigan
Survey Area Data: Version 8, Jun 22, 2009

Date(s) aerial images were photographed: 7/10/2005

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Monroe County, Michigan				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
13A	Blount loam, 0 to 3 percent slopes	C	144.8	25.2%
14A	Del Rey silt loam, 0 to 3 percent slopes	C	13.5	2.3%
15A	Fulton silty clay loam, 0 to 3 percent slopes	D	15.3	2.7%
19A	Selfridge loamy sand, 0 to 3 percent slopes	B	50.2	8.8%
20A	Selfridge-Pewamo complex, 0 to 3 percent slopes	B	15.6	2.7%
21	Lenawee silty clay loam	B/D	292.7	51.0%
22	Pewamo clay loam	C/D	41.5	7.2%
Totals for Area of Interest			**573.5**	**100.0%**

Note: Area defined for soil characterization differs slightly from the subbasins shown on Figure 4 of the report. The difference does not materially affect the soil data that was applied to the modeling of flows in the drainage subbasins.

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

APPENDIX C
Calculations

Potential Evapotranspiration

Table C.1. Correction Factors for Monthly Sunshine Duration[a]

Latitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
50N	0.71	0.84	0.98	1.14	1.28	1.36	1.33	1.21	1.06	0.90	0.76	0.68
41°52’N	0.78	0.88	0.99	1.11	1.22	1.27	1.25	1.16	1.04	0.93	0.83	0.76
40N	0.80	0.89	0.99	1.10	1.20	1.25	1.23	1.15	1.04	0.93	0.83	0.78

a. Values for 50 and 40 degrees north from Table 3.D.1 in MDOT 2006. Value for Monroe site (41°52’N) calculated by interpolation.

The PET is calculated using the Thornthwaite equation:

$$PET = 16\left(\frac{10T_a}{I}\right)^a$$

Where:

PET = potential evapotranspiration in mm/mo

T_a = mean monthly air temperature (°C)

$a = 0.49 + 0.0179I - 0.0000771I^2 + 0.000000675I^3 = 1.25$

The monthly heat index (I) is calculated over a 12-month interval by:

$$I = \sum_{i=1}^{12}\left(\frac{T_a}{5}\right)^{1.5}$$

The correction factor from Table C.1 is applied to the uncorrected PET derived with the Thornthwaite equation. The results are presented in Table C.2. Given the proposed project is a vegetated wetland with shallow depths and established vegetation, ET is more appropriate loss than evaporation alone.

Table C.2. Potential Evapotranspiration for average year

Month	T_a (°F)[a]	T_a (°C)	$(Ta/5)^{1.5}$	Uncorrected PET (mm/mo)	Correction Factor	PET (mm/mo)	PET (in/mo)	PET (ft/mo)
January	25.6	-3.6	0	0	0.78	0	0	0
February	28.1	-2.2	0	0	0.88	0	0	0
March	36.7	2.6	0.37	7.44	0.99	7.4	0.29	0.02
April	48.3	9.1	2.44	35.35	1.11	39.2	1.54	0.1
May	59.9	15.5	5.45	68.80	1.22	83.9	3.30	0.3
June	70.2	21.2	8.73	101.82	1.27	129.3	5.09	0.4
July	74.4	23.5	10.22	116.08	1.25	145.1	5.71	0.5
August	72.5	22.5	9.55	109.70	1.16	127.3	5.01	0.4
September	64.5	18.1	6.86	83.34	1.04	86.7	3.41	0.3
October	52.4	11.3	3.41	46.65	0.93	43.4	1.71	0.1
November	41.1	5.1	1.02	17.07	0.83	14.2	0.56	0.05
December	30.1	-1.1	0	0	0.76	0	0	0
			I = 48.05					

a. Mean monthly temperatures from Monroe Station #5558 (1981-2010) available at http://climate.geo.msu.edu/stations/5558/.

Infiltration

Two samples from the Monroe site were tested for hydraulic conductivity in May 2011.

- First Sample i = 5.62×10^{-8} cm/sec
- Second Sample i = 5.11×10^{-8} cm/sec

Average hydraulic conductivity for the two samples was 5.37×10^{-8} cm/sec.

The average infiltration rate is calculated as:

$$5.37 \times 10^{-8}\ \text{cm/sec} \times \frac{2{,}592{,}000\ \text{sec}}{1\ \text{mo}} \times \frac{1\ \text{in}}{2.54\ \text{cm}} \times \frac{1\ \text{ft}}{12\ \text{in}} = 0.0046\ \text{ft/mo}$$

The average infiltration is about 0.05 in/month or less than 0.7 in/year. So, neglect infiltration.

Inflows

SWMM software is used to model every storm for a long-term record. This provides a more accurate estimate of hydrology than only looking at runoff from a few select, large storms.

Precipitation

Precipitation input is estimated using mean monthly rainfall data for the Monroe Station #5558 (available at http://climate.geo.msu.edu/stations/5558/). The volume is estimated as rainfall over the approximately 70-acre impoundment [volume (ac-ft) = rainfall (feet) × 70 acres].

Table C.3 Precipitation Input to Water Budget

Month	Rainfall (inches)	Volume in impoundment (ac-ft)
Jan	2.13	12.4
Feb	1.87	10.9
Mar	2.36	13.8
Apr	3.20	18.7
May	3.56	20.7
Jun	3.21	18.7
Jul	3.48	20.3
Aug	3.80	22.1
Sep	2.90	16.9
Oct	2.66	15.5
Nov	3.06	17.8
Dec	2.60	15.2
Total	34.82	

APPENDIX D
Soil Boring Data


GP-11-05
GP-11-02
GP-11-06
GP-11-01
GP-11-04
GP-11-03
Approximate Location for Geoprobe Boring
0 250 500 1,000 Feet
N
P:\Projects\Tetra Tech NUS\Mitigation Design\FieldOffsite Proposed Geoprobe Locs.mxd

Tetra Tech
710 Avis Drive
Ann Arbor, MI 48108
Telephone: (734) 213-2204
Fax: (734) 213-5008

LOG OF: GP-11-01

Site: **DTE Monroe**		Drilling Company: **Terra Probe**	
Address: **Bolles Harbor**		Driller: **Steve Bischoff**	
City, State: **Monroe, MI**		Sampling Method: **Shelby tube**	
Northing: **NM**	Easting: **NM**	Logged By: **JRN**	Checked By: **PJM**
Total Depth **18'** / Elev: **NM**	Weather: **40°F, Sleet/Rain**	Start Date: **4/19/2011**	Finish Date: **4/19/2011**
Hole Diameter: **3"**	PID Model & Lamp eV: **LEL Meter**	Sand Pack Interval: **0-2'**	Bentonite Chip Interval: **na**
Casing (Interval, Diameter, Type): **na**	Hole Abandonment: **Cuttings**	Grout Type & Interval: **na**	
Groundwater Sample Screen (Interval, Diameter, SLOT Size, Type): **0-2', 1" 10-Slot PVC**		Location: **Central-south side of property**	

Sample Type/No.	Blow Counts	Rec (%)	SOIL DESCRIPTION	Depth (feet)	PID (ppm)	WELL LOG	REMARKS
P-1		95	Brown, dry, CLAY, trace Sand and Silt	2	nm	2	GP-11-01-0.5-2.5' (Shelby Tube Sample) @ 11:30
				4			
P-2		100		6	nm		
				8			
P-3		100		10	nm		
			Gray, dry CLAY , trace Sand and Silt	12			
P-4		100		14	nm		
				16			
P-5		100			nm		
			Boring terminated at 18 ft	18			
				20			

Tetra Tech
710 Avis Drive
Ann Arbor, MI 48108
Telephone: (734) 213-2204
Fax: (734) 213-5008

LOG OF: **GP-11-02**

Site: **DTE Monroe**		Drilling Company: **Terra Probe**	
Address: **Bolles Harbor**		Driller: **Steve Bischoff**	
City, State: **Monroe, MI**		Sampling Method: **Shelby tube**	
Northing: **NM**	Easting: **NM**	Logged By: **JRN**	Checked By: **PJM**
Total Depth **12'** / Elev: **NM**	Weather: **40°F, Sleet/Rain**	Start Date: **4/19/2011**	Finish Date: **4/19/2011**
Hole Diameter: **3"**	PID Model & Lamp eV: **LEL Meter**	Sand Pack Interval: **0-2'**	Bentonite Chip Interval: **na**
Casing (Interval, Diameter, Type): **na**	Hole Abandonment: **Cuttings**	Grout Type & Interval: **na**	
Groundwater Sample Screen (Interval, Diameter, SLOT Size, Type): **0-2', 1" 10-Slot PVC**		Location: **Central-north side of property**	

Sample Type/No.	Blow Counts	Rec (%)	SOIL DESCRIPTION	Depth (feet)	PID (ppm)	WELL LOG	REMARKS
			Brown, dry, CLAY, trace Sand and Silt	0		Screen 0-2	GP-11-02-0.5-2.5' (Shelby Tube Sample) @ 12:00
P-1		90		2	nm		
				4			
P-2		100		6	nm		
				8			
P-3		100		10	nm		
			Gray, dry CLAY	11			
			Boring terminated at 12 ft	12			
				14			
				16			
				18			
				20			

Tetra Tech
710 Avis Drive
Ann Arbor, MI 48108
Telephone: (734) 213-2204
Fax: (734) 213-5008

LOG OF: GP-11-03

Site: **DTE Monroe**		Drilling Company: **Terra Probe**	
Address: **Bolles Harbor**		Driller: **Steve Bischoff**	
City, State: **Monroe, MI**		Sampling Method: **Shelby tube**	
Northing: **NM**	Easting: **NM**	Logged By: **JRN**	Checked By: **PJM**
Total Depth **16'** / Elev: **NM**	Weather: **40°F, Sleet/Rain**	Start Date: **4/19/2011**	Finish Date: **4/19/2011**
Hole Diameter: **3"**	PID Model & Lamp eV: **LEL Meter**	Sand Pack Interval: **0-2'**	Bentonite Chip Interval: **na**
Casing (Interval, Diameter, Type): **na**	Hole Abandonment: **Cuttings**	Grout Type & Interval: **na**	
Groundwater Sample Screen (Interval, Diameter, SLOT Size, Type): **0-2', 1" 10-Slot PVC**		Location: **Southeast corner of property**	

Sample Type/No.	Blow Counts	Rec (%)	SOIL DESCRIPTION	Depth (feet)	PID (ppm)	WELL LOG	REMARKS
P-1		80	Brown to orange, dry CLAY, trace Sand and Silt	2	nm	2	GP-11-03-0.5-2.5' (Shelby Tube Sample) @ 15:00
				4			
P-2		100		6	nm		
				8			
P-3		100		10	nm		
				12			
P-4		100	Gray and brown mottled, dry CLAY, trace Sand and Silt	14	nm		
			Boring terminated at 16 ft	16			
				18			
				20			

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LOG OF: **GP-11-04**

Site: **DTE Monroe**		Drilling Company: **Terra Probe**	
Address: **Bolles Harbor**		Driller: **Steve Bischoff**	
City, State: **Monroe, MI**		Sampling Method: **Shelby tube**	
Northing: **NM**	Easting: **NM**	Logged By: **JRN**	Checked By: **PJM**
Total Depth **16'** / Elev: **NM**	Weather: **40°F, Sleet/Rain**	Start Date: **4/19/2011**	Finish Date: **4/19/2011**
Hole Diameter: **3"** / PID Model & Lamp eV: **LEL Meter**		Sand Pack Interval: **na**	Bentonite Chip Interval: **na**
Casing (Interval, Diameter, Type): **na**	Hole Abandonment: **Cuttings**	Grout Type & Interval: **na**	
Groundwater Sample Screen (Interval, Diameter, SLOT Size, Type): **na**		Location: **Northeast corner of property**	

Sample Type/No.	Blow Counts	Rec (%)	SOIL DESCRIPTION	Depth (feet)	PID (ppm)	REMARKS
			Brown to slight orange, dry CLAY, trace Sand and Silt	0		GP-11-04-0.5-2.5' (Shelby Tube Sample) @ 15:45
P-1		85		2	nm	
				4		
P-2		100		6	nm	
				8		
P-3		100		10	nm	
			Gray, dry CLAY, trace Sand and Silt	11.25		
				12		
P-4		100		14	nm	
			Boring terminated at 16 ft	16		
				18		
				20		

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LOG OF: GP-11-05

Site: DTE Monroe		Drilling Company: Terra Probe	
Address: Bolles Harbor		Driller: Steve Bischoff	
City, State: Monroe, MI		Sampling Method: Shelby tube	
Northing: NM	Easting: NM	Logged By: JRN	Checked By: PJM
Total Depth 20' / Elev: NM	Weather: 40°F, Overcast	Start Date: 4/20/2011	Finish Date: 4/20/2011
Hole Diameter: 2.25" / PID Model & Lamp eV: LEL Meter		Sand Pack Interval: 0-2'	Bentonite Chip Interval: na
Casing (Interval, Diameter, Type): na	Hole Abandonment: Cuttings	Grout Type & Interval: na	
Groundwater Sample Screen (Interval, Diameter, SLOT Size, Type): 0-2', 1" 10-Slot PVC		Location: Northwest corner of property	

Sample Type/No.	Blow Counts	Rec (%)	SOIL DESCRIPTION	Depth (feet)	PID (ppm)	WELL LOG	REMARKS
P-1		90	Brown to black, dry CLAY, trace Sand and Silt	2	nm	2	GP-11-05-0.5-2.5' (Shelby Tube Sample) @ 10:45
				4			
P-2		100	Black to brown and grey mottled, dry CLAY	6	nm		
			Gray to black, dry CLAY	8			
P-3		100		10	nm		
				12			
P-4		100		14	nm		
			Brown, dry CLAY	16			
P-5		100	Brown and gray mottled, dry CLAY	18	nm		
			Boring terminated at 20 ft	20			

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LOG OF: GP-11-06

Site: **DTE Monroe**		Drilling Company: **Terra Probe**	
Address: **Bolles Harbor**		Driller: **Steve Bischoff**	
City, State: **Monroe, MI**		Sampling Method: **Shelby tube**	
Northing: **NM**	Easting: **NM**	Logged By: **JRN**	Checked By: **PJM**
Total Depth **12'** / Elev: **NM**	Weather: **40°F, Overcast**	Start Date: **4/20/2011**	Finish Date: **4/20/2011**
Hole Diameter: **2.25"**	PID Model & Lamp eV: **LEL Meter**	Sand Pack Interval: **0-2'**	Bentonite Chip Interval: **na**
Casing (Interval, Diameter, Type): **na**	Hole Abandonment: **Cuttings**	Grout Type & Interval: **na**	
Groundwater Sample Screen (Interval, Diameter, SLOT Size, Type): **0-2', 1" 10-Slot PVC**		Location: **Southwest corner of property**	

Sample Type/No.	Blow Counts	Rec (%)	SOIL DESCRIPTION	Depth (feet)	PID (ppm)	WELL LOG	REMARKS
			Dark brown, damp CLAY (0-2)			Screen 0-2	GP-11-06-0.5-2.5' (Shelby Tube Sample) @ 11:45
P-1		60	Light brown and gray mottled, dry CLAY, trace Sand and Silt (2-8.5)	2	nm	2	
P-2		90		6	nm		
P-3		90	Brown and gray mottled, dry CLAY, trace Sand and Silt (8.5-12)	10	nm		
			Boring terminated at 12 ft	12			

May 9, 2011 TTL Project No. 7671.01

Mr. Brian Rubel
Tetra Tech
710 Avis Drive
Ann Arbor, Michigan 48108

Geotechnical Laboratory Testing
DTE Energy
Monroe, Michigan

Dear Mr. Rubel:

At your request, laboratory testing was performed on two Shelby tube samples from the referenced project site. The samples were obtained by Tetra Tech and were labeled GP-11-04 and GP-11-06.

Both samples were tested in accordance with ASTM D 5084 - Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.

The sample identified as GP-11-04 was found to have a hydraulic conductivity of $5.62 * 10^{-8}$ cm/sec and the sample identified as GP-11-06 was found to have a hydraulic conductivity of $5.11 * 10^{-8}$ cm/sec.

Detailed results of these tests are attached to this letter report. Should you have any questions or need further information, please feel free to contact us.

Sincerely,

TTL Associates, Inc.

Jeffrey S. Elliott, P.E. .
Vice President

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MEASUREMENT OF HYDRAULIC CONDUCTIVITYOF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER (ASTM D 5084)

TTL Assoc.Project No.: 7671.01

Client: Tetra Tech

Project: Detroit Edison

Sample Number: GP-11-04 ST-1

Report Date: 05/03/11

File: GP-11-04ST-1

Permeant: tap water

Test Start Date: 04/27/11

SAMPLE PROPERTIES

Diameter: 2.8 in. 7.112 cm

Area: 6.154 in² 39.708 cm²

Length: 3.080 in 7.823 cm

Volume: 0.01097 ft³ 310.624 cm³

Initial Weight of Testing Sample: 611.3 g

Final Weight of Testing Sample: 629.4 g

Initial Moisture Content: 26.8 %

Final Moisture Content: 29.1 %

Initital Wet Wt. of M.C. Sample: 295.4 g

Initial Dry Wt. of M.C. Sample: 233 g

Final Wet Wt. of M.C. Sample: 629.4 g

Final Dry Wt. of M.C. Sample: 487.4 g

Initial Wet Density: 122.9 lb/ft³

Initial Dry Density: 96.9 lb/ft³

Final Wet Density: 126.5 lb/ft³

Final Dry Density: 98.0 lb/ft³

DEGREE OF SATURATION

Date	Time	Cell Pressure (psi)	Back Pressure (psi)	Head Pressure (psi)	Confining Pressure Increase (psi) - a	Pore Pressure Increase (psi) - b	Skempton's Parameter (B) (b/a)
05/02/11	7:00 AM	25.0	23.0	23.0	5.0	5.0	1

CONSOLIDATION OF SAMPLE

Date	Time	Cell Pressure (psi)	Back Pressure (psi)	Effective Confining Pressure (psi)	h (cc)	Q (cc)	t (sec)

PERMEABILITY MEASUREMENT

Test No.	Date	Time	Cell Pressure (psi)	Head Pressure (psi)	Back Pressure (psi)	Water Head (cm)	h (cc)	Q (h1-h2) (cc)	t (sec)	T (°C)	k (cm/sec)	k,corr. (cm/sec)
Start	05/02/11	8:00 AM	25.0	22.0	20.0	140.9						
1	05/02/11	9:00 AM	25.0	22.0	20.0	140.9		0.15	3600	21.5	5.83E-08	5.62E-08
2	05/02/11	10:00 AM	25.0	22.0	20.0	140.9		0.15	3600	21.5	5.83E-08	5.62E-08
3	05/02/11	12:00 PM	25.0	22.0	20.0	140.9		0.30	7200	21.5	5.83E-08	5.62E-08
4	05/02/11	4:00 PM	25.0	22.0	20.0	140.9		0.60	14400	21.5	5.83E-08	5.62E-08

AVERAGE HYDRAULIC CONDUCTIVITY (K)	5.62E-08	cm/sec

MEASUREMENT OF HYDRAULIC CONDUCTIVITYOF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER (ASTM D 5084)

TTL Assoc.Project No.: 7671.01

Report Date: 05/03/11

Client: Tetra Tech

File: GP-11-06ST-1

Project: Detroit Edison

Permeant: tap water

Sample Number: GP-11-06 ST-1

Test Start Date: 04/27/11

SAMPLE PROPERTIES

Diameter:	2.8 in.	7.112 cm
Area:	6.154 in²	39.708 cm²
Length:	2.800 in	7.112 cm
Volume:	0.009972 ft³	282.385 cm³

Initial Weight of Testing Sample:	548.1 g
Final Weight of Testing Sample:	573.1 g
Initial Moisture Content:	30.8 %
Final Moisture Content:	32.5 %

Initital Wet Wt. of M.C. Sample:	204.5 g
Initial Dry Wt. of M.C. Sample:	156.4 g
Final Wet Wt. of M.C. Sample:	572.8 g
Final Dry Wt. of M.C. Sample:	432.2 g

Initial Wet Density:	121.2 lb/ft³
Initial Dry Density:	92.7 lb/ft³
Final Wet Density:	126.7 lb/ft³
Final Dry Density:	95.6 lb/ft³

DEGREE OF SATURATION

Date	Time	Cell Pressure (psi)	Back Pressure (psi)	Head Pressure (psi)	Confining Pressure Increase (psi) - a	Pore Pressure Increase (psi) - b	Skempton's Parameter (B) (b/a)
05/02/11	7:00 AM	25.0	23.0	23.0	5.0	5.0	1

CONSOLIDATION OF SAMPLE

Date	Time	Cell Pressure (psi)	Back Pressure (psi)	Effective Confining Pressure (psi)	h (cc)	Q (cc)	t (sec)

PERMEABILITY MEASUREMENT

Test No.	Date	Time	Cell Pressure (psi)	Head Pressure (psi)	Back Pressure (psi)	Water Head (cm)	h (cc)	Q (h1-h2) (cc)	t (sec)	T (°C)	k (cm/sec)	k,corr. (cm/sec)
Start	05/02/11	8:00 AM	25.0	22.0	20.0	140.9						
1	05/02/11	9:00 AM	25.0	22.0	20.0	140.9		0.15	3600	21.5	5.30E-08	5.11E-08
2	05/02/11	10:00 AM	25.0	22.0	20.0	140.9		0.15	3600	21.5	5.30E-08	5.11E-08
3	05/02/11	12:00 PM	25.0	22.0	20.0	140.9		0.30	7200	21.5	5.30E-08	5.11E-08
4	05/02/11	4:00 PM	25.0	22.0	20.0	140.9		0.60	14400	21.5	5.30E-08	5.11E-08

AVERAGE HYDRAULIC CONDUCTIVITY (K) 5.11E-08 cm/sec