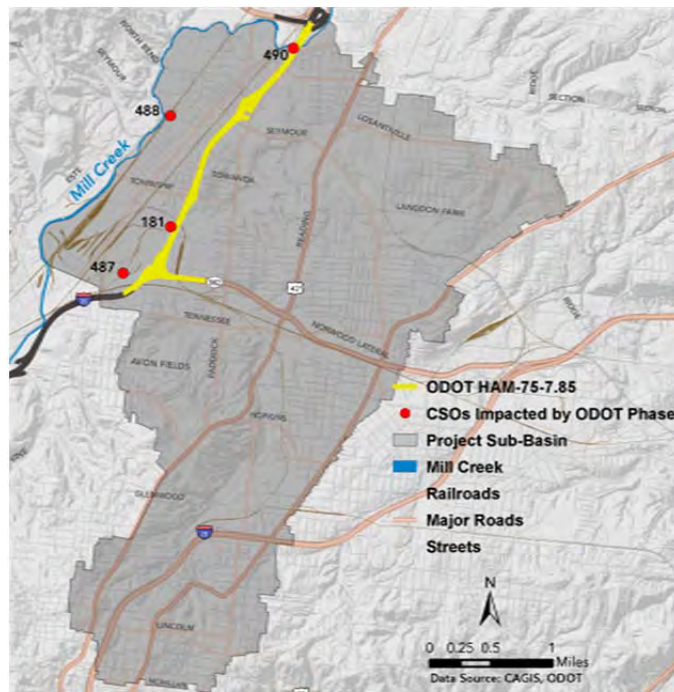


November 19, 2013

METROPOLITAN SEWER DISTRICT OF GREATER CINCINNATI

CSO 488 and CSO 490 I-75 Reconstruction Coordination *Storm Sewer Sizing Calculations*



PROJECT NUMBER:
131902

PROJECT CONTACT:
Kathleen A. Bollmer
EMAIL:
Katie.bollmer@powereng.com
PHONE:
513.326.1574



INTRODUCTION

Through the I-75 Reconstruction Analysis project, MSD seeks to achieve storm sewer crossings of I-75 where I-75 acts as a physical barrier to strategic sewer separation. Strategic separation is a potential wet weather solution for both CSOs 488 and 490; therefore, MSD is evaluating the potential to request that ODOT upsize proposed highway storm sewer crossings or install new highway crossings to accommodate the future separation of the portion of the watershed located upstream of the highway. This document summarizes the storm sewer sizing calculations associated with each potential crossing location.

STORMWATER CALCULATIONS

Storm sewer calculations were performed per City of Cincinnati Stormwater Utility Rules and Regulations. Hydrologic calculations were performed using the SCS Curve Number Method as outlined in the *Urban Hydrology for Small Watersheds, TR-55, Manual*, dated June 1986. Autodesk Storm and Sanitary Analysis 2012 was the software utilized to run these calculations.

RESULTS

CSO 490 – Woodland Avenue Storm Crossing

Per the following calculations, the proposed storm sewer crossing at Woodland Avenue is sized as a 48-in diameter storm sewer to serve future CSO 490 separation. ODOT's proposed outfall, currently sized as a 42-in storm sewer, would need to be upsized to a 60-in sewer to accommodate the additional flow.

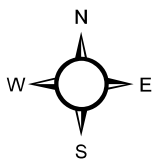
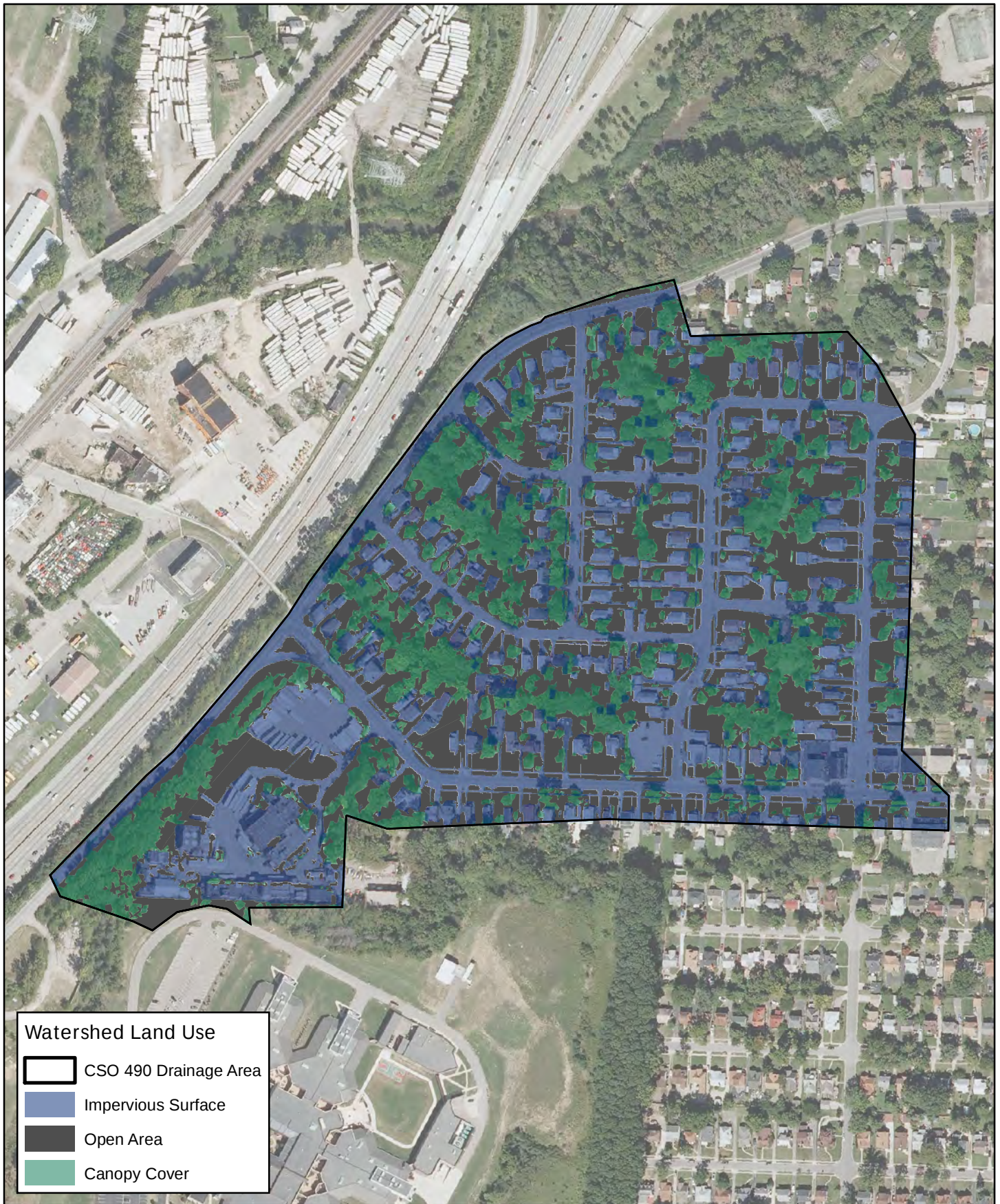
CSO 488 – Seymour Avenue Storm Crossing

ODOT proposes a 54-in storm sewer crossing at Seymour Avenue to serve highway runoff. Per the following calculations, a 54-in storm sewer could accommodate both the highway runoff and the future separation of the upstream watershed tributary to CSO 488. This assumes that the highway runoff would discharge into the storm sewer at a peak discharge no greater than today's peak rates.

CSO 488 – 69th Street Storm Crossing

ODOT proposes an 18-in and 30-in storm sewer crossing at Seymour Avenue to serve highway runoff. Per the following calculations, a 36-in storm sewer could accommodate both the highway runoff and the future separation of the upstream watershed tributary to CSO 488. This assumes that the highway runoff would discharge into the storm sewer at a peak discharge no greater than today's peak rates.

CSO 490 STORM SEWER CALCULATIONS



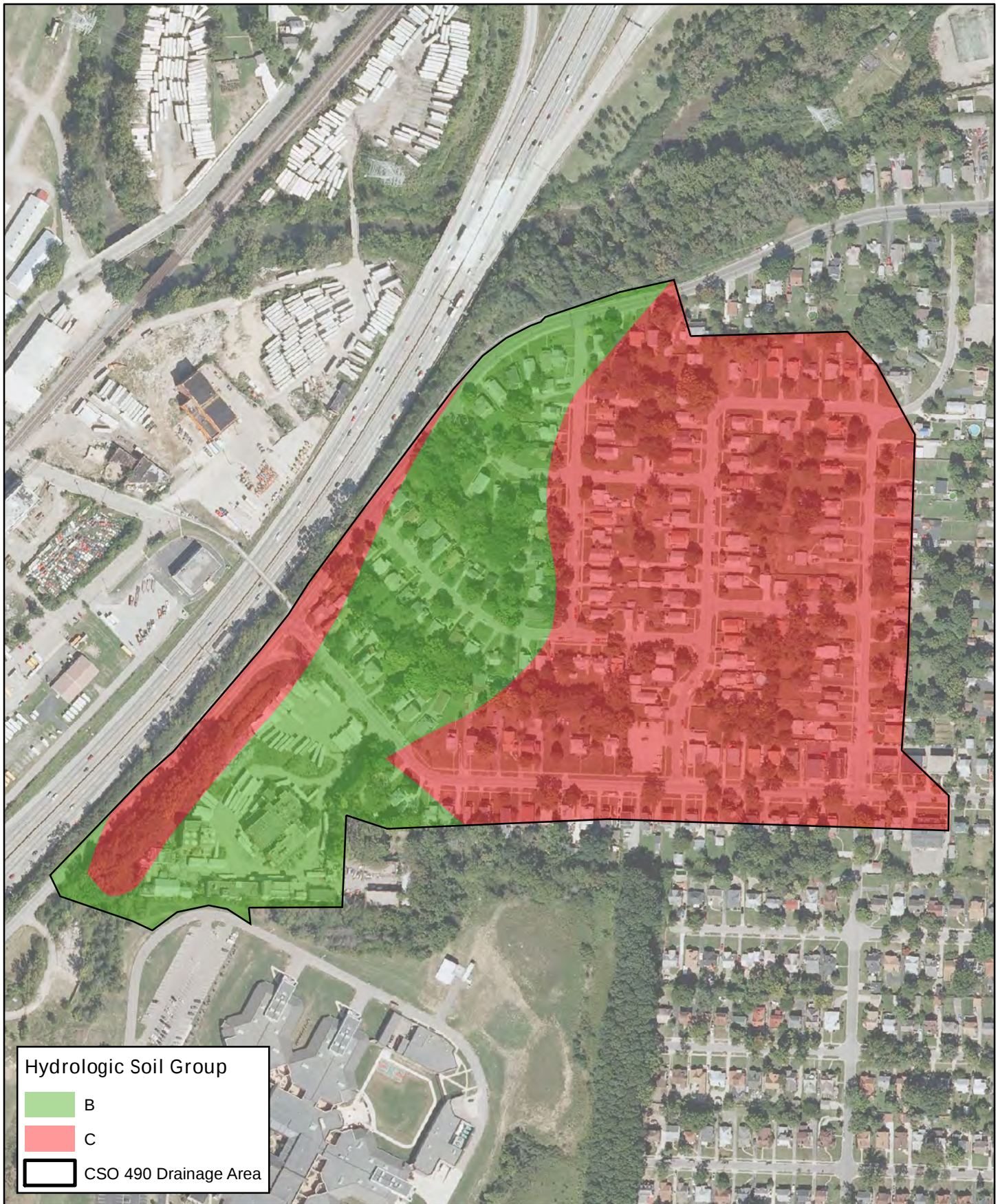
CSO 490 Storm Calculations
Land Use Map

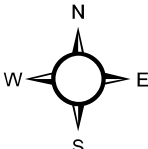
PN: 131902

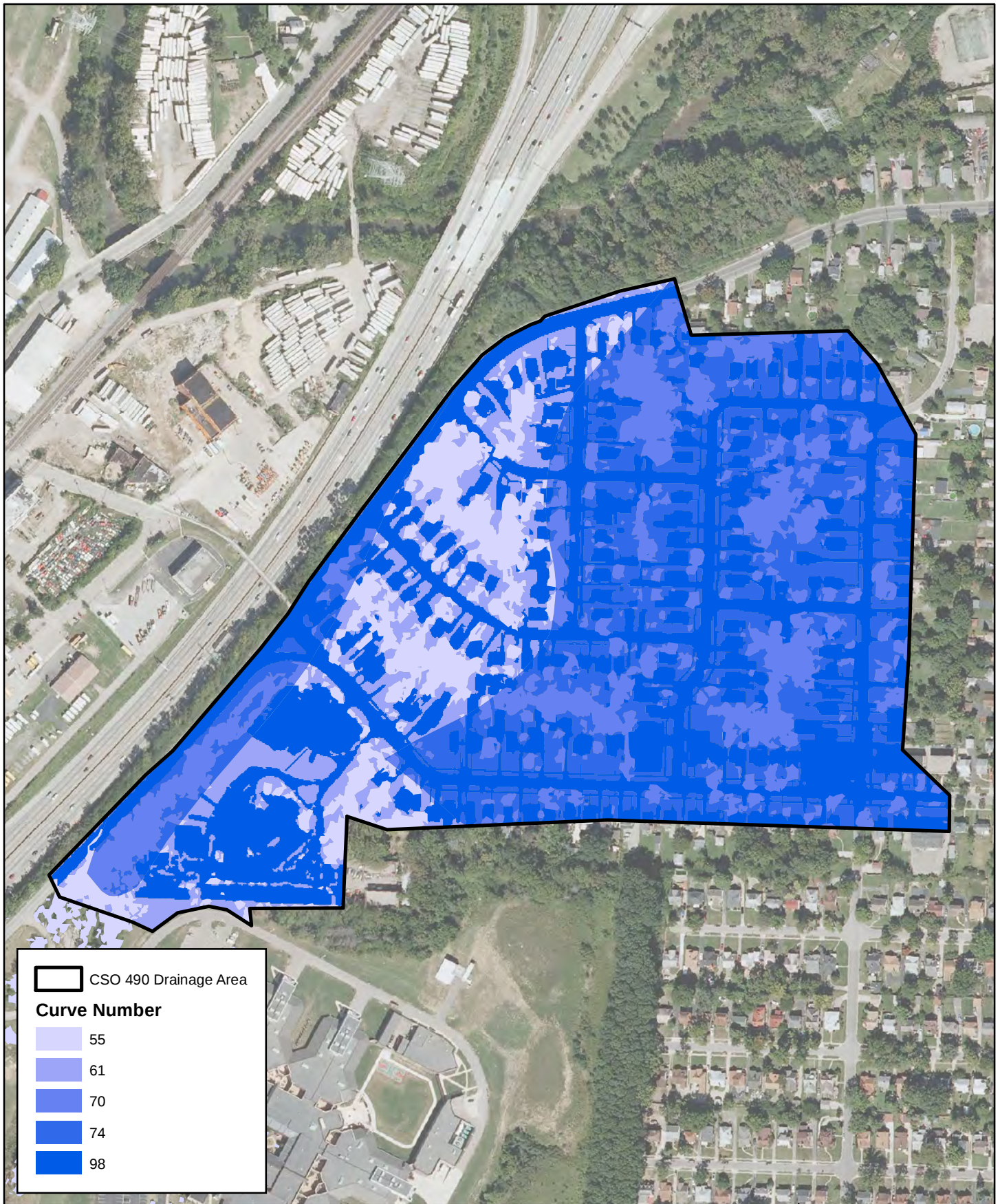
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MSD PN 11143260





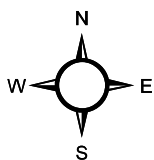
	CSO 490 Storm Calculations Hydrologic Soil Group			
	PN: 131902 MSD PN: 11143260	Feet 0 500	NRCS 2009 Soil Data	



CSO 490 Drainage Area

Curve Number

- 55
- 61
- 70
- 74
- 98



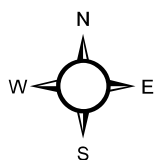
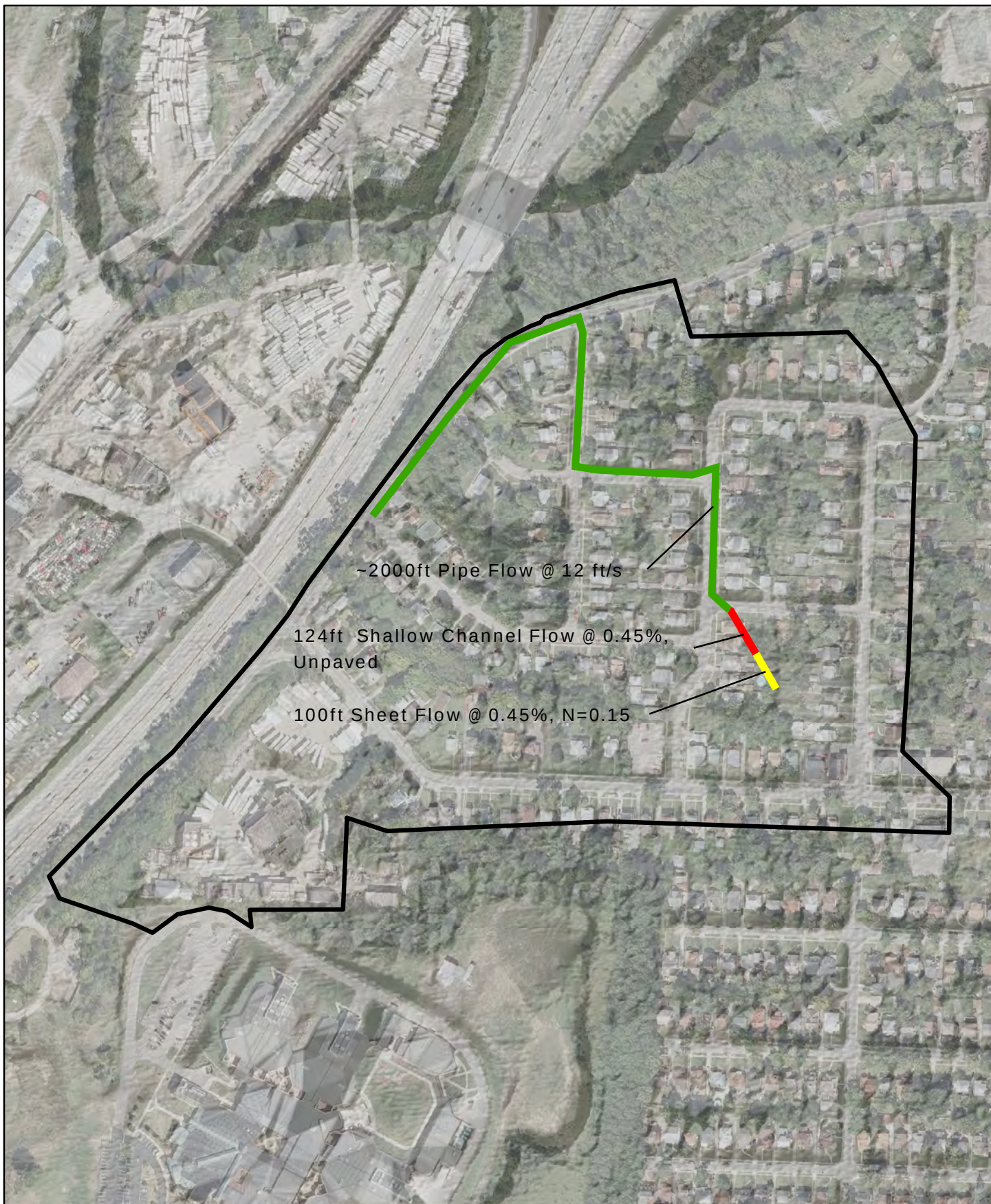
**CSO 490 Storm Calculations
Curve Number Map**

PN: 131902
MSD PN: 11143260

Feet
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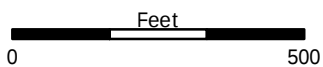
USDA. Urban Hydrology
for Small Watersheds.
TR-55 Manual





CSO 490 Storm Calculations
Time of Concentration

PN: 131902



MSD PN: 11143260



TABLE 1. SUB-BASIN SUMMARY

Storm Frequency	Element ID	Area (acres)	Drainage Node ID	Weighted Curve Number	Rain Gage ID	Total Precipitation (Inches)	Total Runoff (inches)	Peak Runoff (cfs)	Time of Concentration (day hh:mm:ss)
10-YR	490 North	46.55	Upstream	81.38	Rain Gage-01	4.08	2.22	103.71	0 00:24:00
25-YR	490 North	46.55	Upstream	81.38	Rain Gage-01	4.80	2.84	132.93	0 00:24:00

TABLE 2. CONDUITS, RESULTS FOR 24-HOUR, 10-YEAR EVENT

Element ID	From (Inlet Node)	To (Outlet Node)	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (inches)	Pipe Width (inches)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Peak Flow (cfs)	Max Flow Velocity (ft/sec)	Travel Time (min)	Design Flow Capacity (cfs)	Total Time Surcharged (min)	Max Flow Depth (ft)
702-701	702	701	68.00	520.32	0.00	520.00	0.00	0.32	0.47	CIRCULAR	60.00	60.00	0.01	0.50	0.50	146.72	7.47	0.15	178.66	1440.00	5.00
703-702	703	702	195.00	521.22	0.00	520.42	0.10	0.80	0.41	CIRCULAR	60.00	60.00	0.01	0.50	0.50	150.07	7.93	0.41	166.82	1440.00	5.00
722-703	722	703	121.00	529.62	0.00	528.42	7.20	1.20	0.99	CIRCULAR	48.00	48.00	0.01	0.50	0.50	100.52	8.00	0.25	143.05	13.00	4.00
726-722	726	722	200.00	536.51	0.00	530.12	0.50	6.39	3.19	CIRCULAR	48.00	48.00	0.01	0.50	0.50	100.52	10.55	0.32	256.76	0.00	3.10
Upstream-726	Upstream	726	200.00	537.51	0.00	536.51	0.00	1.00	0.50	CIRCULAR	48.00	48.00	0.01	0.50	0.50	100.63	10.33	0.32	101.57	0.00	2.94

TABLE 3. CONDUITS, RESULTS FOR 24-HOUR STORM, 25-YEAR EVENT

Element ID	From (Inlet Node)	To (Outlet Node)	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (inches)	Pipe Width (inches)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Peak Flow (cfs)	Max Flow Velocity (ft/sec)	Travel Time (min)	Design Flow Capacity (cfs)	Total Time Surcharged (min)	Max Flow Depth (ft)
702-701	702	701	68.00	520.32	0.00	520.00	0.00	0.32	0.47	CIRCULAR	60.00	60.00	0.01	0.50	0.50	174.86	8.91	0.13	178.66	1440.00	5.00
703-702	703	702	195.00	521.22	0.00	520.42	0.10	0.80	0.41	CIRCULAR	60.00	60.00	0.01	0.50	0.50	174.86	8.91	0.36	166.82	1440.00	5.00
722-703	722	703	121.00	529.62	0.00	528.42	7.20	1.20	0.99	CIRCULAR	48.00	48.00	0.01	0.50	0.50	128.66	10.24	0.20	143.05	21.00	4.00
726-722	726	722	200.00	536.51	0.00	530.12	0.50	6.39	3.19	CIRCULAR	48.00	48.00	0.01	0.50	0.50	128.66	10.64	0.31	256.76	0.00	3.68
Upstream-726	Upstream	726	200.00	537.51	0.00	536.51	0.00	1.00	0.50	CIRCULAR	48.00	48.00	0.01	0.50	0.50	128.77	10.80	0.31	101.57	0.00	3.68

TABLE 4. OUTFALLS, 24-HOUR, 10-YEAR EVENT

Element ID	Invert Elevation (ft)	Boundary Type	Flap Gate	Fixed Water Elevation (ft)	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Maximum HGL Depth Attained (ft)	Maximum HGL Elevation Attained (ft)
701.00	520.00	FIXED	YES	530.50	146.72	0.00	10.50	530.50

TABLE 5. OUTFALLS, 24-HOUR, 25-YEAR EVENT

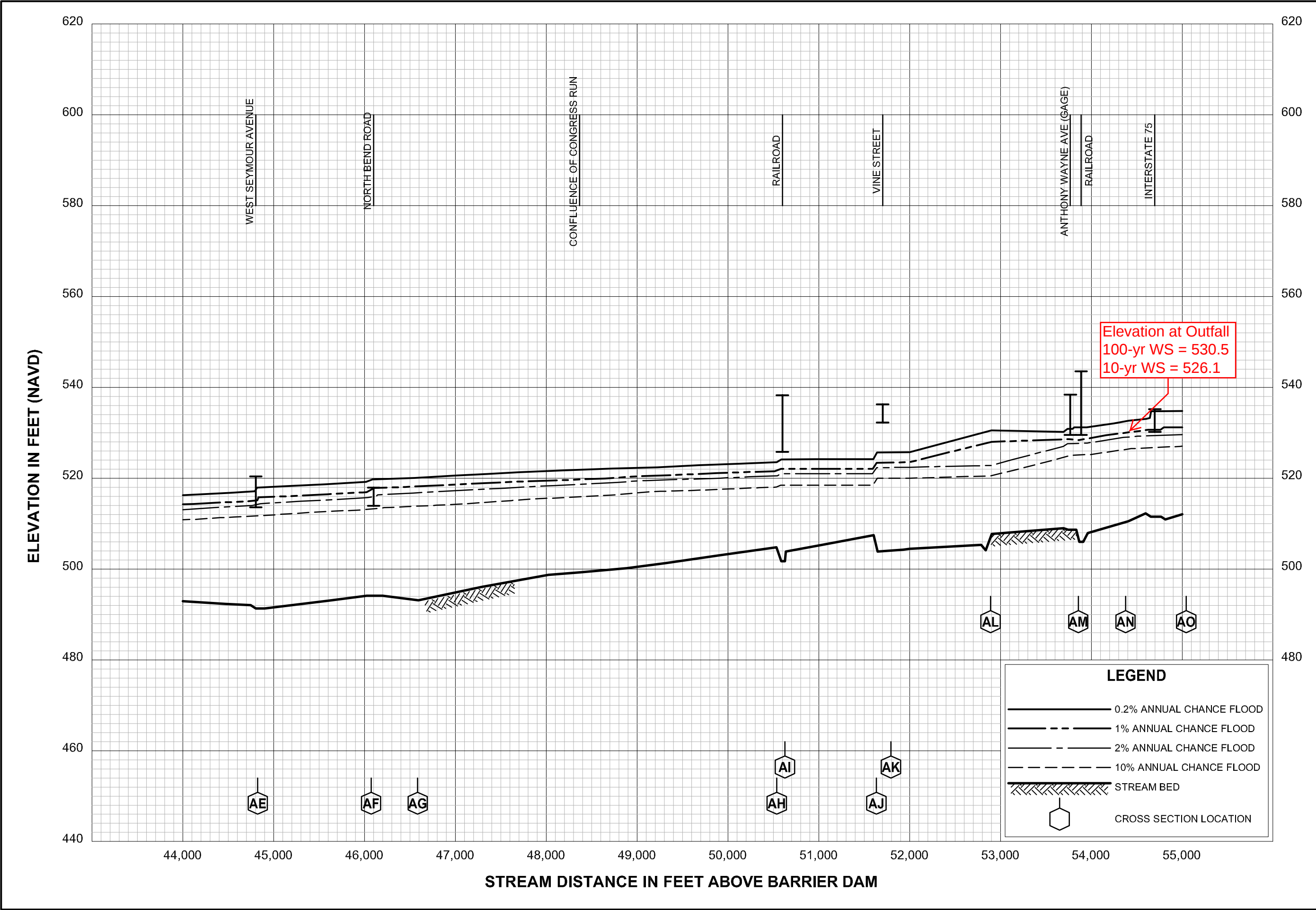
Element ID	Invert Elevation (ft)	Boundary Type	Flap Gate	Fixed Water Elevation (ft)	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Maximum HGL Depth Attained (ft)	Maximum HGL Elevation Attained (ft)
701	520.00	FIXED	YES	530.50	174.86	0.00	10.50	530.50

TABLE 6. JUNCTIONS 24-HOUR, 10-YEAR EVENT

Element ID	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Depth	Surcharge Depth	Minimum Pipe Cover	Peak Inflow	Peak Lateral Inflow	Maximum HGL Elevation Attained	Maximum Surcharge Depth Attained	Total Time Flooded
	(ft)	(ft)	(ft)	(ft)	(inches)	(cfs)	(cfs)	(ft)	(ft)	(minutes)
702	520.32	535.88	0.00	0.00	125.52	146.72	0.00	531.58	0.00	0.00
703	521.22	538.14	0.00	0.00	68.64	196.27	46.20	533.07	0.00	0.00
722	529.62	540.74	0.00	0.00	79.44	100.52	0.00	534.66	0.00	0.00
726	536.51	543.42	0.00	0.00	34.92	100.63	0.00	538.70	0.00	0.00
Upstream	537.51	566.43	0.00	0.00	299.04	100.53	100.53	541.20	0.00	0.00

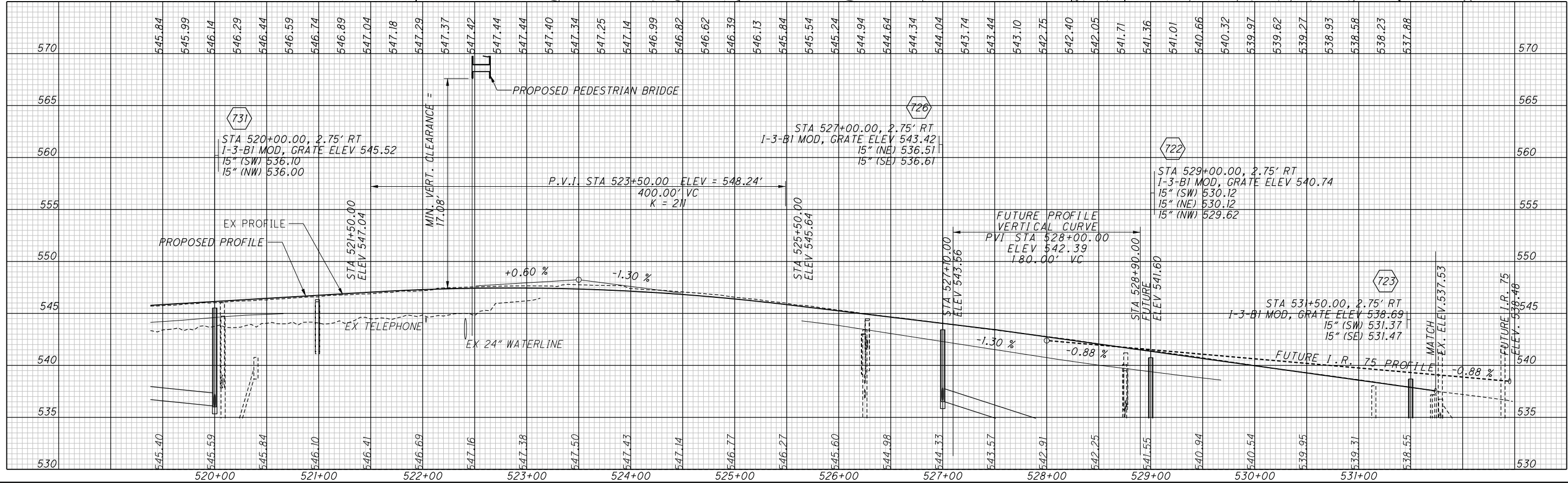
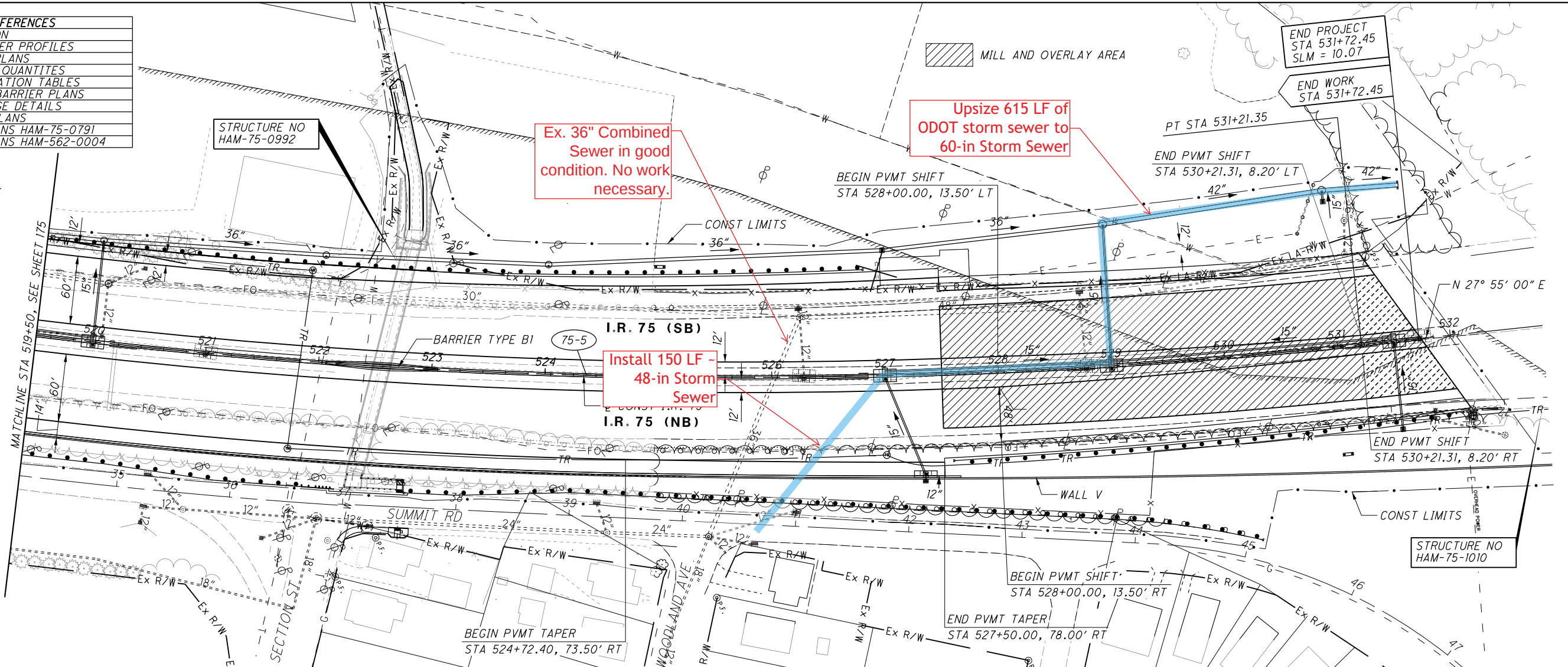
TABLE 7. JUNCTIONS 24-HOUR, 25-YEAR EVENT

Element ID	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Depth	Surcharge Depth	Minimum Pipe Cover	Peak Inflow	Peak Lateral Inflow	Maximum HGL Elevation Attained	Maximum Surcharge Depth Attained	Total Time Flooded
	(ft)	(ft)	(ft)	(ft)	(inches)	(cfs)	(cfs)	(ft)	(ft)	(minutes)
702	520.32	535.88	0.00	0.00	125.52	174.86	0.00	532.04	0.00	0.00
703	521.22	538.14	0.00	0.00	68.64	196.27	46.20	534.15	0.00	0.00
722	529.62	540.74	0.00	0.00	79.44	128.66	0.00	536.75	0.00	0.00
726	536.51	543.42	0.00	0.00	34.92	128.77	0.00	539.87	0.00	0.00
Upstream	537.51	566.43	0.00	0.00	299.04	128.74	128.74	543.31	0.00	0.00



CROSS REFERENCES	
SHEET NO	DESCRIPTION
670 - 704	STORM SEWER PROFILES
630 - 661	DRAINAGE PLANS
-	ESTIMATED QUANTITIES
586 - 605	SUPERELEVATION TABLES
906 - 916	ROADSIDE BARRIER PLANS
606 - 627	INTERCHANGE DETAILS
978 - 1004	LIGHTING PLANS
1069 - 1118	BRIDGE PLANS HAM-75-0791
1017 - 1068	BRIDGE PLANS HAM-562-0004

CURVE 75-5
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 $R = 5,208.71'$
 $T = 734.06'$
 $L = 1,458.52'$
 $E = 51.47'$
 $e_{max} = 0.030$



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HORIZONTAL SCALE IN FEET

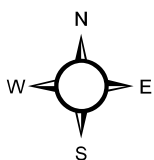
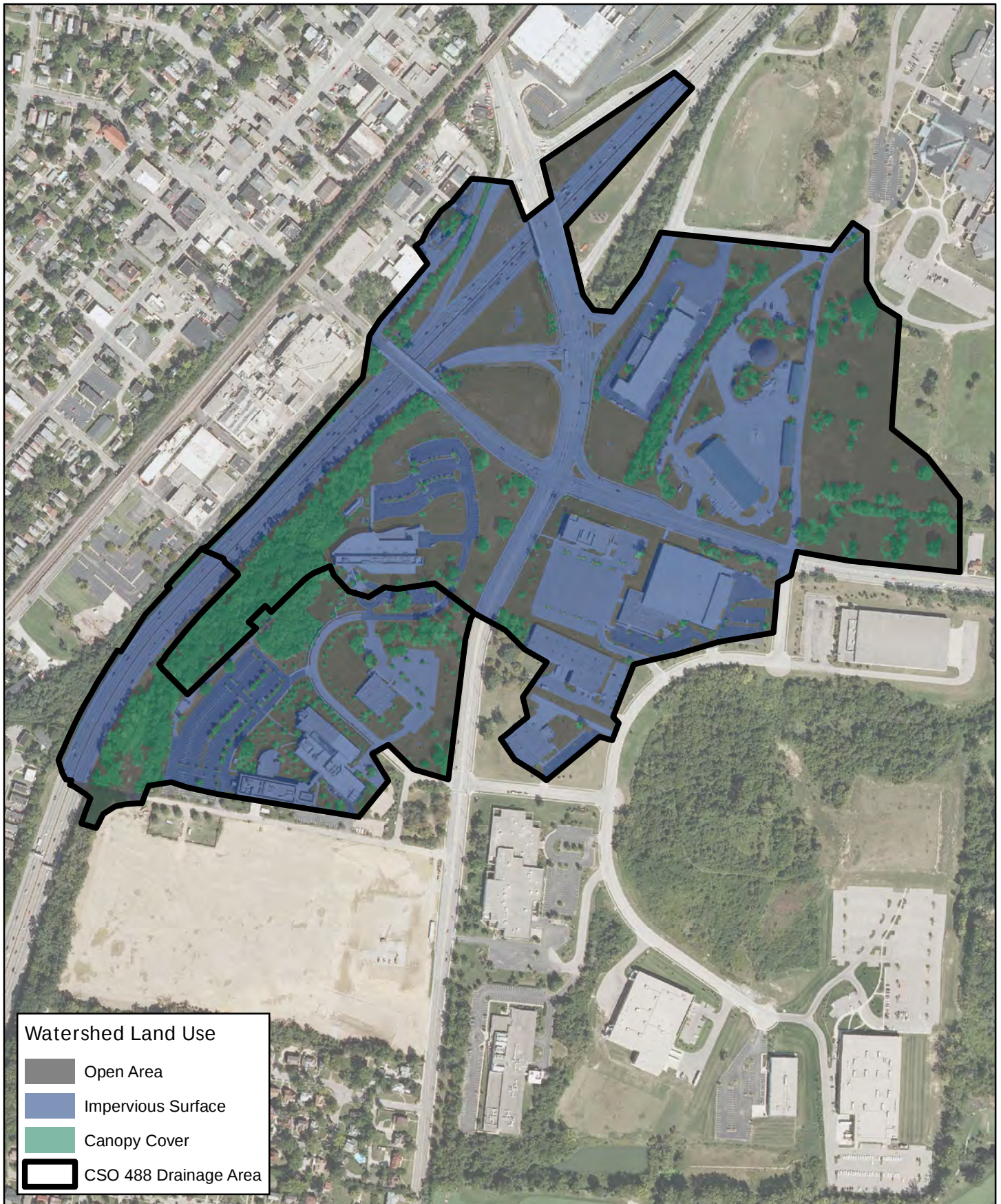
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PLAN AND PROFILE - I.R. 75
 STA 519+50 TO STA 531+72.45

HAM-75-7.85

176
1271

CSO 488 STORM SEWER CALCULATIONS



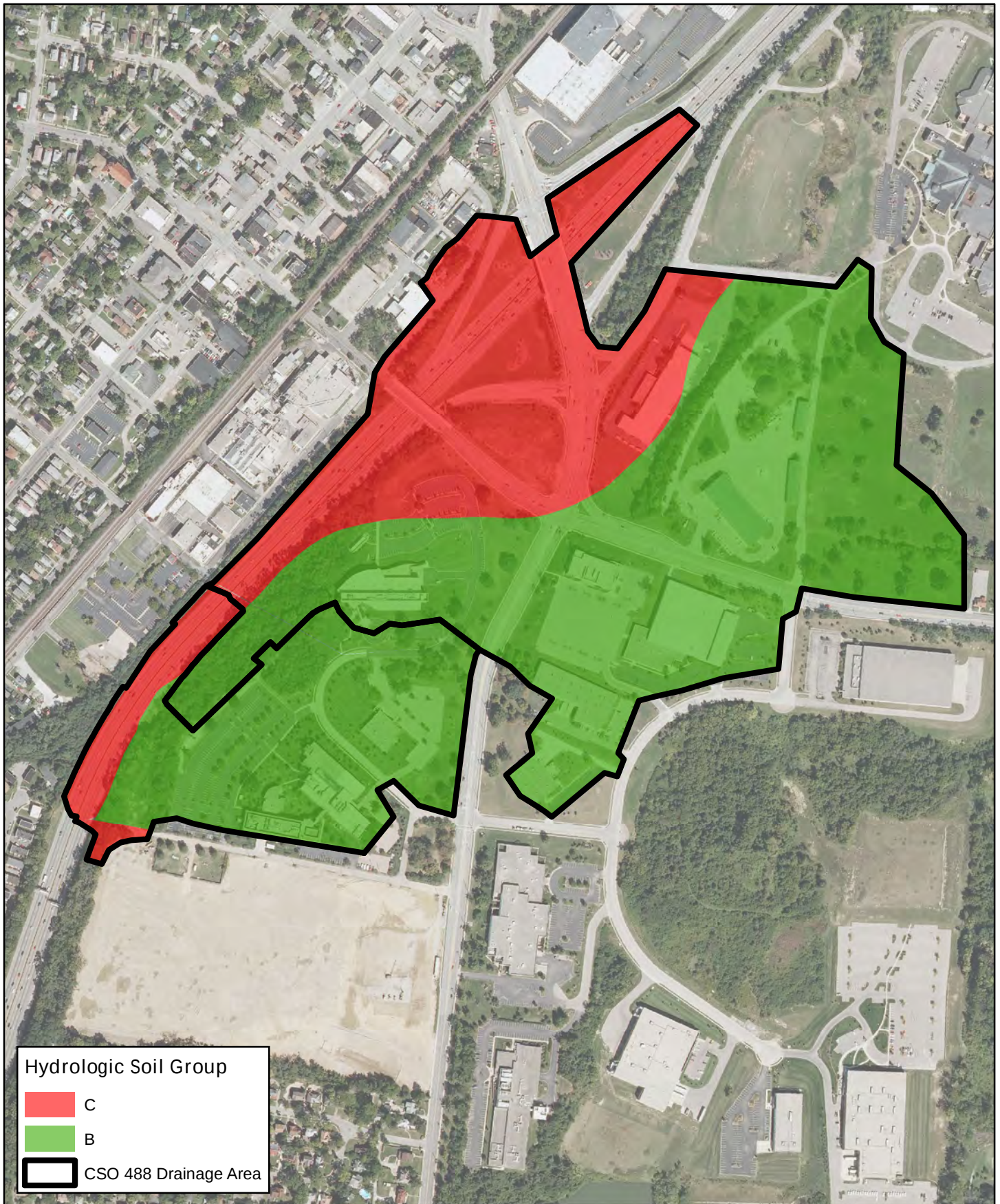
CSO 488 Storm Calculations
Land Use Map

PN: 131902

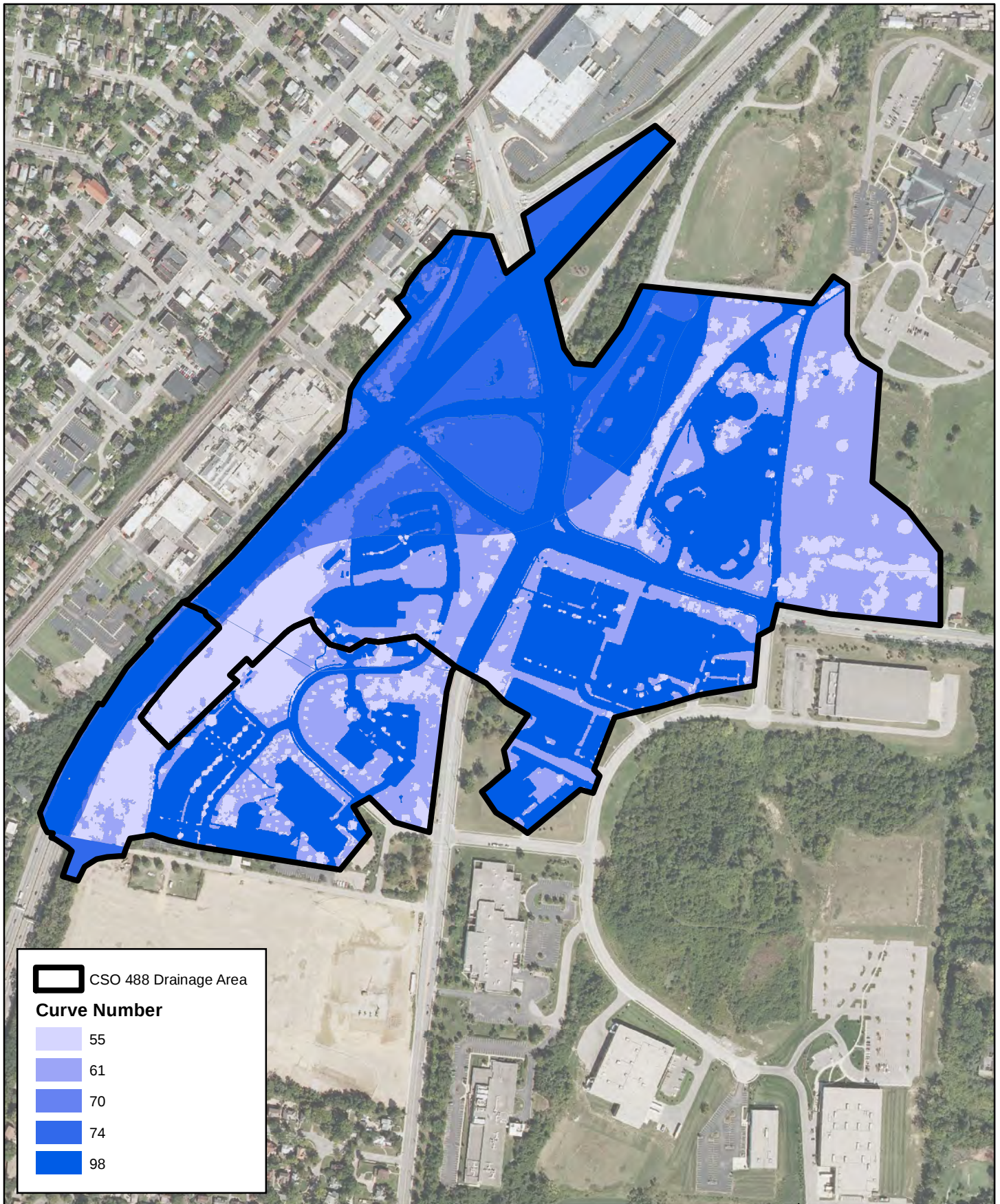
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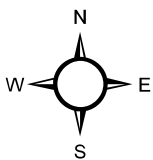
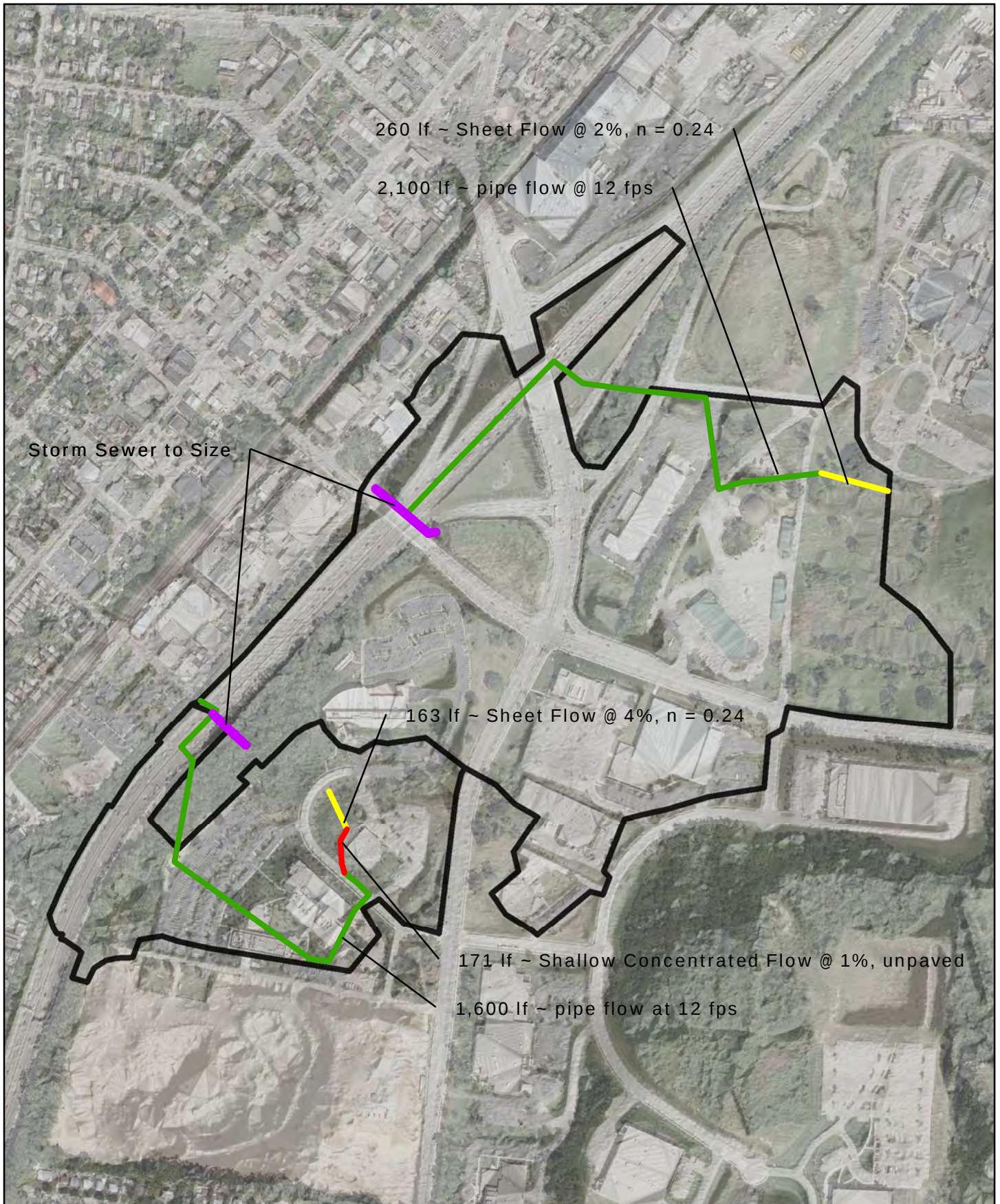
MSD PN 11143260





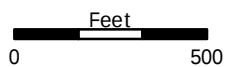
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	PN: 131902 MSD PN: 11143260	 0 500	





CSO 488 Storm Calculations
Time of Concentration

PN: 131902



MSD PN: 11143260



TABLE 1. SUB-BASIN SUMMARY, 24-HOUR, 10-YEAR EVENT

Element ID	Area (acres)	Drainage Node ID	Weighted Curve Number	Rain Gage ID	Total Precipitation (Inches)	Total Runoff (inches)	Peak Runoff (cfs)	Time of Concentration (day hh:mm:ss)
69th St Crossing	23.05	69thUpstream	77.83	Rain Gage-01	4.08	1.94	47.49	0 00:21:18
Seymour Crossing	80.20	SeymourUpstream	80.68	Rain Gage-01	4.08	2.16	139.07	0 00:35:00

TABLE 2. SUB-BASIN SUMMARY, 24-HOUR, 25-YEAR EVENT

Element ID	Area (acres)	Drainage Node ID	Weighted Curve Number	Rain Gage ID	Total Precipitation (Inches)	Total Runoff (inches)	Peak Runoff (cfs)	Time of Concentration (day hh:mm:ss)
69th St Crossing	23.05	69thUpstream	77.83	Rain Gage-01	4.80	2.53	62.27	0 00:21:18
Seymour Crossing	80.20	SeymourUpstream	80.68	Rain Gage-01	4.80	2.78	179.24	0 00:35:00

TABLE 3. CONDUITS, RESULTS FOR 24-HOUR, 10-YEAR EVENT

Element ID	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (inches)	Pipe Width (inches)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Peak Flow (cfs)	Max Flow Velocity (ft/sec)	Travel Time (min)	Design Flow Capacity (cfs)	Total Time Surcharge d (min)	Max Flow Depth (ft)
69thCrossing	69thUpstream	69thDownstream	250.00	535.00	0.00	532.50	0.00	2.50	1.00	CIRCULAR	36.00	36.00	0.02	0.50	0.00	46.93	8.72	0.48	57.81	0.00	2.13
SeymourCrossing	SeymourUpstream	SeymourDownstream	250.00	535.00	0.00	533.75	0.00	1.25	0.50	CIRCULAR	54.00	54.00	0.01	0.50	0.50	138.17	9.12	0.46	139.05	0.00	4.08

TABLE 4. CONDUITS, RESULTS FOR 24-HOUR STORM, 25-YEAR EVENT

Element ID	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (inches)	Pipe Width (inches)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Peak Flow (cfs)	Max Flow Velocity (ft/sec)	Travel Time (min)	Design Flow Capacity (cfs)	Total Time Surcharge d (min)	Max Flow Depth (ft)
69thCrossing	69thUpstream	69thDownstream	250.00	535.00	0.00	532.50	0.00	2.50	1.00	CIRCULAR	36.00	36.00	0.02	0.50	0.00	61.45	8.92	0.47	57.81	5.00	3.00
SeymourCrossing	SeymourUpstream	SeymourDownstream	250.00	535.00	0.00	533.75	0.00	1.25	0.50	CIRCULAR	54.00	54.00	0.01	0.50	0.50	177.85	11.18	0.37	139.05	20.00	4.50

TABLE 5. OUTFALLS, 24-HOUR, 10-YEAR EVENT

Element ID	Invert Elevation (ft)	Boundary Type	Flap Gate	Fixed Water Elevation (ft)	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Maximum HGL Depth Attained (ft)	Maximum HGL Elevation Attained (ft)
69thDownstream	532.50	NORMAL	NO		46.93	0.00	2.05	534.55
SeymourDownstream	533.75	NORMAL	NO		138.17	0.00	3.66	537.41

TABLE 6. OUTFALLS, 24-HOUR, 25-YEAR EVENT

Element ID	Invert Elevation (ft)	Boundary Type	Flap Gate	Fixed Water Elevation (ft)	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Maximum HGL Depth Attained (ft)	Maximum HGL Elevation Attained (ft)
69thDownstream	532.50	NORMAL	NO		61.45	0.00	3.00	535.50
SeymourDownstream	533.75	NORMAL	NO		177.85	0.00	4.50	538.25

TABLE 7. JUNCTIONS 24-HOUR, 10-YEAR EVENT

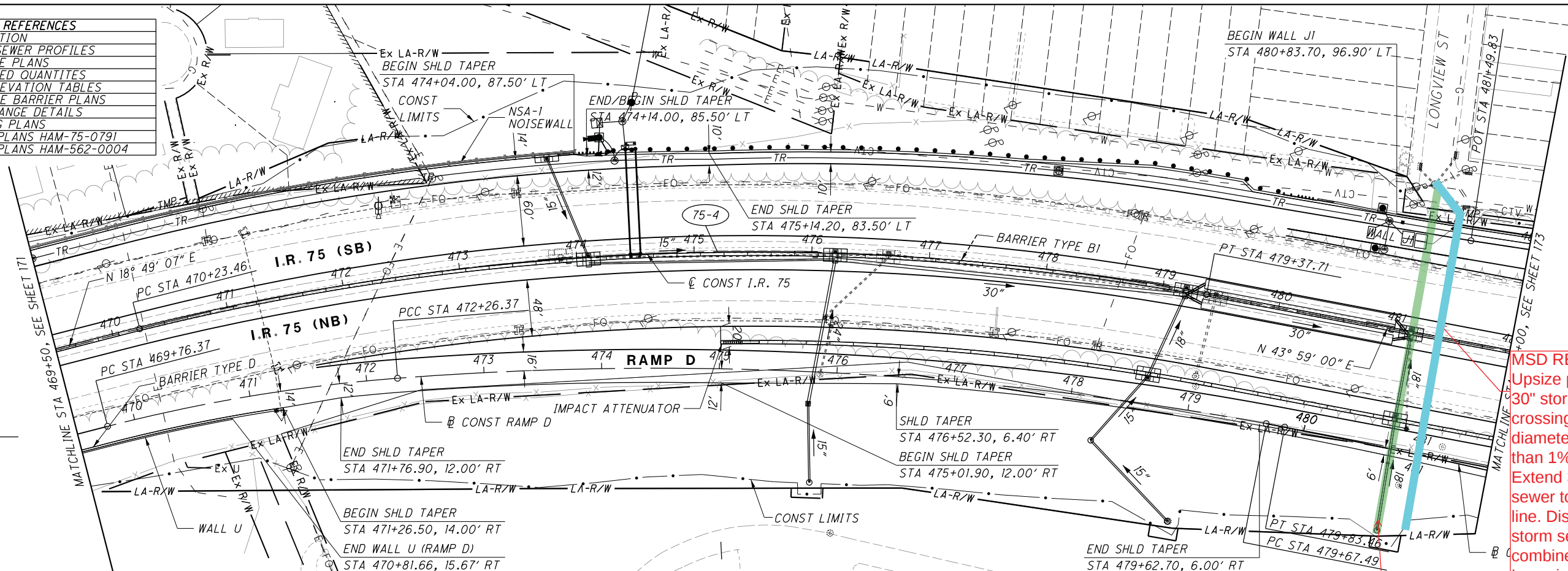
Element ID	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Depth	Surcharge Depth	Minimum Pipe Cover	Peak Inflow	Peak Lateral Inflow	Maximum HGL Elevation Attained	Maximum Surcharge Depth Attained	Total Time Flooded
	(ft)	(ft)	(ft)	(ft)	(inches)	(cfs)	(cfs)	(ft)	(ft)	(minutes)
69thUpstream	535.00	542.00	0.00	0.00	48.00	46.93	46.93	537.23	0.00	0.00
SeymourUpstream	535.00	545.00	0.00	-3.00	66.00	138.25	138.25	540.09	0.00	0.00

TABLE 8. JUNCTIONS 24-HOUR, 25-YEAR EVENT

Element ID	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Depth	Surcharge Depth	Minimum Pipe Cover	Peak Inflow	Peak Lateral Inflow	Maximum HGL Elevation Attained	Maximum Surcharge Depth Attained	Total Time Flooded
	(ft)	(ft)	(ft)	(ft)	(inches)	(cfs)	(cfs)	(ft)	(ft)	(minutes)
69thUpstream	535.00	542.00	0.00	0.00	48.00	61.46	61.46	539.00	0.00	0.00
SeymourUpstream	535.00	545.00	0.00	-3.00	66.00	177.94	177.94	542.25	0.00	0.00

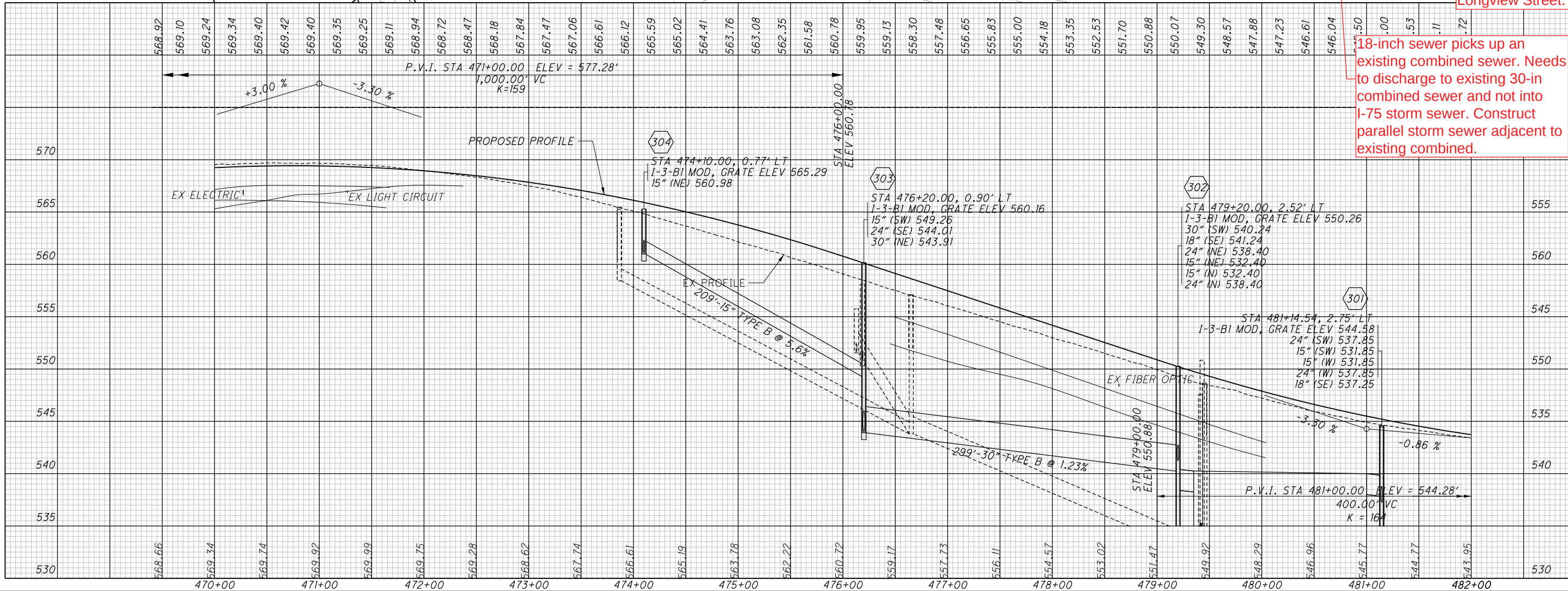
CROSS REFERENCES	
SHEET NO	DESCRIPTION
670 - 704	STORM SEWER PROFILES
630 - 661	DRAINAGE PLANS
-	ESTIMATED QUANTITIES
586 - 605	SUPERELEVATION TABLES
906 - 916	ROADSIDE BARRIER PLANS
606 - 627	INTERCHANGE DETAILS
978 - 1004	LIGHTING PLANS
1069 - 1118	BRIDGE PLANS HAM-75-0791
1017 - 1068	BRIDGE PLANS HAM-562-0004

CURVE 75-4
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 $L = 914.25'$
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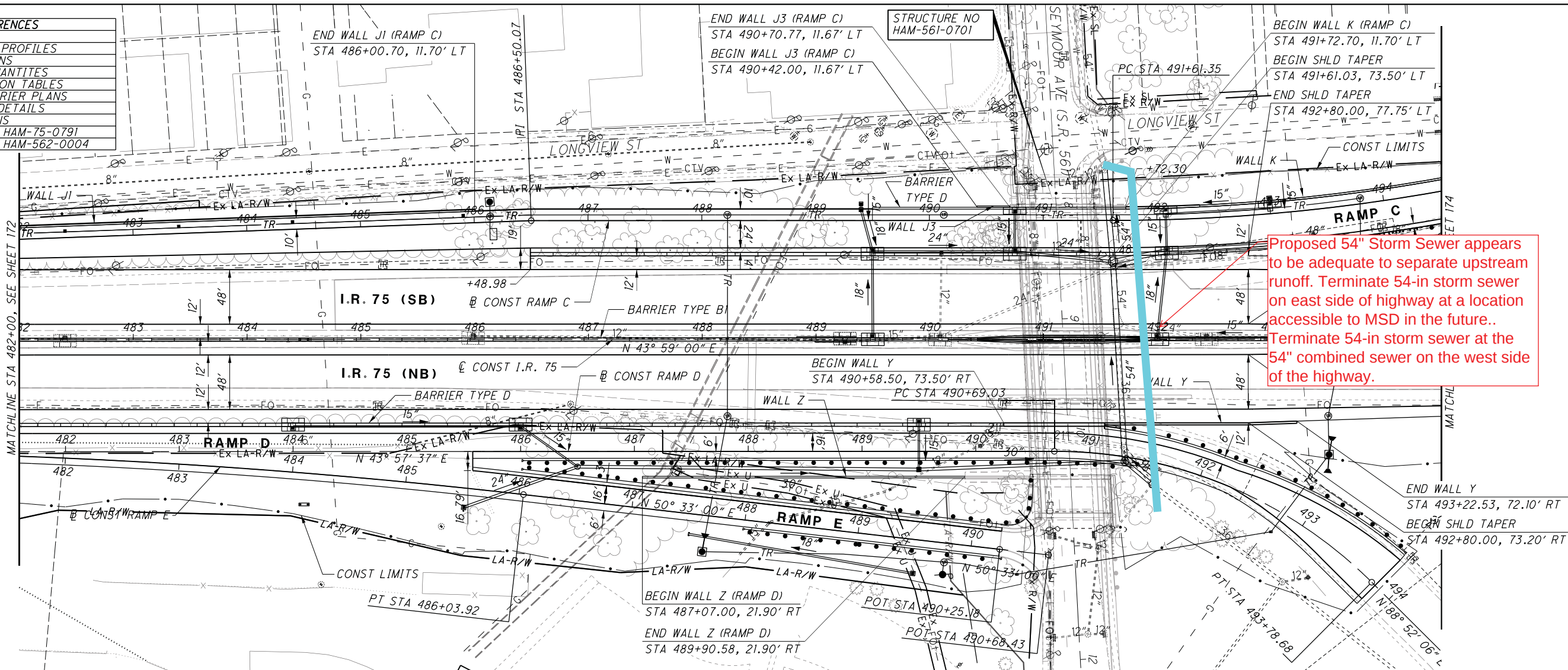
MSD REQUEST:
 Upsize proposed 30" storm sewer crossing to 36" diameter (greater than 1% slope). Extend 36" storm sewer to east R/W line. Discharge 36" storm sewer to combined sewer at Longview Street.

18-inch sewer picks up an existing combined sewer. Needs to discharge to existing 30-in combined sewer and not into I-75 storm sewer. Construct parallel storm sewer adjacent to existing combined.



J:\20110903\ODOT\HAM\77889\roadway\sheet\77889GP404.dgn 8/12/2013 9:40:10 AM afeicht

CROSS REFERENCES	
SHEET NO	DESCRIPTION
670-704	STORM SEWER PROFILES
630-661	DRAINAGE PLANS
-	ESTIMATED QUANTITIES
586-605	SUPERELEVATION TABLES
906-916	ROADSIDE BARRIER PLANS
606-627	INTERCHANGE DETAILS
978-1004	LIGHTING PLANS
1069-1118	BRIDGE PLANS HAM-75-0791
1017-1068	BRIDGE PLANS HAM-562-0004



Proposed 54" Storm Sewer appears to be adequate to separate upstream runoff. Terminate 54-in storm sewer on east side of highway at a location accessible to MSD in the future.. Terminate 54-in storm sewer at the 54" combined sewer on the west side of the highway.

