STORMWATER MANAGEMENT REPORT

for

Proposed Multi-Family Development

Prepared for:

212 Durham Urban Renewal Entity, LLC

Block 37, Lots 5.12, 5.22, 6, 7.01, 7.02, 13,
14, 15.01, 16.02, 16.03, 17.01, 17.02 & Block 42, Lots 1-7
212 Durham Avenue, Borough of Metuchen
Middlesex County, New Jersey

Prepared by:

BOHLER

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1. <u>Introduction</u>

The intention of this study is to analyze the stormwater drainage conditions that will occur as a result of the Proposed Development located at 212 Durham Ave. in the Borough of Metuchen, Middlesex County, New Jersey. The subject site is more specifically defined as Block 37, Lots 5.12, 5.22, 6, 7.01, 7.02, 13, 14, 15.01, 16.02, 16.03, 17.01, 17.02 & Block 42, Lots 1-7 in the Borough of Metuchen. These lots have been approved to be consolidated and re-subdivided by the Borough of Metuchen, under Resolution #22-1334E. The overall lot consolidation is shown on the USGS Map and Site Location Map within the Appendix of this report. This area has additionally been deemed an area in need of redevelopment, in accordance with the "Amended Gulton Tract Redevelopment Plan", adopted by the Borough of Metuchen. The County Parcel (Parcel A), as shown on the Overall Parcel Plan (Sheet C-301), will be set aside for future sale and/or management to Middlesex County, as part of efforts to create a southern gateway to the Peter J. Barnes III Wildlife Preserve, which contains Dismal Brook, along with other environmentally sensitive areas, such as wetlands. The Borough of Metuchen has sought to advance redevelopment efforts of this tract to provide Parcel A as this gateway for public access, public parking, walking trails and various amenities related to the Peter J. Barnes III Wildlife Preserve, and to coordinate the anticipated extension of, and connectivity to, the future Middlesex Greenway Extension. Trails and other amenities for this Parcel, along with their associated stormwater considerations, will be further refined and permitted with the NJDEP in a <u>future</u> design phase. The proposed improvements on the Parcel A tract in this current phase are limited to the creation of the 'Public Access Drive' with parallel parking spaces. A gravel parking lot on Parcel A has been accounted for in the proposed stormwater design herein, however, will not be constructed until a future phase.

The balance of the tract, identified as the Development Parcel (Parcel B) along Durham Avenue, and as shown on the Overall Parcel Plan (Sheet C-301), was also identified by the Borough of Metuchen as an area in need of redevelopment. Parcel B is where a majority of development and disturbance is proposed as part of this application. The proposed improvements on Parcels A & B collectively consist of approximately 12 acres of disturbance. Said areas of disturbance shall be referenced herein as the 'Site', as shown on the Site Plans. The Site is bordered to the north by Dismal Brook with a large wooded area and commercial development beyond; to the west by a single-family home residential subdivision; to the south by the Metuchen Sportsplex and a single-family home residential subdivision, with New Durham Road beyond; and to the east by the Middlesex Greenway, with an automotive service shop, vehicle storage uses and Jersey Avenue beyond. The **'study area'** that is analyzed throughout this Report consists of approximately 12+/- acres of disturbance within Parcels A & B, along with portions of undisturbed wetlands and wooded areas, that total to approximately **13.5 +/- acres** in size.

The proposed improvements include the demolition of the existing site improvements such as buildings, pavement and limited landscape areas to make room for the proposed improvements. The proposed development consists of one (1) multi-family residential apartment building comprised of 272 residential units and associated amenity spaces with under-story ground floor parking. Additional improvements include parking/loading & circulation areas, garages, landscaping areas, associated utilities, and recreational amenity spaces (dog park, pool courtyard and garden area, etc.) The proposed stormwater management system is designed so that all stormwater management requirements set forth by the New Jersey Department of Environmental Protection (NJDEP) are met.

The scope of this study includes an analysis of both the existing and proposed drainage characteristics associated with the existing and proposed improvements of the site. This Report comparatively analyzes the pre-development site runoff to the post development site runoff. Calculations documenting the design of the stormwater management system, as illustrated on the Site Plan prepared by Bohler Engineering are included within the Appendix of this Report.

The following issues will be addressed and outlined in this Report:

- Calculations for pre- and post-development storm events for the 2-, 10-, and 100-year design storm runoff rate for the study area.
- Narrative of pre- and post-development conditions with calculations to substantiate derived runoff coefficients and time of concentration.
- Calculations to substantiate the capacity of the proposed stormwater conveyance system.

2. Pre-Development Conditions

The subject study area encompasses approximately 13.5 acres. The existing site consists of three (3) existing buildings with associated asphalt parking areas, landscaped and wooded areas, associated utilities, and a portion of Dismal Brook.

2.1 Topography

The topography for the developed portion of the Site varies from less than 1 percent, all the way to 1:1 slopes. There are three (3) existing buildings at varying finished floor elevations (FFE). The highest point on site is about 87.5’ +/- near the western site access from Durham Ave. The lowest point on site is about 68.3’ +/- at the Dismal Brook streambed at the northwest corner of the study area.

2.2 Freshwater Wetlands & Dismal Brook Riparian Zone

As defined on the ALTA/NSPS Land Title Survey, prepared by Control Point Associates, Inc., there is an area of freshwater wetlands located in the southwestern portion of the site, immediately beyond the Houston Street ROW. There is an anticipated 50-foot buffer associated with this wetland, as it was classified as intermediate resource value. The wetland is not a part of a tributary system connected to a surface water, river or stream; it will be filled under an NJDEP FWW General Permit #6. This permit has not been issued yet, however, a copy can be provided to your office upon request. Additionally, based on LOI#1210-13-0001.1, wetland areas are located to the north and west of the Site, overlapping in some areas with the 50-foot riparian zone associated with Dismal Brook that is behind the Site. There is a 50-foot buffer associated with these intermediate resource value wetlands, as well.

Dismal Brook is a stream traversing the overall lot consolidation. The stream flows in a northerly direction along the Site’s eastern boundary, before flowing in a westerly direction along the Site’s northern boundary. Under the existing condition, there is an existing outfall into Dismal Brook located to the east of the Site. The proposed development will keep this existing outfall. In addition, the development proposes to install two new (15” and 36”) stormwater discharge pipes and outfalls to Dismal Brook, also with associated scour hole protections. Our office is working on the required NJDEP permitting and can provide copies of the NJDEP FWW Permits, upon issuance and receipt.

2.3 Flood Hazard Area

Based on FEMA Firm Panel 34023C0061F, a portion of the existing site is within the 100-Year Flood Hazard Area of Dismal Brook. The development proposes to fill a portion of the site to bring the residential parking and access areas above the flood-hazard area design flood elevation (77.6 FT), and to provide net compensation storage in areas more adjacent to the Brook, in accordance with the NJDEP NJAC 7:13 Flood Hazard Control Act Rules. These areas of compensation do not impact any stormwater management systems, as there are no stormwater management basins proposed.

2.4 Seasonal Groundwater

The seasonal high groundwater (SHGW) table was based on borings taken by "Whitestone Associates, Inc." in the areas of proposed Site. Static groundwater was encountered within the borings at depths ranging from approximately 4 to 7 FT below grade surface. Please refer to the "Report of Geotechnical Investigation" last updated on August 8, 2022 by Whitestone Associates, Inc. for further information.

2.5 Drainage

The existing site conditions for the studied subject property are illustrated on the "Existing Drainage Area Map" included within the Appendix of this report. This map is based on an ALTA/NSPS Land Title Survey, prepared by Control Point Associates, Inc. Based on analysis of the existing topography of the subject property, the existing conditions are broken down into one (1) watershed as follows:

- **EDA-1** (approximately 13.45 acres) consists of the entirety of the Site development limits. The area is comprised of three (3) existing buildings, with associated parking, landscaped and wooded areas. Stormwater from this drainage area is collected via a series of inlets & pipes before discharging to Dismal Brook via one (1) existing 15" pipe, along with overland flow to the Brook. No stormwater basin exists on-site today. The existing discharge pipe to Dismal Brook eventually drains to Point of Interest #1 (POI #1) as labeled on the "Existing Drainage Area Map".

2.6 Site Soils

The site soils as depicted per Web Soil Survey by Natural Resources Conservation are as follows:

Soil Symbol	Soil Description	Hydrologic Soil Group
LbuB	Landsdowne-Urban Land Complex, 0 to 6 percent slopes	C
DuyB	Dunellen moderately well drained variant-Urban land complex, 0 to 6 percent slopes	A
PsuB	Psamments, waste substratum, 0 to 8 percent slopes	A
UdwuB	Udorthents, wet substratum-Urban land complex, 0 to 8 percent slopes	D

3. Post-Development Conditions

3.1 Surface Cover / Development

As previously mentioned, the Site includes one (1) multi-family residential building with under-story parking, and recreational & amenity areas. Additional improvements include parking/loading & circulation areas, landscaping areas, stormwater conveyance systems, associated utilities, and related site improvements. The total proposed land disturbance on site is approximately 12+/- acres. The overall impervious area under the existing condition is approximately 8.5+/- acres; under the proposed condition, the overall impervious area is approximately 6.2+/- acres. An overall reduction of approximately **2.3+/-** acres of impervious area (building roof area, sidewalk and motor vehicle surfaces) is proposed for the development. Based on the stormwater management requirements set forth by the New Jersey Department of Environmental Protection (NJDEP), a stormwater management basin will not be required.

3.2 Drainage

The Site has been designed and graded to respect and maintain the natural, existing drainage patterns to the fullest extent possible, and to meet the governing agencies' requirements with respect to water quantity (peak runoff rate reduction), water quality (TSS removal) and groundwater recharge. Under post-development conditions, one (1) major drainage area is proposed as depicted on the accompanying drainage plans, as follows:

- **Drainage Area PDA-1** (approximately 13.45 acres) consists of the entirety of the study area. This area is comprised of the proposed building, amenity areas, parking areas, and landscape areas. The development proposes to reduce the overall impervious area (building roof area, sidewalk and motor vehicle surfaces) by approximately **2.3+/-** acres from the pre-development conditions. Stormwater runoff from this drainage area will be collected by a series of inlets and a stormwater conveyance system. The stormwater conveyance system eventually discharges via three outfalls (one of which is an existing outfall) & scour holes into Dismal Brook, or Point of Interest #1 (POI #1), as labeled on the "proposed Drainage Area Map".

3.3 Off-Site Stormwater

It appears that some off-site stormwater runoff may enter the site from the southwesterly direction under the existing condition and is captured primarily by an open-grate inlet system located within a 15-FT wide drainage easement along the southwestern property line. Under the proposed condition, this runoff is captured via a grass swale and piped to the same existing open-grate inlet system, before eventually discharging to Dismal Brook, downstream of POI #1.

3.4 Non-Structural Stormwater Management Facilities

Below is the list of the nonstructural stormwater management strategies incorporated into the site design:

1. The site design protects areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss. Site visits have been conducted by a licensed environmental specialist, our design team, and a professional landscape architect to locate environmentally sensitive areas and existing tree type/caliper/condition on the site. The proposed development and limit of disturbance have been designed to respect these areas to the maximize extent practical.

2. Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces – The proposed impervious area coverage and motor vehicle surface area is decreased.
3. Maximize the protection of natural drainage features and vegetation – The existing riparian zone is being maintained and improved in the proposed condition, with areas that were previously pavement being replanted in accordance with NJDEP requirements.
4. Minimize the decrease in the "time of concentration" from pre-construction to post construction. "Time of concentration" is defined as the time it takes for runoff to travel from the hydraulically most distant point of the watershed to the point of interest within a watershed. The "time of concentration" is maintained to maximum extent practical under the proposed condition.
5. Minimize land disturbance including clearing and grading – The land disturbance is reduced as much as practical, and the overall condition is improved by reducing the proposed impervious area from the existing condition and revegetating areas that were previously impervious.
6. Minimize soil compaction – The soil compaction will be minimized by utilizing light weight, rubber-tired construction equipment whenever possible.
7. Provide low maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers and pesticides. – An extensive landscaping plan has been prepared by landscape specialist which minimizes the use of lawn, fertilizers and pesticides. The site plan also provides consideration to preservation of the existing wooded and undisturbed areas around the remainder of the tract.
8. Provide vegetated open-channel conveyance systems discharging into and through stable vegetated areas. A grass swale is proposed along the edge of southwestern property lines.
9. Provide other source controls to prevent or minimize the use or exposure of pollutants at the site, in order to prevent or minimize the release of those pollutants into stormwater runoff. – N-ECO inlet curb pieces are proposed for all curbed inlets. Trash receptacles are to be placed inside of buildings and at all entrance doors.

3.5 Soil Erosion and Sediment Control Design

Standard soil erosion and sediment control measures and BMPs will be employed during site construction such as silt fences, inlet protection, stabilized construction entrances, soil stockpiles, etc. These details are also included within the accompanying site plan set.

4. Methodology

The stormwater management facilities have been designed in accordance with the local, county and state requirements.

4.1 Calculation Software

The calculations included within this report were performed using hydrologic software, HydroCAD (Version 10.20) by HydroCAD Software Solutions, LLC. Time of concentration calculations for the pre and post-development were generated utilizing the SCS Method. All storm runoff data for this project were generated using the SCS unit hydrographs.

4.2 Runoff "CN" Values

The soil classifications for use with runoff curve numbers (CN) were taken from the NRCS Web Soil Survey (see Appendix C). Evaluation of these maps indicated that soils within the existing and proposed drainage areas consisted of hydrologic soil groups “A”, “C” & “D” as defined within the United States Soil Conservation Service Manual.

Runoff CN values for the soil groups were assigned to various surfaces as follows:

	Soil Group:	**A**	**C**	**D**
Ground Cover	**CN Values:**			
Wooded Areas (good condition)		30	70	77
Landscaped/Lawn (good condition)		39	74	80
Impervious/Building Areas		98	98	98

Runoff CN value calculations for pre- and post-developed conditions were generated using HydroCAD software and are included within the Appendix of this report.

4.3 Time of Concentration

Time of concentration is defined as “the sum of travel times for segments along the hydraulically most distant flow path”. Based on the latest NJDEP rules, a minimum or default value cannot be used for the time of concentration. Under the existing condition, the time of concentration (Tc) routes are calculated for both impervious and pervious areas separately. Under the proposed condition, the time of concentrations are also calculated for both impervious and pervious areas separately. These time of concentration routes are shown on the “Existing Drainage Area Map” and “Proposed Drainage Area Map”, respectively, located in the Appendix of this report. Using the HydroCAD software, pre-and post-condition hydrographs were generated for the 2-, 10- and 100-year storms. Additionally, comparison tables for the 2-, 10- and 100-year storms are included within the Appendix to demonstrate that the post-construction hydrographs do not exceed, at any point in time, the pre-construction runoff hydrographs for the same storm events. All Tc calculations are in accordance with the methodology outlined in the latest version of the NJBMP Manual Chapter 5.

4.4 Pipe Sizing

Pipe sizing for the stormwater conveyance system is calculated using the “Hydraflow Storm Sewers Extension for Autodesk Civil 3D” with a 25-year design storm for capacity verification. One (1) pipe run between ‘A’ Inlet #1B/C – Scour Hole #1 is sized to handle the 10-year design storm, as the entirety of this system falls under the 10-Year Flood elevation. Conveyance calculations and an Inlet Drainage Area Map outlining the pipe sizing results are included in the Appendix of this report.

4.5 Water Quality / TSS Removal

Per N.J.A.C. 7:8-5.5 (a), stormwater runoff quality standards are applicable when the major development results in an increase of one-quarter acre or more of regulated motor vehicle surface. The proposed development proposes to reduce regulated motor vehicle surfaces on-site by approximately **2.2+/-** acres, thus making it exempt from the NJDEP water quality requirement.

4.6 Water Quantity (Peak Runoff Rate Reduction)

Per N.J.A.C. 7:8-5.6 (b) 1, post-construction runoff hydrographs for the two-, 10- and 100-year storm events do not exceed, at any point in time, the pre-construction runoff hydrographs for the same storm events.

The following tables show the comparison between the pre-development and the post-development stormwater runoff rates for POI #1 and demonstrate that the site design meets the quantity reduction for the peak runoff rate requirement.

Stormwater Runoff Rate Comparison to POI #1

Per N.J.A.C. 7:8-5.6 (b)1

EDA-1 VS. PDA-1			
	2 YEAR	**10 YEAR**	**100 YEAR**
Pre-Development Flow Rate (CFS)	21.36	32.87	56.00
Post Development Flow Rate (CFS)	15.60	25.49	52.46
NJDEP Standard Achieved?	YES	YES	YES

For a point-to-point comparison report (@ any point in time), refer to Appendix A for the 2-year, 10-year and 100-year storm events.

4.7 Groundwater Recharge

Per the New Jersey Stormwater Best Management Practices Manual, the proposed development shall comply with one of the following two groundwater recharge requirements:

Requirement 1: That 100 percent of the Site's average annual pre-developed groundwater recharge volume be maintained after development; or

Requirement 2: That 100 percent of the difference between the Site's pre- and post-development 2-year runoff volumes be infiltrated.

The Site is located within PA-1, groundwater recharge is not required. In addition, as demonstrated in the New Jersey Groundwater Recharge Spreadsheet (NJGRS), the NJDEP groundwater recharge requirement is satisfied for the proposed development, and there is no groundwater recharge volume deficit based on the soil type and area inputs in the NJGRS.

5. Conclusions

In summary, the proposed stormwater management approach illustrated on the drawings prepared by Bohler Engineering NJ, LLC meets the requirements set forth by all reviewing jurisdictional agencies and the NJDEP Stormwater Regulations. Specifically, the design meets water quality, peak runoff rate reductions and groundwater recharge requirements. As a result, we would anticipate the proposed development will have no negative impact on the existing stormwater management system in the vicinity of the subject parcel.

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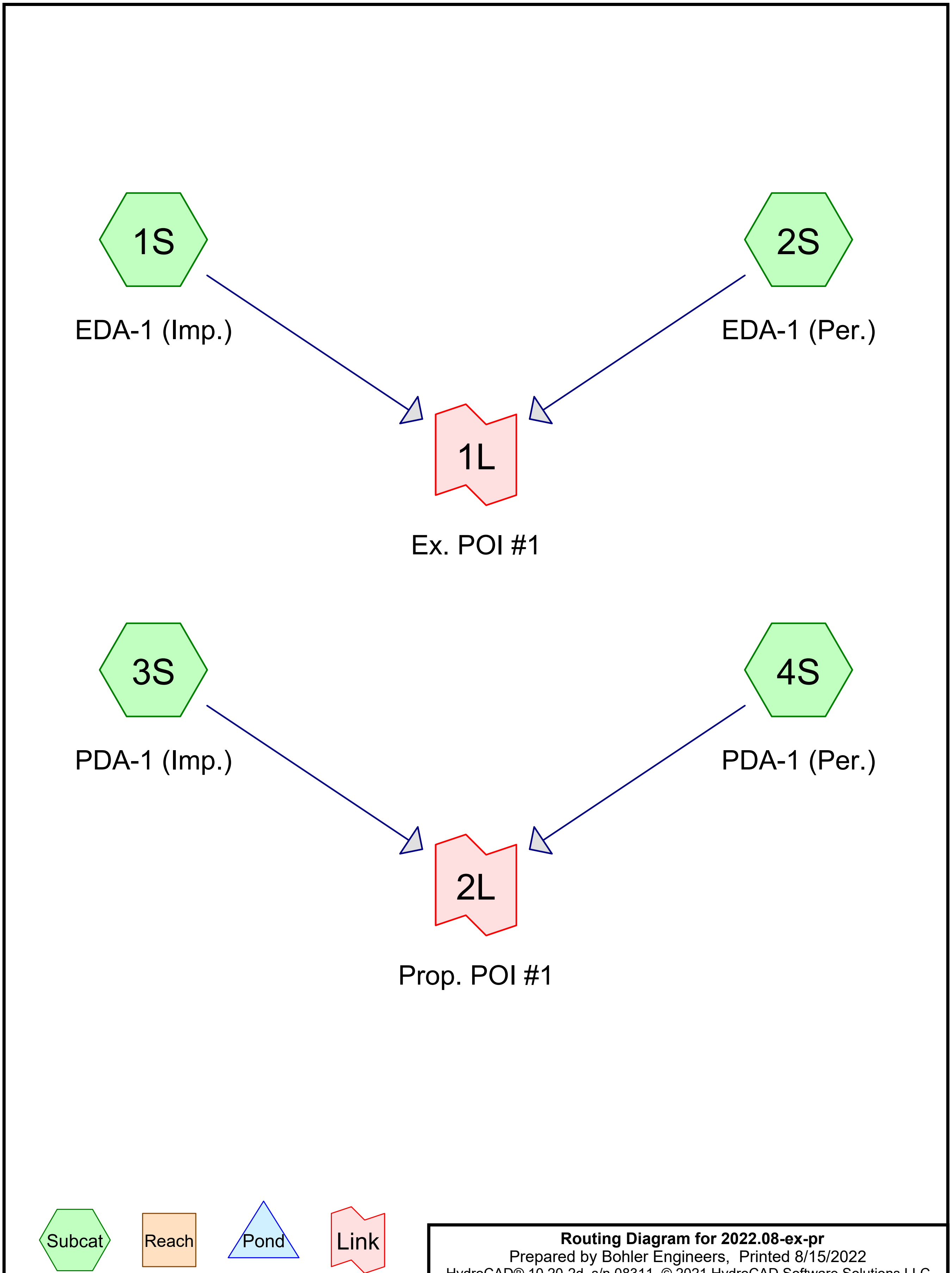
A. PRE- AND POST - DEVELOPMENT HYDROGRAPHS & TABLES

- **2-Year Storm Event**
- **10-Year Storm Event**
- **100-Year Storm Event**

2-YEAR STORM EVENT



Routing Diagram for 2022.08-ex-pr
Prepared by Bohler Engineers, Printed 8/15/2022
HydroCAD® 10.20-2d s/n 08311 © 2021 HydroCAD Software Solutions LLC

Summary for Subcatchment 1S: EDA-1 (Imp.)

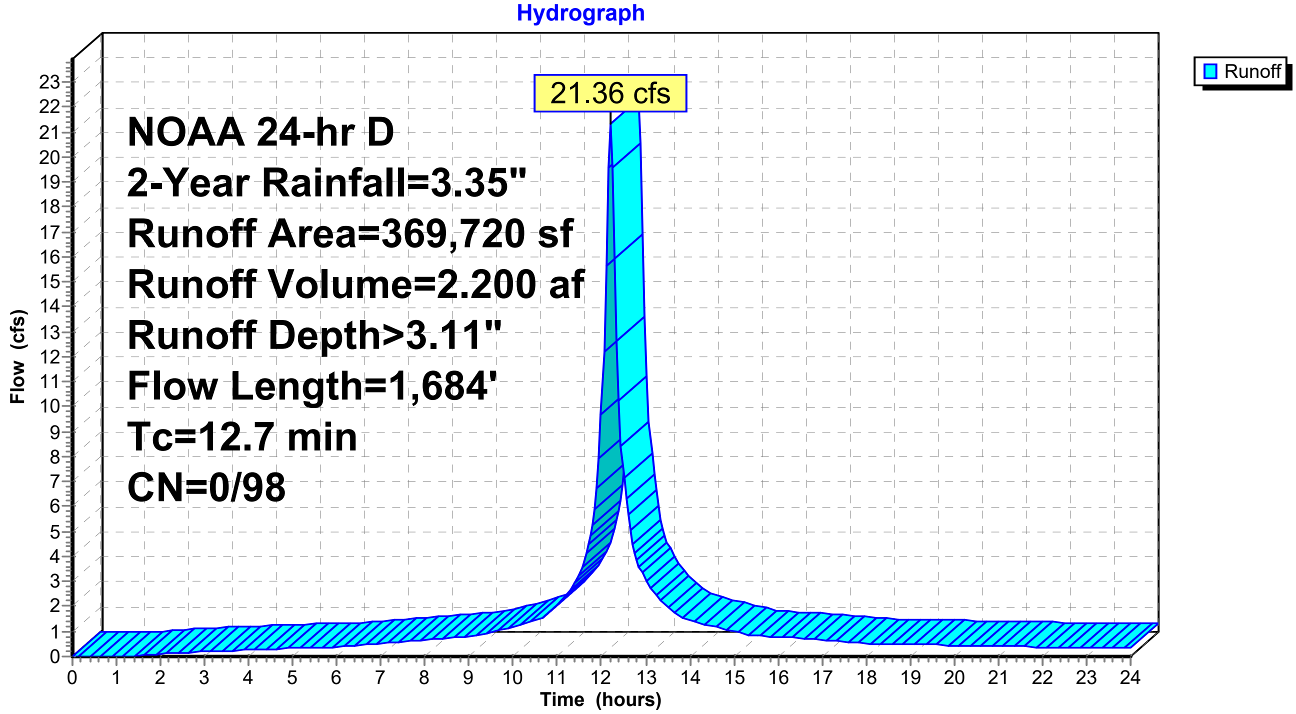
Runoff = 21.36 cfs @ 12.20 hrs, Volume= 2.200 af, Depth> 3.11"
Routed to Link 1L : Ex. POI #1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 2-Year Rainfall=3.35"

Area (sf)	CN	Description
51,021	98	Paved parking, HSG A
108,193	98	Paved parking, HSG A
21,694	98	Paved parking, HSG C
65,327	98	Paved parking, HSG D
56,573	98	Roofs, HSG A
22,044	98	Roofs, HSG C
44,868	98	Roofs, HSG D
369,720	98	Weighted Average
369,720	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	100	0.0100	1.07		**Sheet Flow, A~B** Smooth surfaces n= 0.011 P2= 3.35"
1.1	217	0.0280	3.40		**Shallow Concentrated Flow, B~C** Paved Kv= 20.3 fps
0.7	264	0.0120	5.87	4.61	**Pipe Channel, C~D** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011
0.5	153	0.0111	5.55	6.81	**Pipe Channel, D~E** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
8.8	950	0.0017	1.81	26.22	**Channel Flow, E~F** Area= 14.5 sf Perim= 17.4' r= 0.83' n= 0.030
12.7	1,684	Total			

Subcatchment 1S: EDA-1 (Imp.)



Summary for Subcatchment 2S: EDA-1 (Per.)

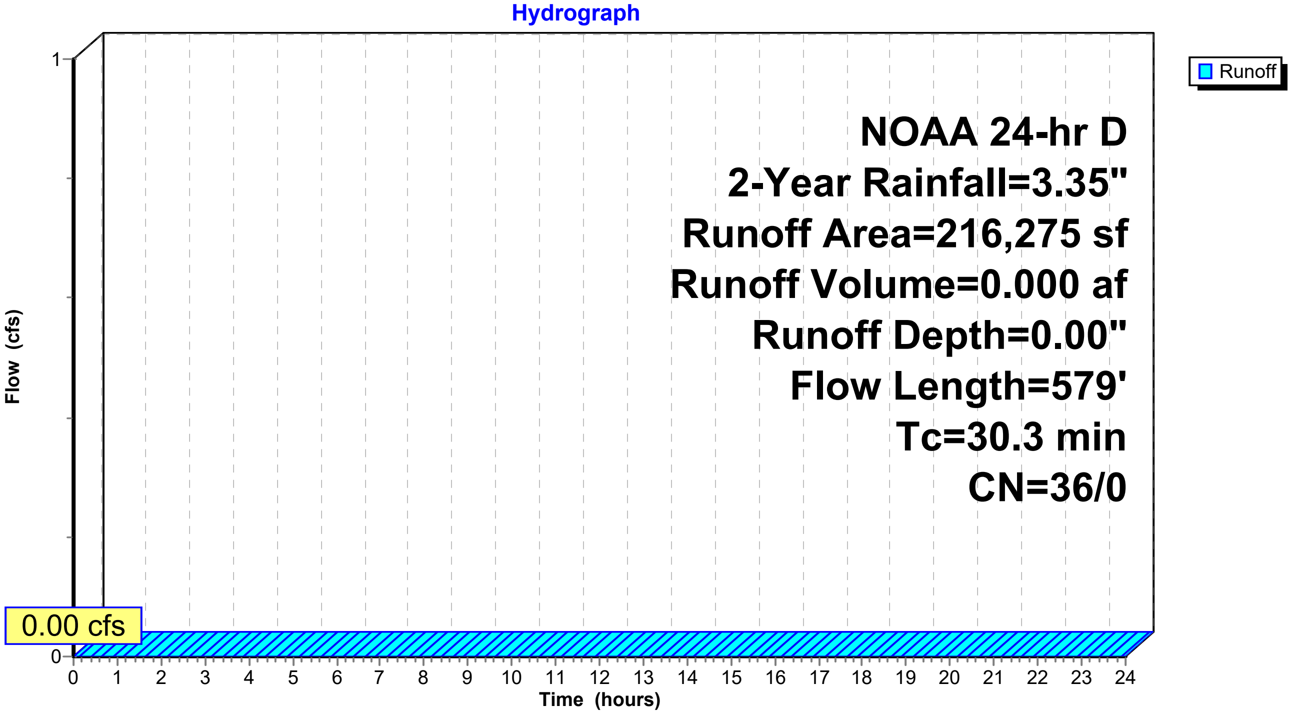
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"
Routed to Link 1L : Ex. POI #1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 2-Year Rainfall=3.35"

Area (sf)	CN	Description
32,518	39	>75% Grass cover, Good, HSG A
37,364	39	>75% Grass cover, Good, HSG A
3,661	74	>75% Grass cover, Good, HSG C
1,887	80	>75% Grass cover, Good, HSG D
111,025	30	Woods, Good, HSG A
20,151	30	Woods, Good, HSG A
9,669	77	Woods, Good, HSG D
216,275	36	Weighted Average
216,275	36	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	100	0.0163	0.11		**Sheet Flow, A~B** Grass: Dense n= 0.240 P2= 3.35"
6.7	206	0.0053	0.51		**Shallow Concentrated Flow, B~C** Short Grass Pasture Kv= 7.0 fps
8.1	228	0.0088	0.47		**Shallow Concentrated Flow, C~D** Woodland Kv= 5.0 fps
0.4	45	0.0827	2.01		**Shallow Concentrated Flow, D~F** Short Grass Pasture Kv= 7.0 fps
30.3	579	Total			

Subcatchment 2S: EDA-1 (Per.)



Summary for Subcatchment 3S: PDA-1 (Imp.)

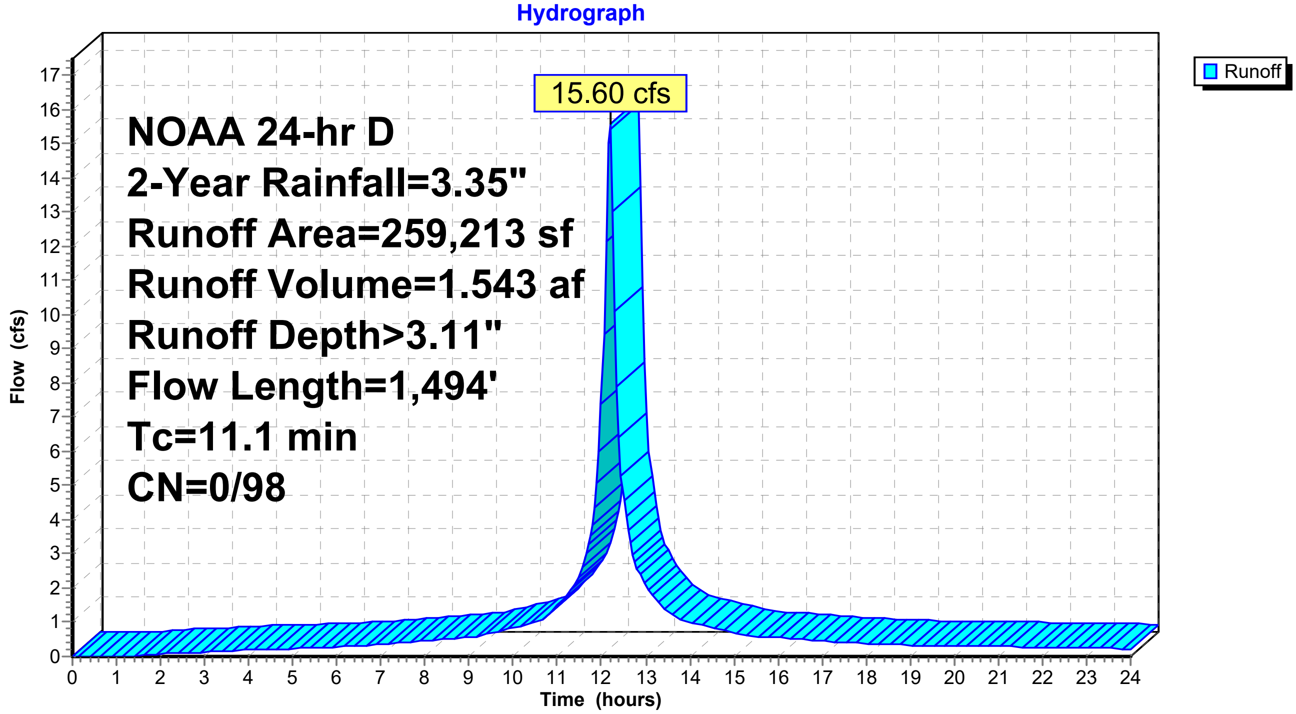
Runoff = 15.60 cfs @ 12.18 hrs, Volume= 1.543 af, Depth> 3.11"
Routed to Link 2L : Prop. POI #1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
	15,569	98	Paved parking, HSG A
	70,518	98	Paved parking, HSG A
	16,892	98	Paved parking, HSG C
	32,366	98	Paved parking, HSG D
	27	98	Roofs, HSG A
	85,831	98	Roofs, HSG A
	12,752	98	Roofs, HSG C
	19,568	98	Roofs, HSG D
*	5,690	98	Pool
	259,213	98	Weighted Average
	259,213	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0350	1.53		**Sheet Flow, A~B** Smooth surfaces n= 0.011 P2= 3.35"
1.0	232	0.0040	3.93	4.83	**Pipe Channel, B~C** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.011
0.7	210	0.0100	5.26	6.46	**Pipe Channel, C~D** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
0.1	52	0.0120	6.81	8.36	**Pipe Channel, D~E** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.011
8.8	950	0.0017	1.81	26.22	**Channel Flow, E~F** Area= 14.5 sf Perim= 17.4' r= 0.83' n= 0.030
11.1	1,494	Total			

Subcatchment 3S: PDA-1 (Imp.)



Summary for Subcatchment 4S: PDA-1 (Per.)

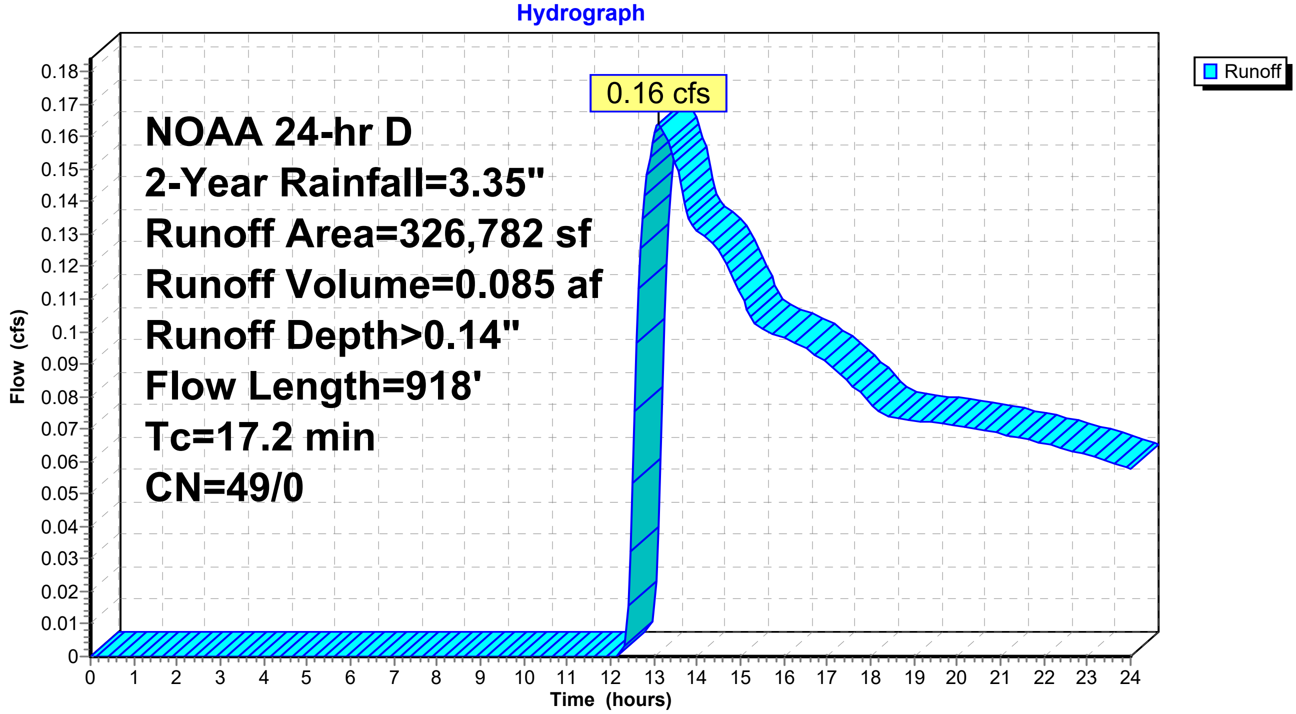
Runoff = 0.16 cfs @ 13.11 hrs, Volume= 0.085 af, Depth> 0.14"
Routed to Link 2L : Prop. POI #1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 2-Year Rainfall=3.35"

Area (sf)	CN	Description
85,969	39	>75% Grass cover, Good, HSG A
58,847	39	>75% Grass cover, Good, HSG A
17,755	74	>75% Grass cover, Good, HSG C
65,953	80	>75% Grass cover, Good, HSG D
81,345	30	Woods, Good, HSG A
2,229	77	Woods, Good, HSG D
11,654	76	Gravel roads, HSG A
1,395	76	Gravel roads, HSG A
1,635	91	Gravel roads, HSG D
326,782	49	Weighted Average
326,782	49	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	42	0.0100	0.08		**Sheet Flow, A~B** Grass: Dense n= 0.240 P2= 3.35"
1.3	66	0.0150	0.86		**Shallow Concentrated Flow, B~C** Short Grass Pasture Kv= 7.0 fps
0.5	97	0.0050	3.21	2.52	**Pipe Channel, C~D** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.4	87	0.0050	3.72	4.57	**Pipe Channel, D~E** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
5.8	626	0.0017	1.81	26.22	**Channel Flow, E~F** Area= 14.5 sf Perim= 17.4' r= 0.83' n= 0.030
17.2	918	Total			

Subcatchment 4S: PDA-1 (Per.)

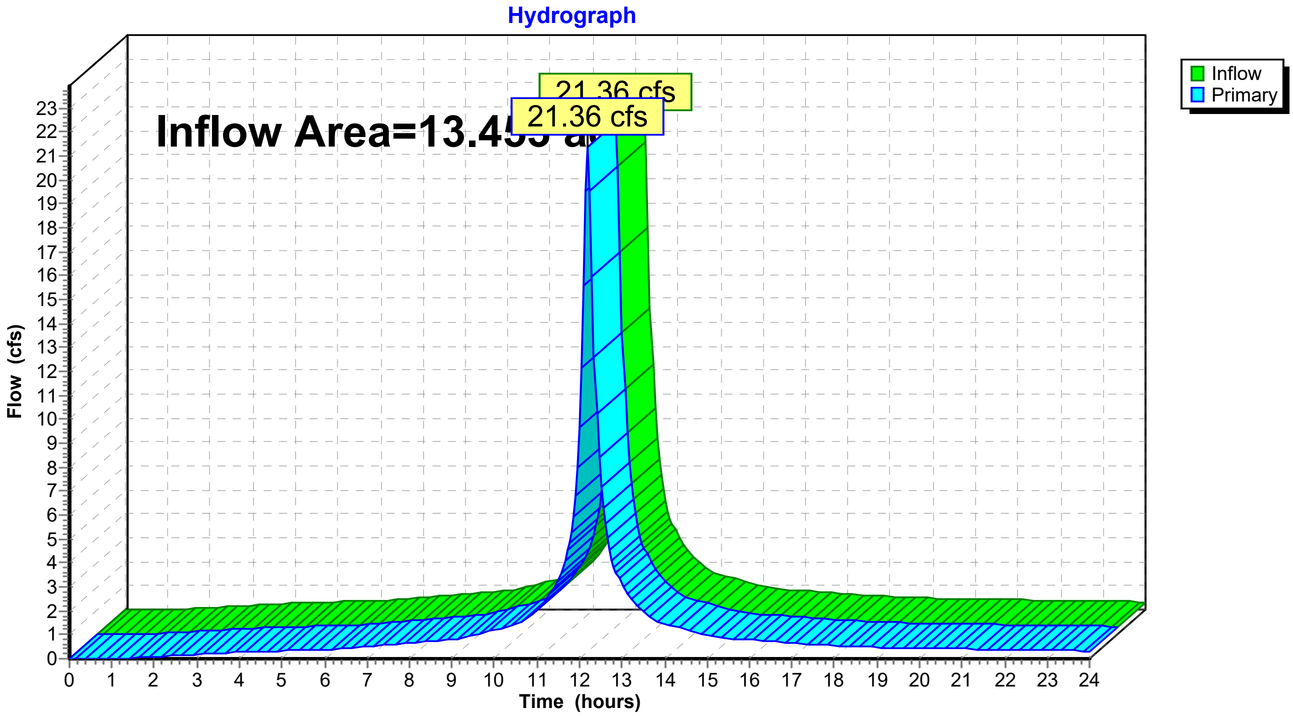


Summary for Link 1L: Ex. POI #1

Inflow Area =	13.453 ac,	63.09% Impervious,	Inflow Depth > 1.96"	for 2-Year event
Inflow =	21.36 cfs @	12.20 hrs, Volume=	2.200 af	
Primary =	21.36 cfs @	12.20 hrs, Volume=	2.200 af, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

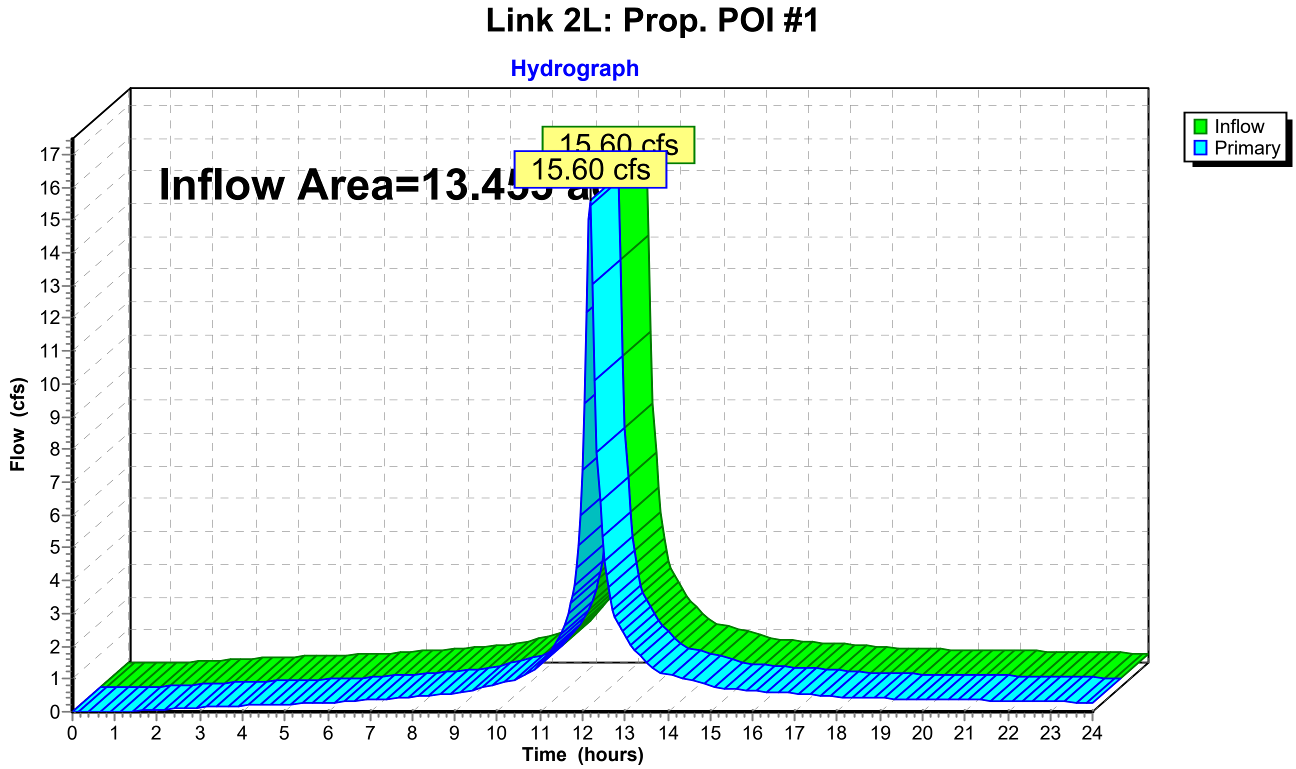
Link 1L: Ex. POI #1



Summary for Link 2L: Prop. POI #1

Inflow Area = 13.453 ac, 44.23% Impervious, Inflow Depth > 1.45" for 2-Year event
Inflow = 15.60 cfs @ 12.18 hrs, Volume= 1.628 af
Primary = 15.60 cfs @ 12.18 hrs, Volume= 1.628 af, Atten= 0%, Lag= 0.0 min

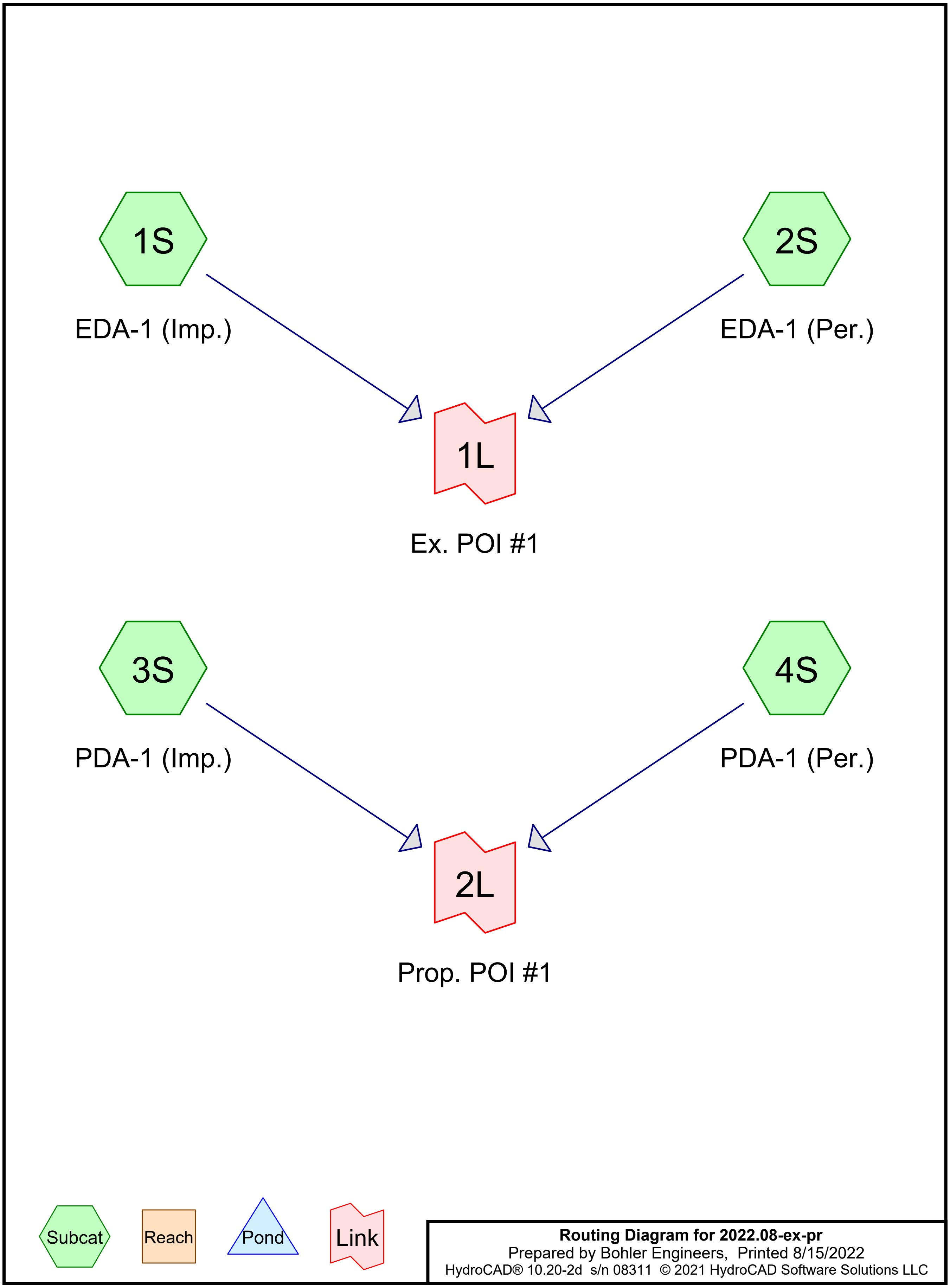
Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs



POI 1

2 - Year Storm Hydrograph Table Comparison Report			
Time (hours)	Pre-Construction (CFS)	Post-Construction (CFS)	Difference in Flow Rate (CFS) Pre - Post
0.0	0.0	0.0	0.0
0.5	0.0	0.0	0.0
1.0	0.0	0.0	0.0
1.5	0.0	0.0	0.0
2.0	0.1	0.1	0.0
2.5	0.1	0.1	0.0
3.0	0.2	0.1	0.1
3.5	0.2	0.2	0.0
4.0	0.3	0.2	0.1
4.5	0.3	0.2	0.1
5.0	0.3	0.2	0.1
5.5	0.4	0.3	0.1
6.0	0.4	0.3	0.1
6.5	0.4	0.3	0.1
7.0	0.5	0.4	0.1
7.5	0.6	0.4	0.2
8.0	0.7	0.5	0.2
8.5	0.7	0.5	0.2
9.0	0.8	0.6	0.2
9.5	1.0	0.7	0.3
10.0	1.2	0.8	0.4
10.5	1.4	1.0	0.4
11.0	2.1	1.5	0.6
11.5	3.3	2.4	0.9
12.0	9.7	7.4	2.3
12.5	7.2	4.6	2.6
13.0	3.1	2.3	0.8
13.5	2.0	1.5	0.5
14.0	1.4	1.1	0.3
14.5	1.2	1.0	0.2
15.0	1.0	0.8	0.2
15.5	0.9	0.7	0.2
16.0	0.8	0.7	0.1
16.5	0.7	0.6	0.1
17.0	0.7	0.6	0.1
17.5	0.6	0.5	0.1
18.0	0.5	0.5	0.0
18.5	0.5	0.4	0.1
19.0	0.5	0.4	0.1
19.5	0.5	0.4	0.1
20.0	0.4	0.4	0.0
20.5	0.4	0.4	0.0
21.0	0.4	0.4	0.0
21.5	0.4	0.4	0.0
22.0	0.4	0.3	0.1
22.5	0.4	0.3	0.1
23.0	0.4	0.3	0.1
23.5	0.3	0.3	0.0
24.0	0.3	0.3	0.0
	POST is less than or equal to PRE?		YES

10-YEAR STORM EVENT



Routing Diagram for 2022.08-ex-pr
Prepared by Bohler Engineers, Printed 8/15/2022
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Summary for Subcatchment 1S: EDA-1 (Imp.)

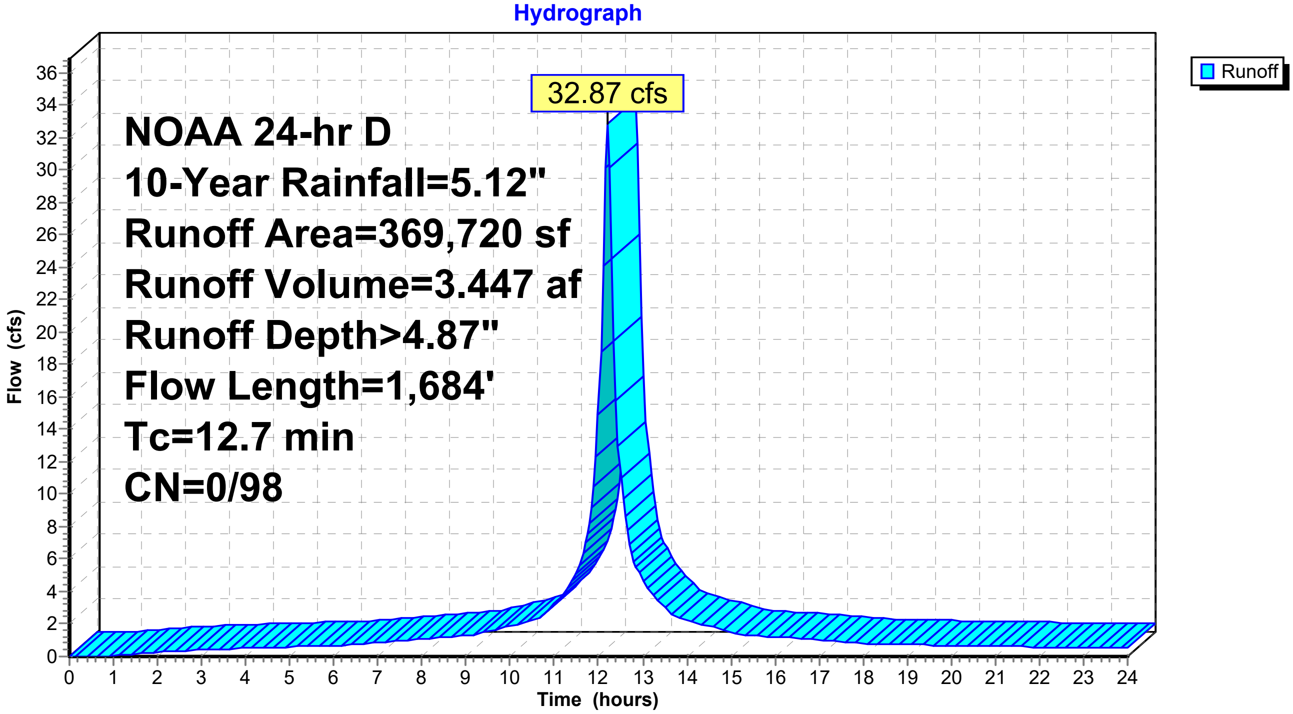
Runoff = 32.87 cfs @ 12.20 hrs, Volume= 3.447 af, Depth> 4.87"
Routed to Link 1L : Ex. POI #1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 10-Year Rainfall=5.12"

Area (sf)	CN	Description
51,021	98	Paved parking, HSG A
108,193	98	Paved parking, HSG A
21,694	98	Paved parking, HSG C
65,327	98	Paved parking, HSG D
56,573	98	Roofs, HSG A
22,044	98	Roofs, HSG C
44,868	98	Roofs, HSG D
369,720	98	Weighted Average
369,720	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	100	0.0100	1.07		**Sheet Flow, A~B** Smooth surfaces n= 0.011 P2= 3.35"
1.1	217	0.0280	3.40		**Shallow Concentrated Flow, B~C** Paved Kv= 20.3 fps
0.7	264	0.0120	5.87	4.61	**Pipe Channel, C~D** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011
0.5	153	0.0111	5.55	6.81	**Pipe Channel, D~E** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
8.8	950	0.0017	1.81	26.22	**Channel Flow, E~F** Area= 14.5 sf Perim= 17.4' r= 0.83' n= 0.030
12.7	1,684	Total			

Subcatchment 1S: EDA-1 (Imp.)



Summary for Subcatchment 2S: EDA-1 (Per.)

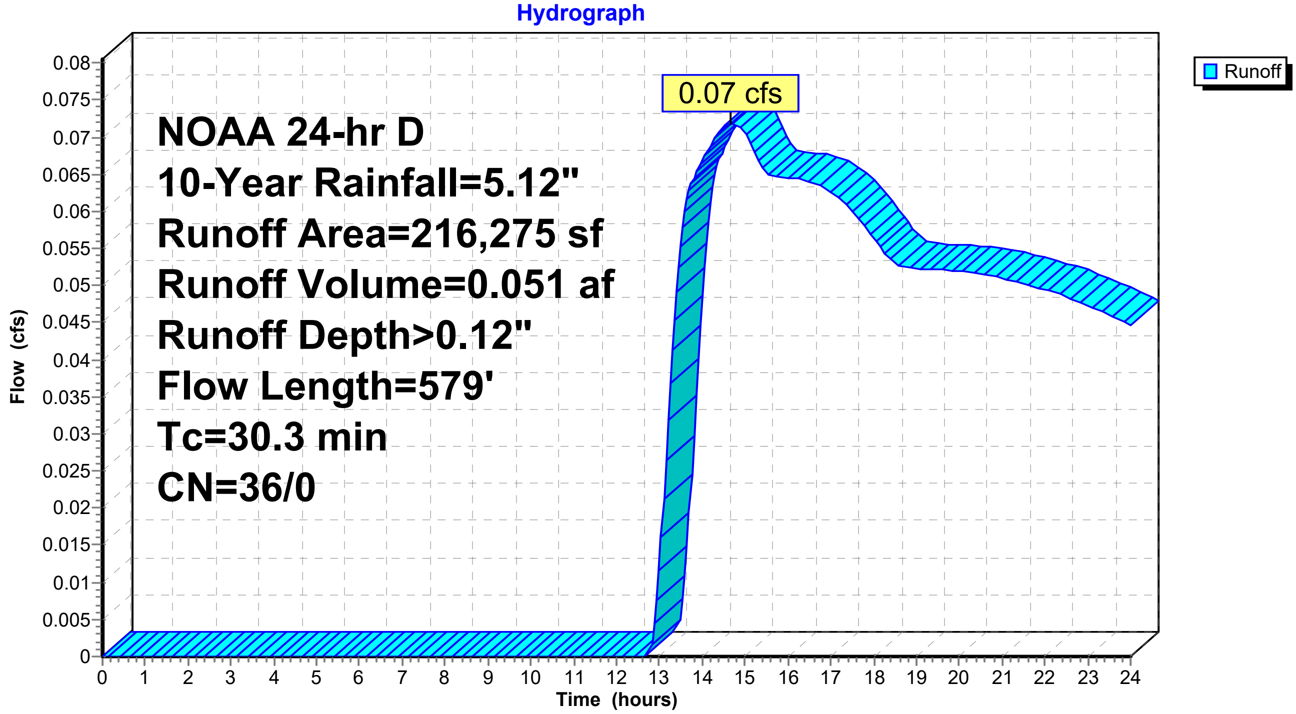
Runoff = 0.07 cfs @ 14.67 hrs, Volume= 0.051 af, Depth> 0.12"
Routed to Link 1L : Ex. POI #1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 10-Year Rainfall=5.12"

Area (sf)	CN	Description
32,518	39	>75% Grass cover, Good, HSG A
37,364	39	>75% Grass cover, Good, HSG A
3,661	74	>75% Grass cover, Good, HSG C
1,887	80	>75% Grass cover, Good, HSG D
111,025	30	Woods, Good, HSG A
20,151	30	Woods, Good, HSG A
9,669	77	Woods, Good, HSG D
216,275	36	Weighted Average
216,275	36	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	100	0.0163	0.11		**Sheet Flow, A~B** Grass: Dense n= 0.240 P2= 3.35"
6.7	206	0.0053	0.51		**Shallow Concentrated Flow, B~C** Short Grass Pasture Kv= 7.0 fps
8.1	228	0.0088	0.47		**Shallow Concentrated Flow, C~D** Woodland Kv= 5.0 fps
0.4	45	0.0827	2.01		**Shallow Concentrated Flow, D~F** Short Grass Pasture Kv= 7.0 fps
30.3	579	Total			

Subcatchment 2S: EDA-1 (Per.)



Summary for Subcatchment 3S: PDA-1 (Imp.)

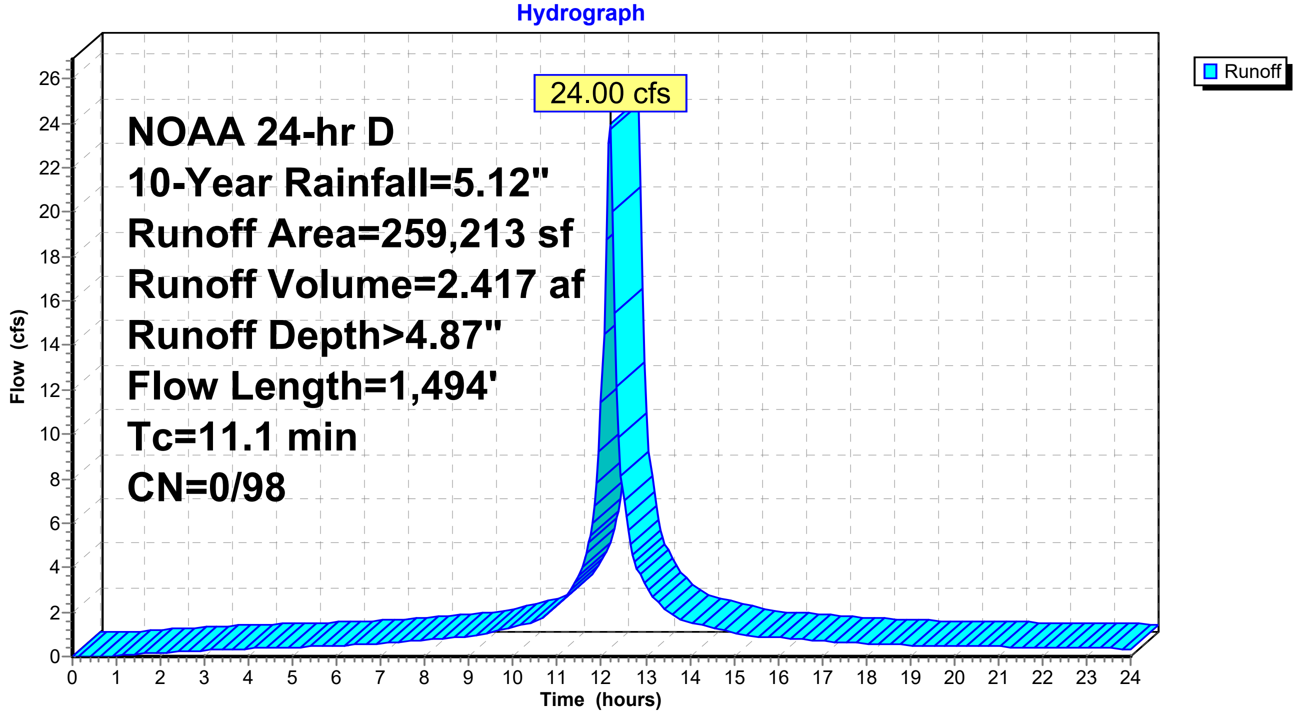
Runoff = 24.00 cfs @ 12.18 hrs, Volume= 2.417 af, Depth> 4.87"
Routed to Link 2L : Prop. POI #1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 10-Year Rainfall=5.12"

	Area (sf)	CN	Description
	15,569	98	Paved parking, HSG A
	70,518	98	Paved parking, HSG A
	16,892	98	Paved parking, HSG C
	32,366	98	Paved parking, HSG D
	27	98	Roofs, HSG A
	85,831	98	Roofs, HSG A
	12,752	98	Roofs, HSG C
	19,568	98	Roofs, HSG D
*	5,690	98	Pool
	259,213	98	Weighted Average
	259,213	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0350	1.53		**Sheet Flow, A~B** Smooth surfaces n= 0.011 P2= 3.35"
1.0	232	0.0040	3.93	4.83	**Pipe Channel, B~C** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.011
0.7	210	0.0100	5.26	6.46	**Pipe Channel, C~D** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
0.1	52	0.0120	6.81	8.36	**Pipe Channel, D~E** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.011
8.8	950	0.0017	1.81	26.22	**Channel Flow, E~F** Area= 14.5 sf Perim= 17.4' r= 0.83' n= 0.030
11.1	1,494	Total			

Subcatchment 3S: PDA-1 (Imp.)



Summary for Subcatchment 4S: PDA-1 (Per.)

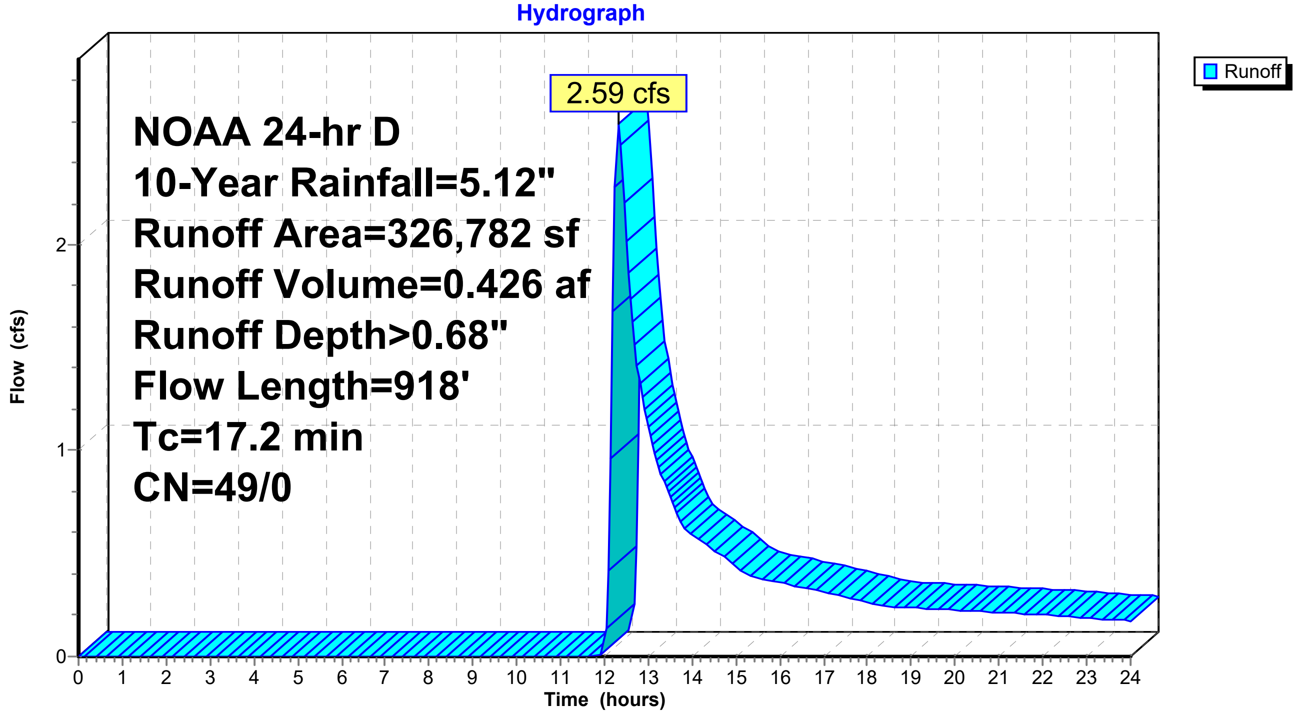
Runoff = 2.59 cfs @ 12.33 hrs, Volume= 0.426 af, Depth> 0.68"
Routed to Link 2L : Prop. POI #1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 10-Year Rainfall=5.12"

Area (sf)	CN	Description
85,969	39	>75% Grass cover, Good, HSG A
58,847	39	>75% Grass cover, Good, HSG A
17,755	74	>75% Grass cover, Good, HSG C
65,953	80	>75% Grass cover, Good, HSG D
81,345	30	Woods, Good, HSG A
2,229	77	Woods, Good, HSG D
11,654	76	Gravel roads, HSG A
1,395	76	Gravel roads, HSG A
1,635	91	Gravel roads, HSG D
326,782	49	Weighted Average
326,782	49	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	42	0.0100	0.08		**Sheet Flow, A~B** Grass: Dense n= 0.240 P2= 3.35"
1.3	66	0.0150	0.86		**Shallow Concentrated Flow, B~C** Short Grass Pasture Kv= 7.0 fps
0.5	97	0.0050	3.21	2.52	**Pipe Channel, C~D** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.4	87	0.0050	3.72	4.57	**Pipe Channel, D~E** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
5.8	626	0.0017	1.81	26.22	**Channel Flow, E~F** Area= 14.5 sf Perim= 17.4' r= 0.83' n= 0.030
17.2	918	Total			

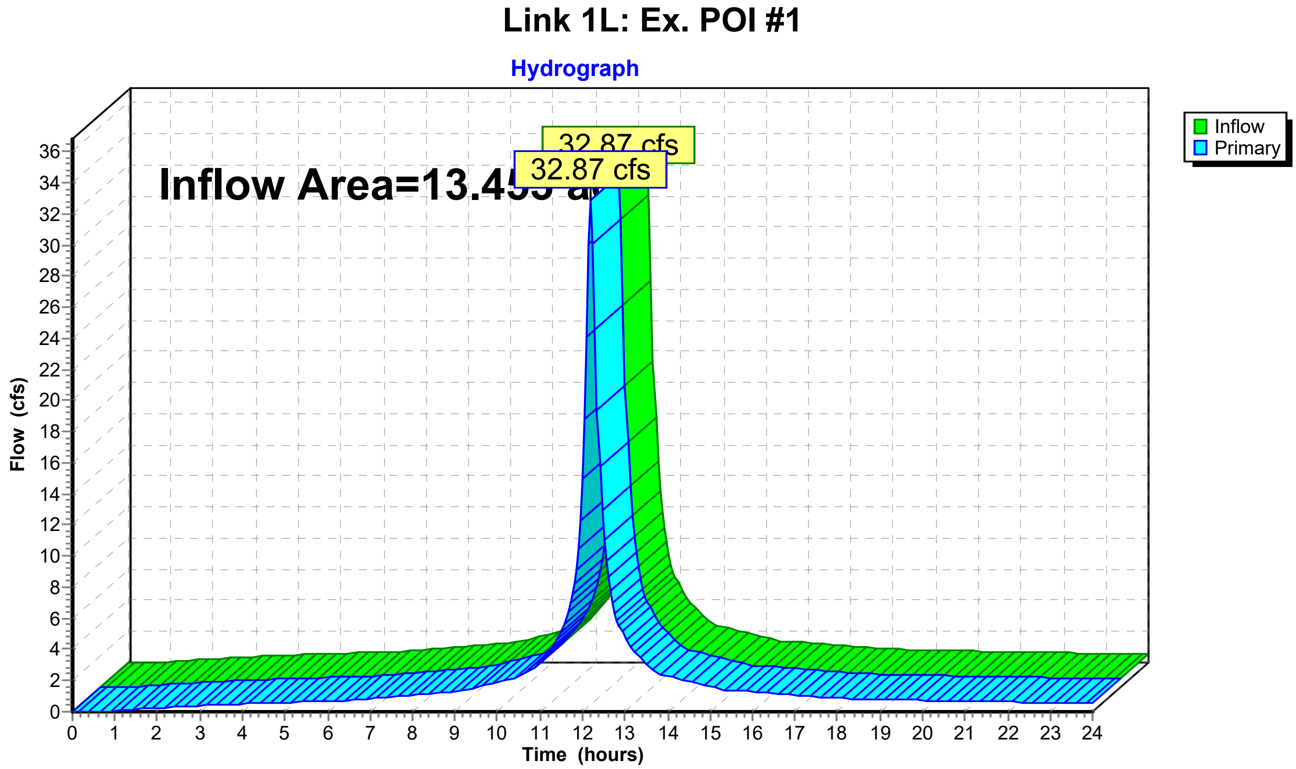
Subcatchment 4S: PDA-1 (Per.)



Summary for Link 1L: Ex. POI #1

Inflow Area =	13.453 ac,	63.09% Impervious,	Inflow Depth > 3.12"	for 10-Year event
Inflow =	32.87 cfs @	12.20 hrs, Volume=	3.498 af	
Primary =	32.87 cfs @	12.20 hrs, Volume=	3.498 af, Atten= 0%, Lag= 0.0 min	

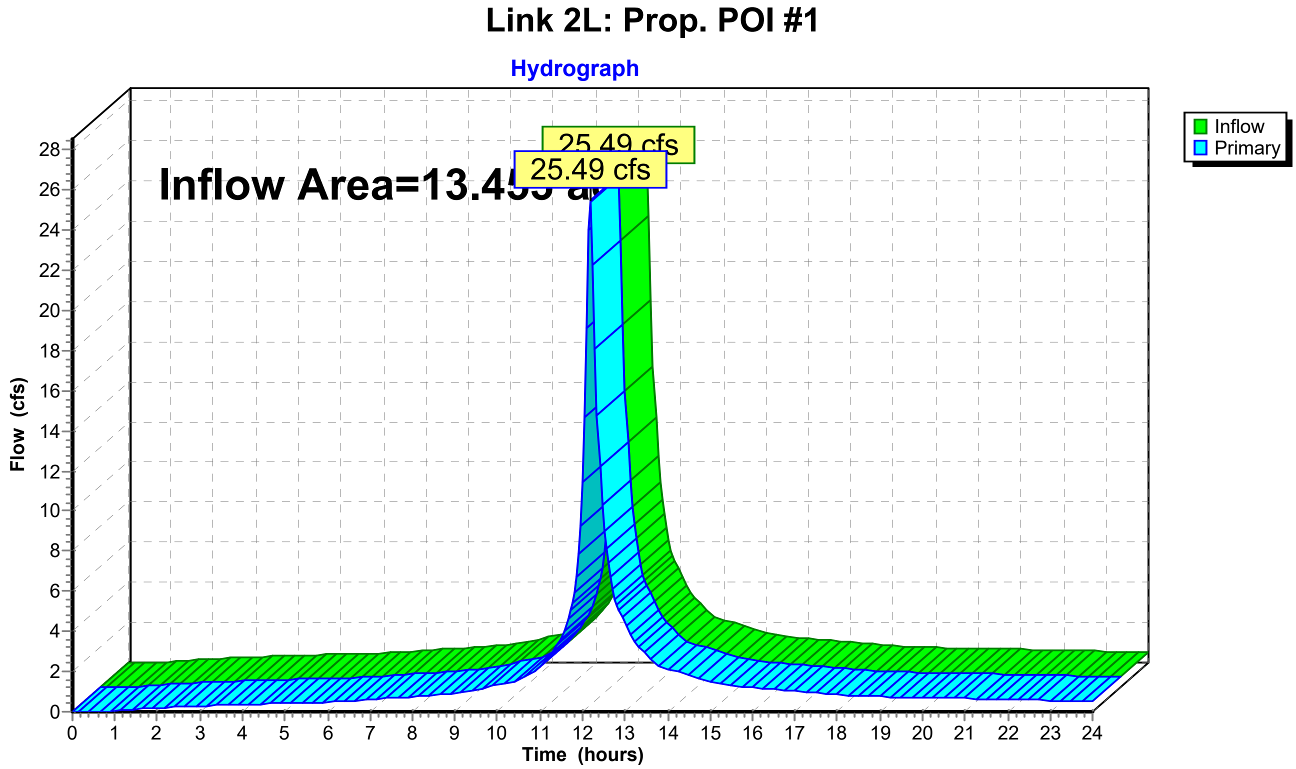
Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs



Summary for Link 2L: Prop. POI #1

Inflow Area = 13.453 ac, 44.23% Impervious, Inflow Depth > 2.54" for 10-Year event
Inflow = 25.49 cfs @ 12.19 hrs, Volume= 2.843 af
Primary = 25.49 cfs @ 12.19 hrs, Volume= 2.843 af, Atten= 0%, Lag= 0.0 min

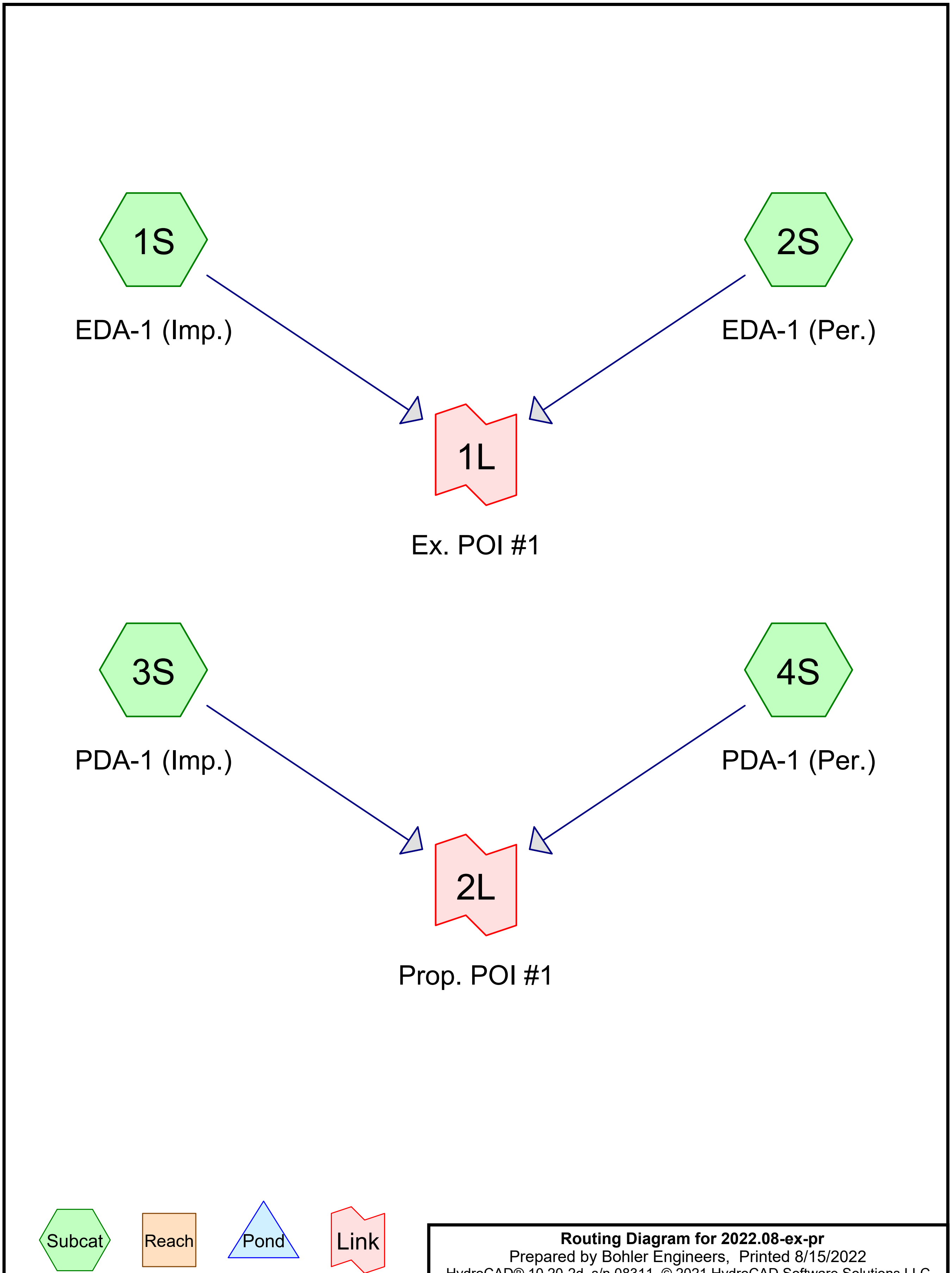
Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs



POI 1

10 - Year Storm Hydrograph Table Comparison Report			
Time (hours)	**Pre-Construction (CFS)**	**Post-Construction (CFS)**	**Difference in Flow Rate (CFS) Pre - Post**
0.0	0.0	0.0	0.0
0.5	0.0	0.0	0.0
1.0	0.0	0.0	0.0
1.5	0.2	0.1	0.1
2.0	0.3	0.2	0.1
2.5	0.3	0.2	0.1
3.0	0.4	0.3	0.1
3.5	0.5	0.3	0.2
4.0	0.5	0.4	0.1
4.5	0.6	0.4	0.2
5.0	0.6	0.4	0.2
5.5	0.6	0.4	0.2
6.0	0.7	0.5	0.2
6.5	0.8	0.5	0.3
7.0	0.9	0.6	0.3
7.5	1.0	0.7	0.3
8.0	1.1	0.7	0.4
8.5	1.2	0.8	0.4
9.0	1.3	0.9	0.4
9.5	1.5	1.1	0.4
10.0	1.9	1.3	0.6
10.5	2.2	1.6	0.6
11.0	3.2	2.3	0.9
11.5	5.2	3.7	1.5
12.0	14.9	11.4	3.5
12.5	11.0	9.0	2.0
13.0	4.8	4.4	0.4
13.5	3.1	2.8	0.3
14.0	2.3	2.1	0.2
14.5	1.9	1.8	0.1
15.0	1.6	1.5	0.1
15.5	1.4	1.3	0.1
16.0	1.3	1.2	0.1
16.5	1.2	1.1	0.1
17.0	1.1	1.0	0.1
17.5	1.0	0.9	0.1
18.0	0.9	0.8	0.1
18.5	0.8	0.8	0.0
19.0	0.8	0.8	0.0
19.5	0.8	0.7	0.1
20.0	0.7	0.7	0.0
20.5	0.7	0.7	0.0
21.0	0.7	0.7	0.0
21.5	0.7	0.6	0.1
22.0	0.6	0.6	0.0
22.5	0.6	0.6	0.0
23.0	0.6	0.6	0.0
23.5	0.6	0.5	0.1
24.0	0.5	0.5	0.0
	POST is less than or equal to PRE?		YES

100-YEAR STORM EVENT



Routing Diagram for 2022.08-ex-pr
Prepared by Bohler Engineers, Printed 8/15/2022
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Summary for Subcatchment 1S: EDA-1 (Imp.)

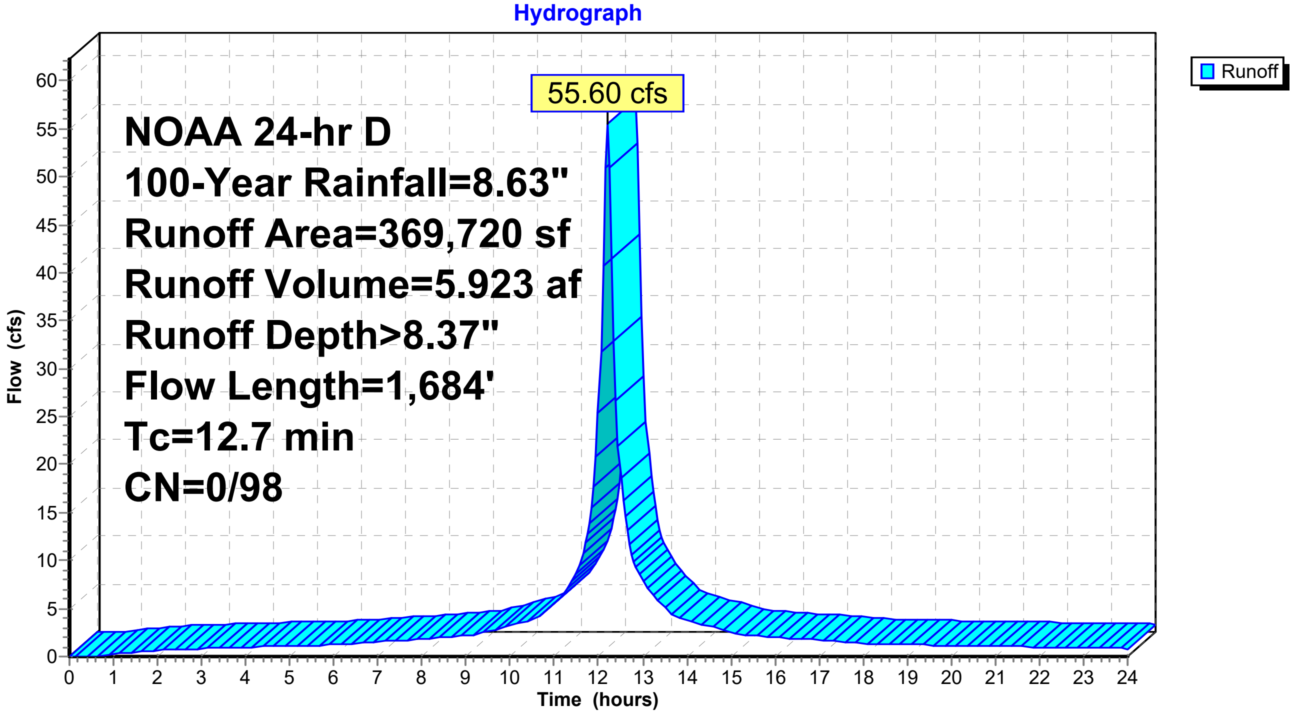
Runoff = 55.60 cfs @ 12.20 hrs, Volume= 5.923 af, Depth> 8.37"
Routed to Link 1L : Ex. POI #1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 100-Year Rainfall=8.63"

Area (sf)	CN	Description
51,021	98	Paved parking, HSG A
108,193	98	Paved parking, HSG A
21,694	98	Paved parking, HSG C
65,327	98	Paved parking, HSG D
56,573	98	Roofs, HSG A
22,044	98	Roofs, HSG C
44,868	98	Roofs, HSG D
369,720	98	Weighted Average
369,720	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	100	0.0100	1.07		**Sheet Flow, A~B** Smooth surfaces n= 0.011 P2= 3.35"
1.1	217	0.0280	3.40		**Shallow Concentrated Flow, B~C** Paved Kv= 20.3 fps
0.7	264	0.0120	5.87	4.61	**Pipe Channel, C~D** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011
0.5	153	0.0111	5.55	6.81	**Pipe Channel, D~E** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
8.8	950	0.0017	1.81	26.22	**Channel Flow, E~F** Area= 14.5 sf Perim= 17.4' r= 0.83' n= 0.030
12.7	1,684	Total			

Subcatchment 1S: EDA-1 (Imp.)



Summary for Subcatchment 2S: EDA-1 (Per.)

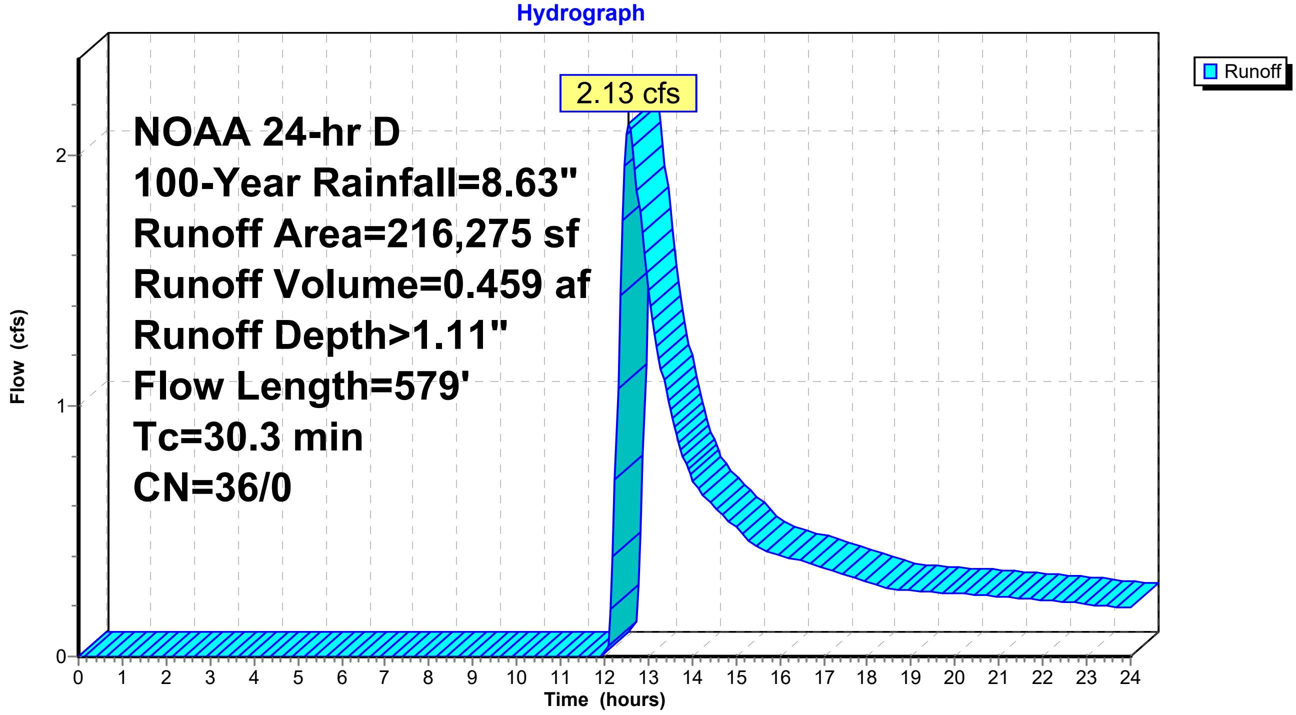
Runoff = 2.13 cfs @ 12.56 hrs, Volume= 0.459 af, Depth> 1.11"
Routed to Link 1L : Ex. POI #1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 100-Year Rainfall=8.63"

Area (sf)	CN	Description
32,518	39	>75% Grass cover, Good, HSG A
37,364	39	>75% Grass cover, Good, HSG A
3,661	74	>75% Grass cover, Good, HSG C
1,887	80	>75% Grass cover, Good, HSG D
111,025	30	Woods, Good, HSG A
20,151	30	Woods, Good, HSG A
9,669	77	Woods, Good, HSG D
216,275	36	Weighted Average
216,275	36	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	100	0.0163	0.11		**Sheet Flow, A~B** Grass: Dense n= 0.240 P2= 3.35"
6.7	206	0.0053	0.51		**Shallow Concentrated Flow, B~C** Short Grass Pasture Kv= 7.0 fps
8.1	228	0.0088	0.47		**Shallow Concentrated Flow, C~D** Woodland Kv= 5.0 fps
0.4	45	0.0827	2.01		**Shallow Concentrated Flow, D~F** Short Grass Pasture Kv= 7.0 fps
30.3	579	Total			

Subcatchment 2S: EDA-1 (Per.)



Summary for Subcatchment 3S: PDA-1 (Imp.)

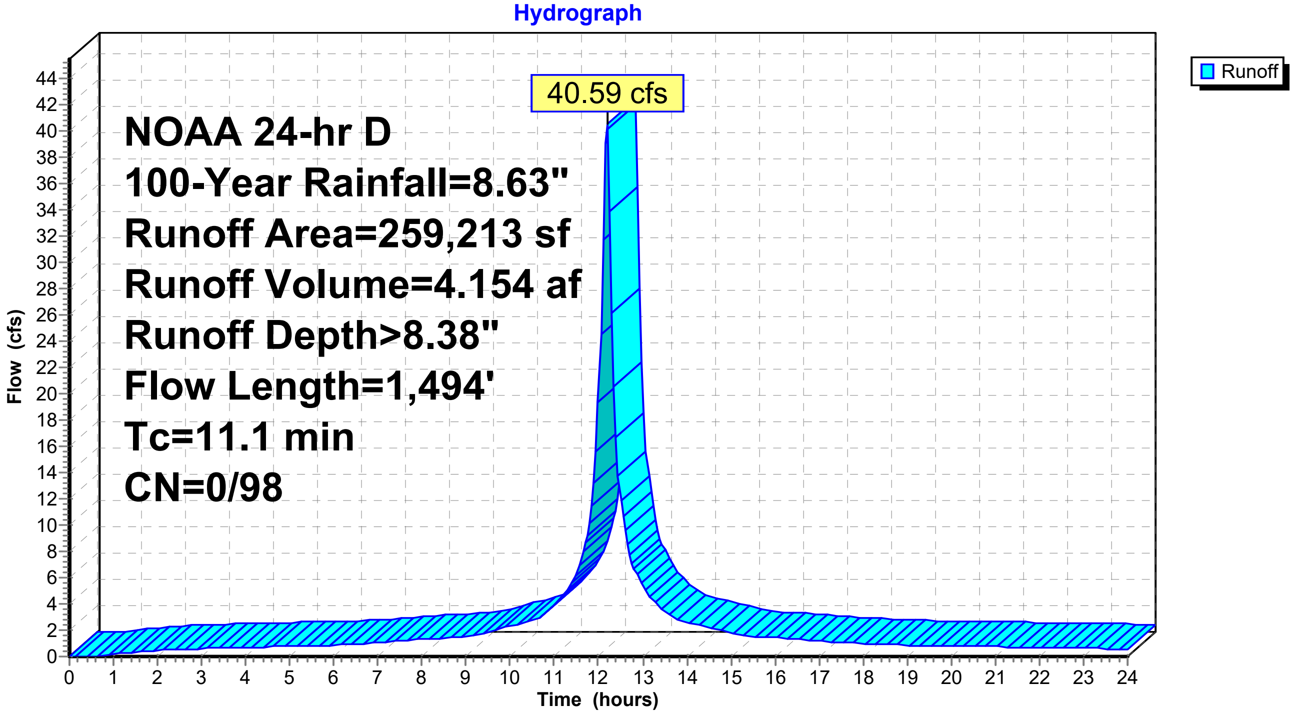
Runoff = 40.59 cfs @ 12.18 hrs, Volume= 4.154 af, Depth> 8.38"
Routed to Link 2L : Prop. POI #1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 100-Year Rainfall=8.63"

	Area (sf)	CN	Description
	15,569	98	Paved parking, HSG A
	70,518	98	Paved parking, HSG A
	16,892	98	Paved parking, HSG C
	32,366	98	Paved parking, HSG D
	27	98	Roofs, HSG A
	85,831	98	Roofs, HSG A
	12,752	98	Roofs, HSG C
	19,568	98	Roofs, HSG D
*	5,690	98	Pool
	259,213	98	Weighted Average
	259,213	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	50	0.0350	1.53		**Sheet Flow, A~B** Smooth surfaces n= 0.011 P2= 3.35"
1.0	232	0.0040	3.93	4.83	**Pipe Channel, B~C** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.011
0.7	210	0.0100	5.26	6.46	**Pipe Channel, C~D** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
0.1	52	0.0120	6.81	8.36	**Pipe Channel, D~E** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.011
8.8	950	0.0017	1.81	26.22	**Channel Flow, E~F** Area= 14.5 sf Perim= 17.4' r= 0.83' n= 0.030
11.1	1,494	Total			

Subcatchment 3S: PDA-1 (Imp.)



Summary for Subcatchment 4S: PDA-1 (Per.)

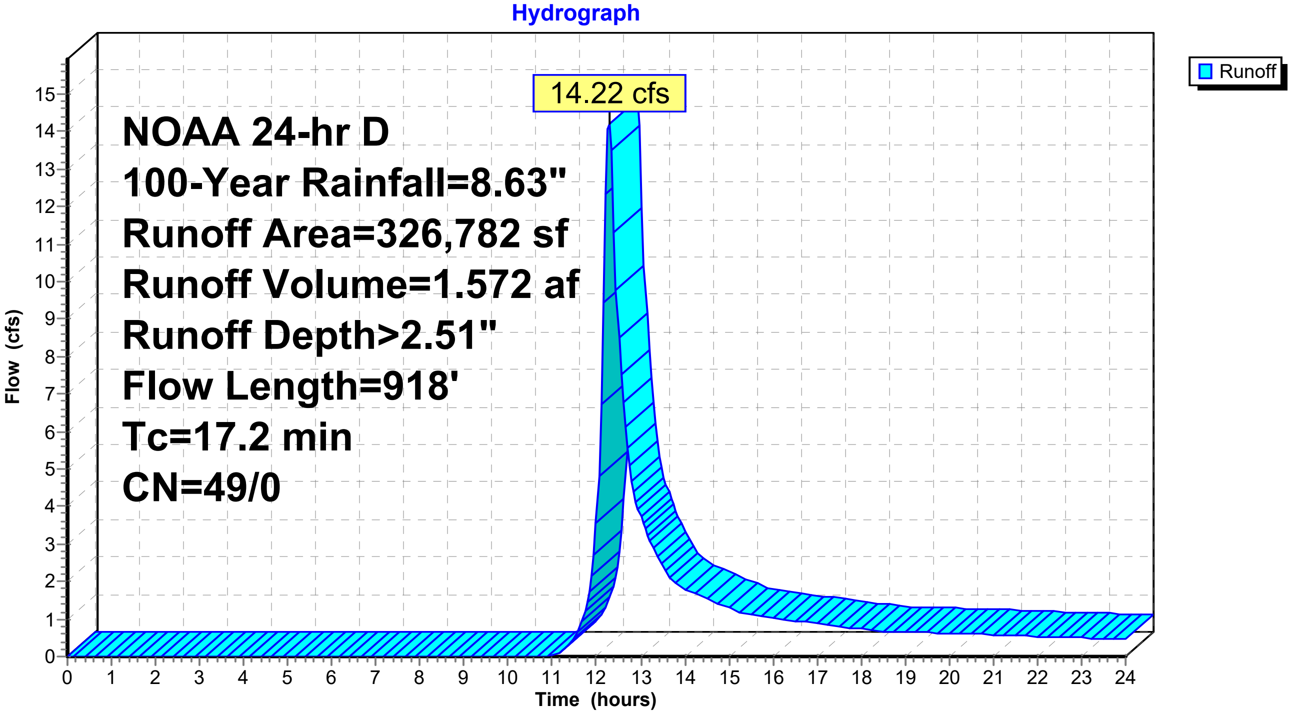
Runoff = 14.22 cfs @ 12.28 hrs, Volume= 1.572 af, Depth> 2.51"
Routed to Link 2L : Prop. POI #1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NOAA 24-hr D 100-Year Rainfall=8.63"

Area (sf)	CN	Description
85,969	39	>75% Grass cover, Good, HSG A
58,847	39	>75% Grass cover, Good, HSG A
17,755	74	>75% Grass cover, Good, HSG C
65,953	80	>75% Grass cover, Good, HSG D
81,345	30	Woods, Good, HSG A
2,229	77	Woods, Good, HSG D
11,654	76	Gravel roads, HSG A
1,395	76	Gravel roads, HSG A
1,635	91	Gravel roads, HSG D
326,782	49	Weighted Average
326,782	49	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	42	0.0100	0.08		**Sheet Flow, A~B** Grass: Dense n= 0.240 P2= 3.35"
1.3	66	0.0150	0.86		**Shallow Concentrated Flow, B~C** Short Grass Pasture Kv= 7.0 fps
0.5	97	0.0050	3.21	2.52	**Pipe Channel, C~D** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.4	87	0.0050	3.72	4.57	**Pipe Channel, D~E** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
5.8	626	0.0017	1.81	26.22	**Channel Flow, E~F** Area= 14.5 sf Perim= 17.4' r= 0.83' n= 0.030
17.2	918	Total			

Subcatchment 4S: PDA-1 (Per.)

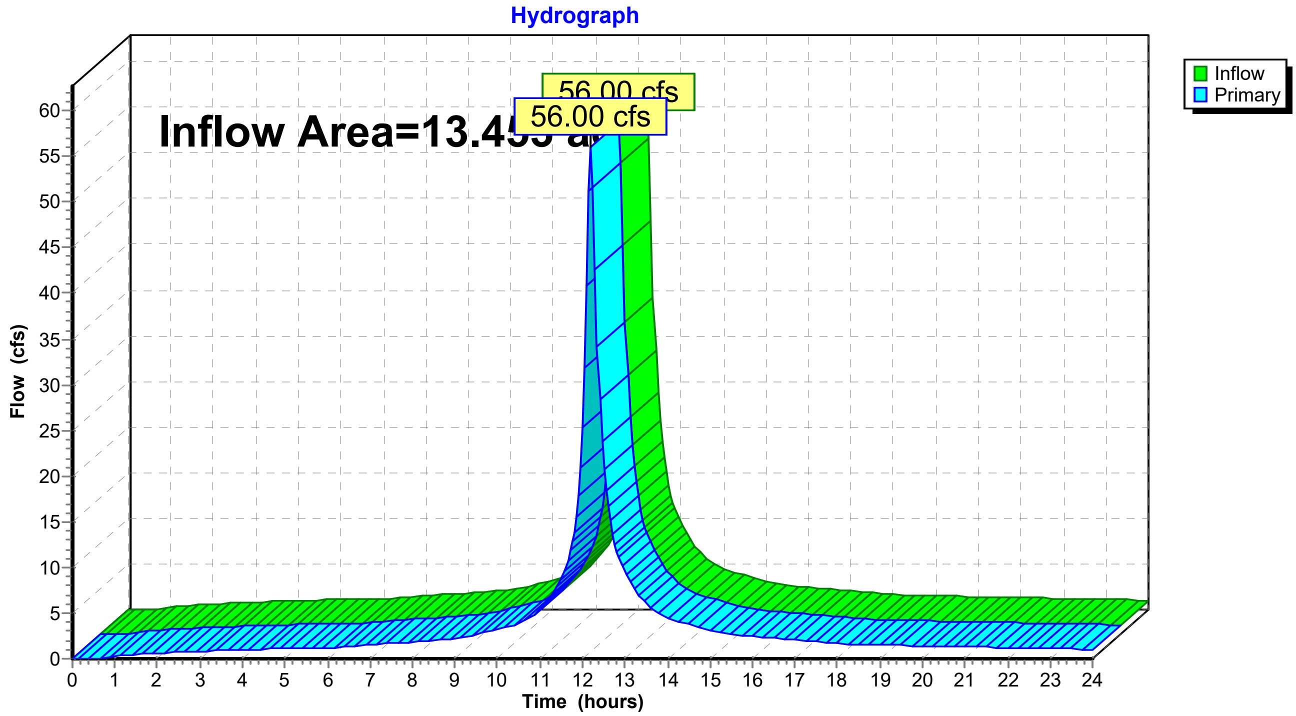


Summary for Link 1L: Ex. POI #1

Inflow Area =	13.453 ac,	63.09% Impervious,	Inflow Depth > 5.69"	for 100-Year event
Inflow =	56.00 cfs @	12.20 hrs, Volume=	6.382 af	
Primary =	56.00 cfs @	12.20 hrs, Volume=	6.382 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

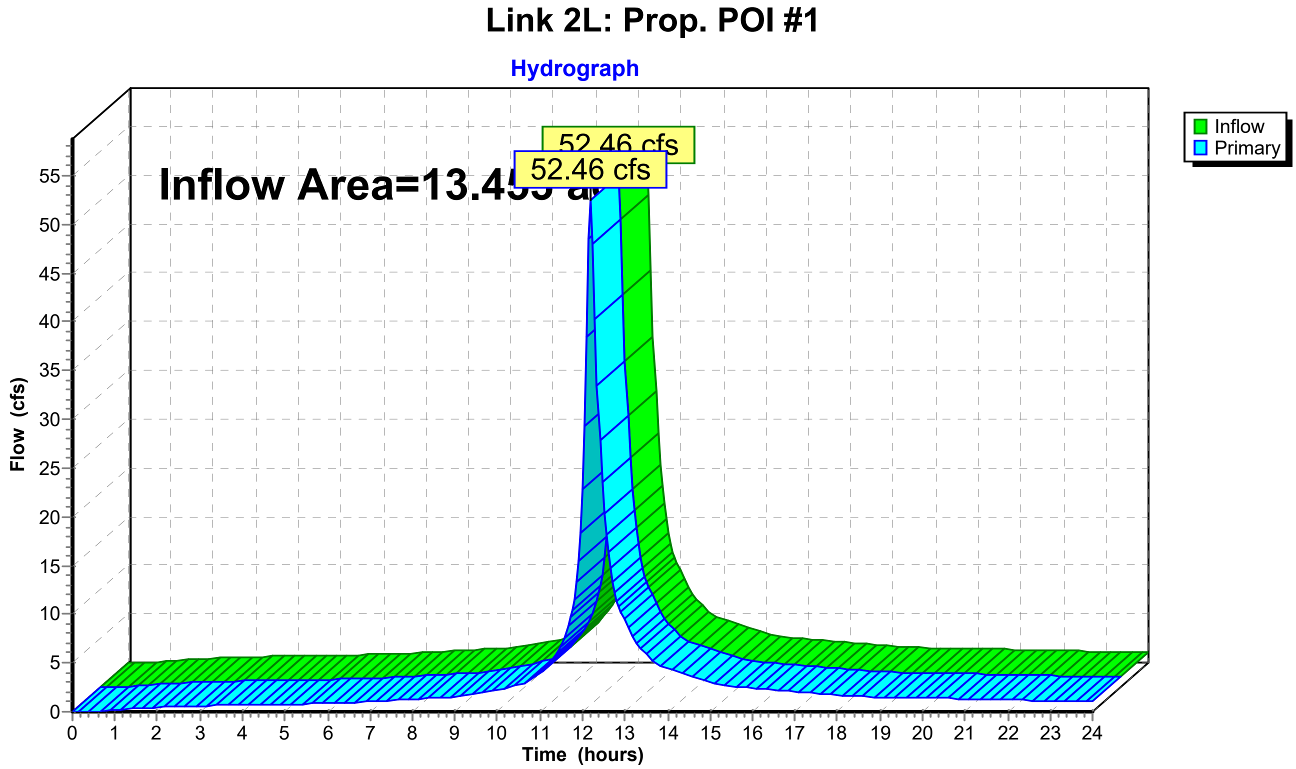
Link 1L: Ex. POI #1



Summary for Link 2L: Prop. POI #1

Inflow Area = 13.453 ac, 44.23% Impervious, Inflow Depth > 5.11" for 100-Year event
Inflow = 52.46 cfs @ 12.20 hrs, Volume= 5.726 af
Primary = 52.46 cfs @ 12.20 hrs, Volume= 5.726 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs



POI 1

100 - Year Storm Hydrograph Table Comparison Report			
Time (hours)	**Pre-Construction (CFS)**	**Post-Construction (CFS)**	**Difference in Flow Rate (CFS) Pre - Post**
0.0	0.0	0.0	0.0
0.5	0.0	0.0	0.0
1.0	0.3	0.2	0.1
1.5	0.5	0.3	0.2
2.0	0.6	0.4	0.2
2.5	0.7	0.5	0.2
3.0	0.8	0.6	0.2
3.5	0.9	0.6	0.3
4.0	1.0	0.7	0.3
4.5	1.1	0.7	0.4
5.0	1.1	0.8	0.3
5.5	1.2	0.8	0.4
6.0	1.2	0.9	0.3
6.5	1.4	1.0	0.4
7.0	1.5	1.1	0.4
7.5	1.7	1.2	0.5
8.0	1.9	1.3	0.6
8.5	2.0	1.4	0.6
9.0	2.2	1.5	0.7
9.5	2.7	1.9	0.8
10.0	3.2	2.3	0.9
10.5	3.8	2.7	1.1
11.0	5.5	4.0	1.5
11.5	8.8	6.8	2.0
12.0	25.3	22.9	2.4
12.5	20.7	20.4	0.3
13.0	9.5	9.2	0.3
13.5	6.1	5.9	0.2
14.0	4.4	4.4	0.0
14.5	3.8	3.7	0.1
15.0	3.1	3.1	0.0
15.5	2.6	2.6	0.0
16.0	2.4	2.4	0.0
16.5	2.3	2.3	0.0
17.0	2.1	2.1	0.0
17.5	1.9	1.9	0.0
18.0	1.7	1.7	0.0
18.5	1.6	1.6	0.0
19.0	1.5	1.5	0.0
19.5	1.5	1.5	0.0
20.0	1.4	1.4	0.0
20.5	1.4	1.4	0.0
21.0	1.3	1.3	0.0
21.5	1.3	1.3	0.0
22.0	1.2	1.2	0.0
22.5	1.2	1.2	0.0
23.0	1.1	1.1	0.0
23.5	1.1	1.1	0.0
24.0	1.0	1.0	0.0
	POST is less than or equal to PRE?		YES

B. DESIGN CALCULATIONS

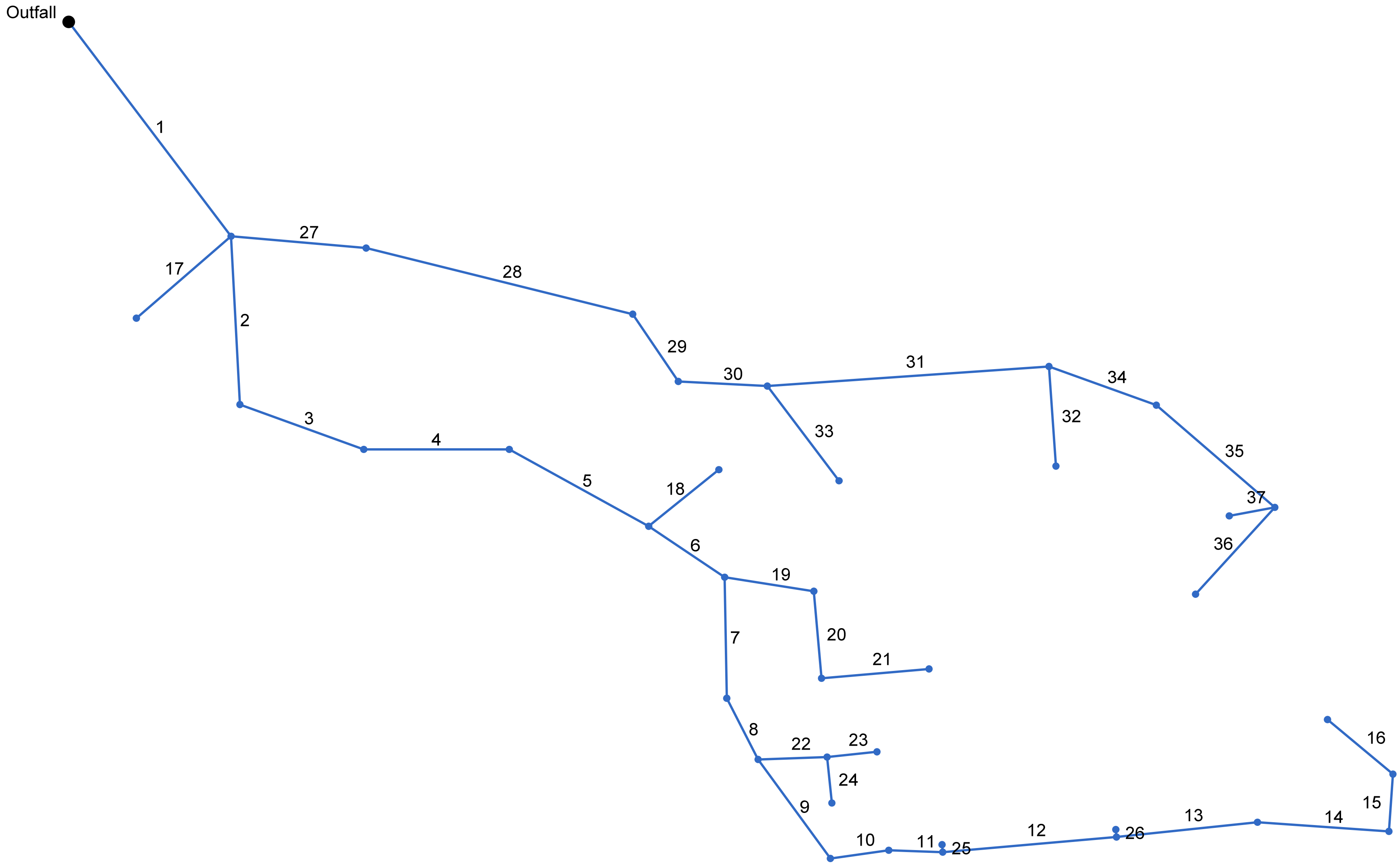
- Pipe Sizing
- Scour Hole Calculation
- NJGRS Calculation
- Calculation per McCuen-Spiess Equation

PIPE SIZING

Runoff Coefficient 'C' Calculation Worksheet

Inlet Area	Total Area (sf)	Total Area (Acres)	Impervious Area (sf)	Open Space (sf)	C
1	18,191	0.42	4,173	14,018	0.50
2	26,227	0.60	8,716	17,511	0.56
3	7,219	0.17	6,725	494	0.95
4	7,353	0.17	6,924	429	0.95
5	7,212	0.17	6,525	688	0.93
6	15,067	0.35	12,807	2,260	0.89
7	2,199	0.05	2,199	0	0.99
8	8,763	0.20	7,884	879	0.93
9	5,789	0.13	3,328	2,461	0.72
10	9,191	0.21	6,090	3,101	0.77
11	3,554	0.08	2,901	653	0.87
12	6,107	0.14	3,572	2,535	0.72
13	754	0.02	292	462	0.60
14	470	0.01	152	318	0.56
15	1,019	0.02	314	706	0.55
16	3,480	0.08	170	3,311	0.38
17	3,528	0.08	148	3,380	0.38
18	4,704	0.11	1,433	3,271	0.54
19	2,500	0.06	680	1,821	0.52
20	3,615	0.08	3,332	283	0.94
21	2,975	0.07	2,291	684	0.84
22	58,762	1.35	23,671	35,092	0.61
23	12,859	0.30	9,540	3,319	0.82
24	11,452	0.26	9,644	1,808	0.89
25	35,162	0.81	11,655	23,507	0.56
26	11,543	0.26	0	11,543	0.35
27	33,911	0.78	9,552	24,359	0.53
28	10,393	0.24	9,091	1,302	0.91
29	6,220	0.14	4,469	1,751	0.81
30	16,213	0.37	9,034	7,179	0.71
31	5,075	0.12	4,901	174	0.97
32	25,535	0.59	25,535	0	0.99
33	1,050	0.02	1,050	0	0.99
34	6,813	0.16	6,586	227	0.97
35	4,251	0.10	3,812	440	0.92
36	7,732	0.18	2,283	5,449	0.54
R1	4,112	0.09	4,112	0	0.99
R2	12,715	0.29	12,715	0	0.99
R3	5,672	0.13	5,672	0	0.99
R4	6,299	0.14	6,299	0	0.99
R5	6,020	0.14	6,020	0	0.99
R6	4,038	0.09	4,038	0	0.99
R7	2,213	0.05	2,213	0	0.99
R8	6,290	0.14	6,290	0	0.99
R9	25,940	0.60	25,940	0	0.99

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Run-1.stm	Number of lines: 37	Date: 8/17/2022

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	215.000	0.42	7.54	0.50	0.21	5.98	10.0	15.9	5.4	32.19	42.18	4.78	36	0.40	68.28	69.14	71.28	71.70	72.00	73.50	E1 - HW2
2	1	135.000	0.17	2.90	0.95	0.16	2.46	10.0	15.4	5.5	13.44	15.93	4.28	24	0.50	69.46	70.13	72.09	72.57	73.50	75.00	B3 - E1
3	2	105.000	0.17	2.73	0.95	0.16	2.30	10.0	15.0	5.5	12.71	22.62	4.12	24	1.00	70.23	71.28	72.83	73.12	75.00	76.00	B4 - B3
4	3	116.000	0.17	2.56	0.93	0.16	2.14	10.0	14.6	5.6	11.96	22.62	4.89	24	1.00	71.38	72.54	73.23	73.78	76.00	77.00	B5 - B4
5	4	127.000	0.35	2.39	0.89	0.31	1.98	10.0	14.2	5.7	11.19	22.62	5.87	24	1.00	72.64	73.91	73.78	75.11	77.00	80.80	B6 - B5
6	5	73.000	0.20	1.99	0.93	0.19	1.62	10.0	14.0	5.7	9.22	16.10	5.24	24	0.51	74.01	74.38	75.11	75.47	80.80	82.00	B8 - B6
7	6	97.000	0.08	1.16	0.87	0.07	0.89	10.0	13.5	5.8	5.14	7.39	3.46	18	0.49	74.48	74.96	75.84	76.01	82.00	83.50	B11 - B8
8	7	55.000	0.14	1.08	0.72	0.10	0.82	10.0	13.3	5.8	4.77	7.49	3.93	18	0.51	75.06	75.34	76.13	76.24	83.50	84.40	B12 - B11
9	8	98.000	0.00	0.89	0.00	0.00	0.69	10.0	12.9	5.9	4.07	4.52	3.87	15	0.49	75.44	75.92	76.51	76.87	84.40	85.70	MH12A - B12
10	9	47.000	0.08	0.89	0.38	0.03	0.69	10.0	12.7	5.9	4.10	4.61	3.77	15	0.51	76.02	76.26	77.10	77.26	85.70	83.50	A16 - MHA12
11	10	43.000	0.08	0.81	0.38	0.03	0.66	10.0	12.5	6.0	3.94	4.51	4.02	15	0.49	76.36	76.57	77.31	77.49	83.50	83.75	A17 - A16
12	11	139.000	0.11	0.60	0.54	0.06	0.50	10.0	11.8	6.1	3.06	4.58	3.38	15	0.50	76.67	77.37	77.75	78.11	83.75	83.75	A18 - A17
13	12	113.000	0.06	0.35	0.52	0.03	0.30	10.0	11.1	6.2	1.89	4.55	2.80	15	0.50	77.47	78.03	78.36	78.59	83.75	83.75	A19 - A18
14	13	105.000	0.08	0.29	0.94	0.08	0.27	10.0	10.6	6.3	1.73	4.59	3.48	15	0.50	78.13	78.66	78.66	79.19	83.75	81.80	B20 - A19
15	14	46.000	0.07	0.21	0.84	0.06	0.20	10.0	10.3	6.4	1.26	6.46	2.66	15	1.00	78.76	79.22	79.38	79.66	81.80	83.40	B21 - B20
16	15	68.000	0.14	0.14	0.99	0.14	0.14	10.0	10.0	6.5	0.90	7.29	3.43	12	3.00	79.32	81.36	79.66	81.76	83.40	85.50	R5 - B21
17	1	100.000	0.60	0.60	0.56	0.34	0.34	10.0	10.0	6.5	2.17	4.57	1.77	15	0.50	69.46	69.96	72.09	72.20	73.50	73.00	E2 - E1
18	5	72.000	0.05	0.05	0.99	0.05	0.05	10.0	10.0	6.5	0.32	6.46	2.47	15	1.00	77.28	78.00	77.47	78.22	80.80	81.00	B7 - B6
19	6	72.000	0.13	0.63	0.72	0.09	0.54	10.0	10.6	6.3	3.43	6.46	4.92	15	1.00	77.00	77.72	77.65	78.47	82.00	83.00	B9 - B8
20	19	70.000	0.21	0.50	0.77	0.16	0.45	10.0	10.4	6.4	2.87	6.46	4.34	15	1.00	77.82	78.52	78.47	79.20	83.00	83.00	B10 - B9
21	20	86.000	0.29	0.29	0.99	0.29	0.29	10.0	10.0	6.5	1.86	7.29	3.93	12	3.00	78.62	81.20	79.20	81.78	83.00	84.83	R2 - B10
22	8	55.000	0.02	0.05	0.60	0.01	0.03	10.0	10.5	6.4	0.18	1.43	2.47	8	1.00	80.30	80.85	80.46	81.05	84.40	84.50	Y13 - B12

Project File: Run-1.stm | Number of lines: 37 | Run Date: 8/17/2022

NOTES:Intensity = 182.59 / (Inlet time + 19.10) ^ 0.99; Return period =Yrs. 25 ; c = cir e = ellip b = box

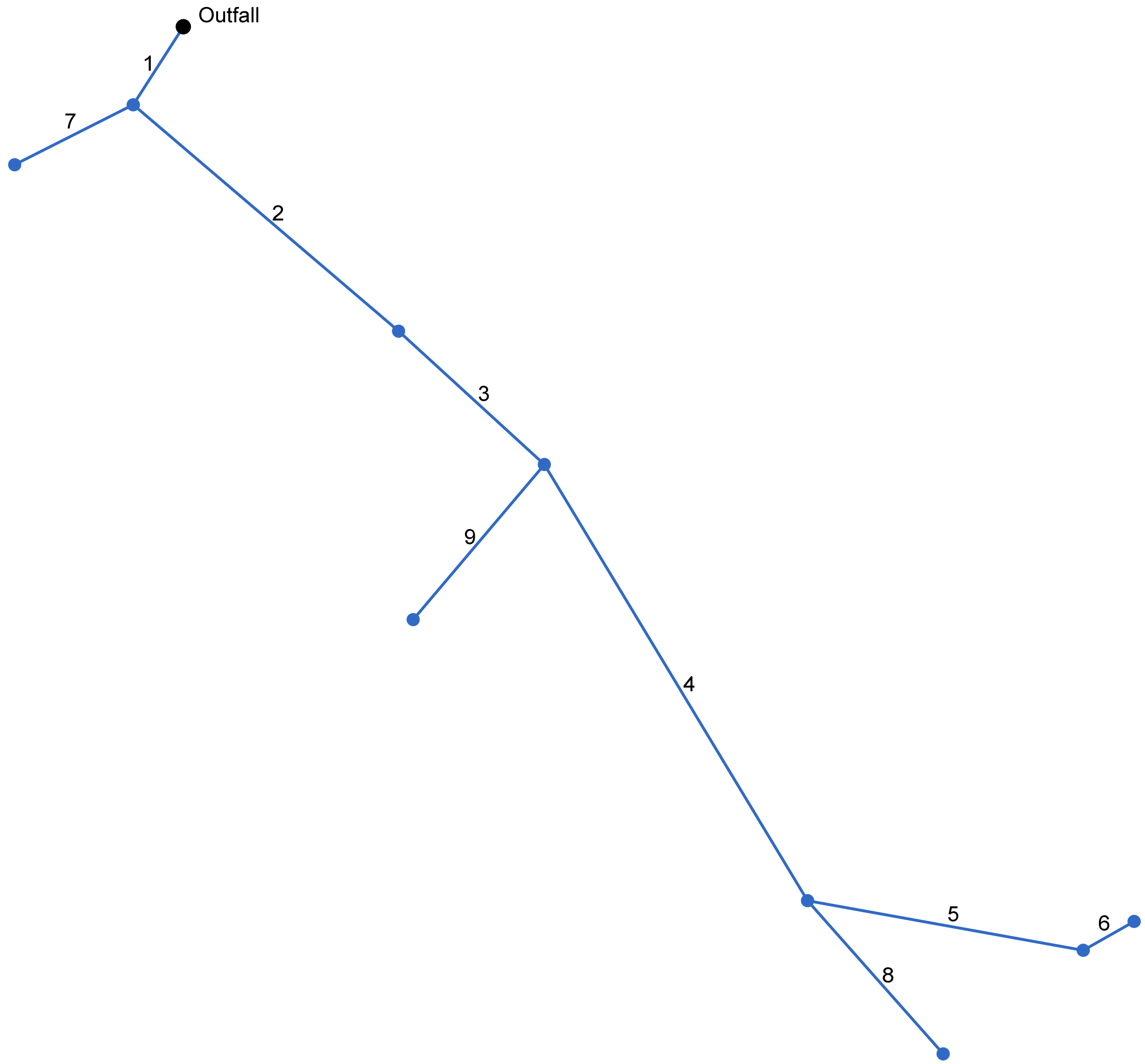
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
23	22	40.000	0.01	0.01	0.56	0.01	0.01	10.0	10.0	6.5	0.04	1.43	1.28	8	1.00	80.95	81.35	81.05	81.44	84.50	84.50	Y14 - Y13
24	22	37.000	0.02	0.02	0.55	0.01	0.01	10.0	10.0	6.5	0.07	1.43	1.89	8	1.00	80.95	81.32	81.05	81.44	84.50	84.50	Y15 - Y13
25	11	6.000	0.13	0.13	0.99	0.13	0.13	10.0	10.0	6.5	0.83	7.29	4.60	12	3.00	81.32	81.50	81.55	81.88	83.75	84.83	R3 - A17
26	12	6.000	0.14	0.14	0.99	0.14	0.14	10.0	10.0	6.5	0.90	7.29	4.70	12	3.00	81.32	81.50	81.56	81.90	83.75	84.83	R4 - A18
27	1	108.000	1.35	3.62	0.61	0.82	2.97	10.0	12.7	5.9	17.61	22.32	3.59	30	0.30	69.46	69.78	72.09	72.28	73.50	73.40	E22 - E1
28	27	219.000	0.30	2.27	0.82	0.25	2.15	10.0	12.0	6.1	13.03	22.62	5.09	24	1.00	69.88	72.07	72.32	73.37	73.40	77.10	B23 - E22
29	28	65.000	0.00	1.97	0.00	0.00	1.91	10.0	11.8	6.1	11.59	18.19	7.40	18	3.00	72.17	74.12	73.37	75.42	77.10	79.90	MH23A - B23
30	29	71.000	0.26	1.97	0.89	0.23	1.91	10.0	11.7	6.1	11.65	18.19	7.44	18	3.00	74.22	76.35	75.42	77.65	79.90	81.00	B24 - MH23A
31	30	225.000	0.24	1.62	0.91	0.22	1.58	10.0	11.1	6.2	9.87	10.50	6.49	18	1.00	76.45	78.70	77.65	79.91	81.00	83.00	B25 - B24
32	31	80.000	0.14	0.14	0.99	0.14	0.14	10.0	10.0	6.5	0.90	7.29	2.12	12	3.00	78.80	81.20	79.91	81.60	83.00	84.83	R8 - B25
33	30	95.000	0.09	0.09	0.99	0.09	0.09	10.0	10.0	6.5	0.58	7.29	1.72	12	3.00	76.45	79.30	77.65	79.62	81.00	84.83	R1 - B24
34	31	91.000	0.00	1.24	0.00	0.00	1.23	10.0	10.8	6.3	7.72	8.82	5.59	18	0.51	78.80	79.26	79.91	80.34	83.00	84.83	MH28C-B25
35	34	125.000	0.00	1.24	0.00	0.00	1.23	10.0	10.5	6.4	7.82	8.81	5.47	18	0.50	79.36	79.99	80.54	81.08	84.83	84.83	MH28A-MH28C
36	35	94.000	1.19	1.19	0.99	1.18	1.18	10.0	10.0	6.5	7.62	12.41	4.99	18	1.00	80.09	81.03	81.58	82.10	84.83	84.83	MH28B-MH28A
37	35	37.000	0.05	0.05	0.99	0.05	0.05	10.0	10.0	6.5	0.32	7.29	1.35	12	3.00	80.39	81.50	81.58	81.73	84.83	84.83	R7-MH28A

Project File: Run-1.stm | Number of lines: 37 | Run Date: 8/17/2022

NOTES:Intensity = 182.59 / (Inlet time + 19.10) ^ 0.99; Return period =Yrs. 25 ; c = cir e = ellip b = box

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Run-2.stm	Number of lines: 9	Date: 8/17/2022

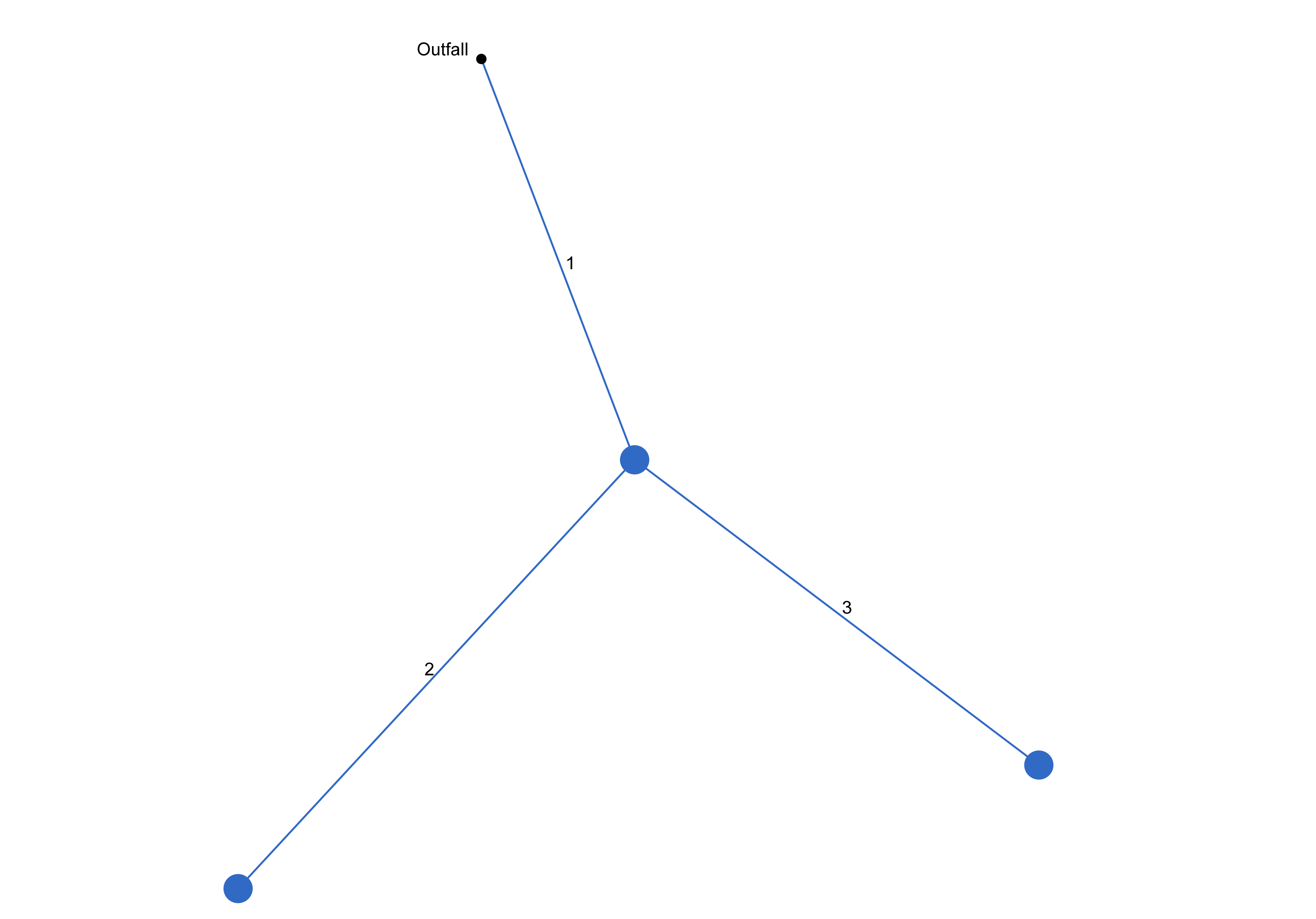
Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	42.000	0.00	1.18	0.00	0.00	0.95	10.0	13.0	5.9	5.55	7.05	5.02	15	1.19	72.00	72.50	73.25	73.46	0.00	76.50	MH26A-OUT
2	1	149.000	0.37	1.04	0.71	0.26	0.83	10.0	12.5	6.0	4.97	6.46	4.64	15	1.00	72.60	74.09	73.90	74.99	76.50	81.00	B27-MH26A
3	2	85.000	0.12	0.67	0.97	0.12	0.57	10.0	12.1	6.0	3.43	6.46	4.31	15	1.00	74.19	75.04	74.99	75.79	81.00	82.85	B28 - B27
4	3	232.000	0.10	0.46	0.92	0.09	0.36	10.0	11.0	6.3	2.28	4.09	3.42	15	0.40	75.14	76.07	75.81	76.74	82.85	82.70	B29 - B28
5	4	109.000	0.02	0.18	0.99	0.02	0.18	10.0	10.1	6.4	1.13	4.10	2.20	15	0.40	76.17	76.61	76.89	77.06	82.70	79.30	B30 - B29
6	5	24.000	0.16	0.16	0.97	0.16	0.16	10.0	10.0	6.5	1.00	2.18	2.71	12	0.38	76.71	76.80	77.19	77.28	79.30	79.40	B31 - B30
7	1	54.000	0.14	0.14	0.81	0.11	0.11	10.0	10.0	6.5	0.73	4.57	0.63	15	0.50	72.60	72.87	73.90	73.91	76.50	76.75	B26-MH26A
8	4	90.000	0.18	0.18	0.54	0.10	0.10	10.0	10.0	6.5	0.63	2.25	1.50	12	0.40	76.17	76.53	76.89	76.96	82.70	76.53	A33 - B29
9	3	89.815	0.09	0.09	0.99	0.09	0.09	10.0	10.0	6.5	0.58	6.17	3.82	12	3.01	78.80	81.50	79.01	81.82	82.85	81.50	R6-B28

Project File: Run-2.stm | Number of lines: 9 | Run Date: 8/17/2022

NOTES:Intensity = 182.59 / (Inlet time + 19.10) ^ 0.99; Return period =Yrs. 25 ; c = cir e = ellip b = box

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Run-3.stm	Number of lines: 3	Date: 8/17/2022

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	76.000	0.27	1.86	0.35	0.09	0.96	10.0	10.5	5.4	5.23	5.24	4.28	15	0.66	71.00	71.50	72.25	72.71	0.00	74.00	A1A-HW1
2	1	97.000	0.81	0.81	0.56	0.45	0.45	10.0	10.0	5.5	2.51	2.56	3.20	12	0.52	71.50	72.00	72.95	73.44	74.00	74.00	A1B-A1A
3	1	81.000	0.78	0.78	0.53	0.41	0.41	10.0	10.0	5.5	2.29	2.50	2.92	12	0.49	71.50	71.90	72.95	73.29	74.00	74.00	A1C-A1A

Project File: Run-3.stm

Number of lines: 3

Run Date: 8/17/2022

NOTES:Intensity = 97.15 / (Inlet time + 13.90) ^ 0.90; Return period =Yrs. 10 ; c = cir e = ellip b = box

SCOUR HOLE CALCULATIONS

BOHLER //
30 Independence Boulevard, Warren, NJ 07059
(908) 668-8300

Date: 8/17/2022
Project: Metuchen, NJ
Project No: J190904

Calculated By: AT
Checked By: JZ / BC

Conduit Outlet Protection Calculations

Scour Hole # 1

Design Parameters:

Design Storm Flow for 25 Year, Q	5.23	cfs
Vertical Dimension of Outlet Pipe, D_o	15	in
Horizontal Dimension of Outlet Pipe, W_o	15	in
Tailwater Depth, TW^1	0.25	ft
Scour Hole Depth, y (1/2 D_o or D_o)	8	in

Apron Dimension Calculations:

Minimum Bottom Width, $W_1 = 2W_o$	W_1 = 2.50 ft
Minimum Bottom Length, $L_1 = 3D_o$	L_1 = 3.75 ft
Minimum Top Width *(max side slope of 3:1)*, W_2	W_2 = 6.25 ft
Minimum Top Length *(max side slope of 3:1)*, L_2	L_2 = 7.50 ft

Rip Rap Stone Size Calculations:

Unit Dicharge, $q = Q/D_o$ = 4.18 cfs per foot

- **Case I: y = 1/2 D_o**

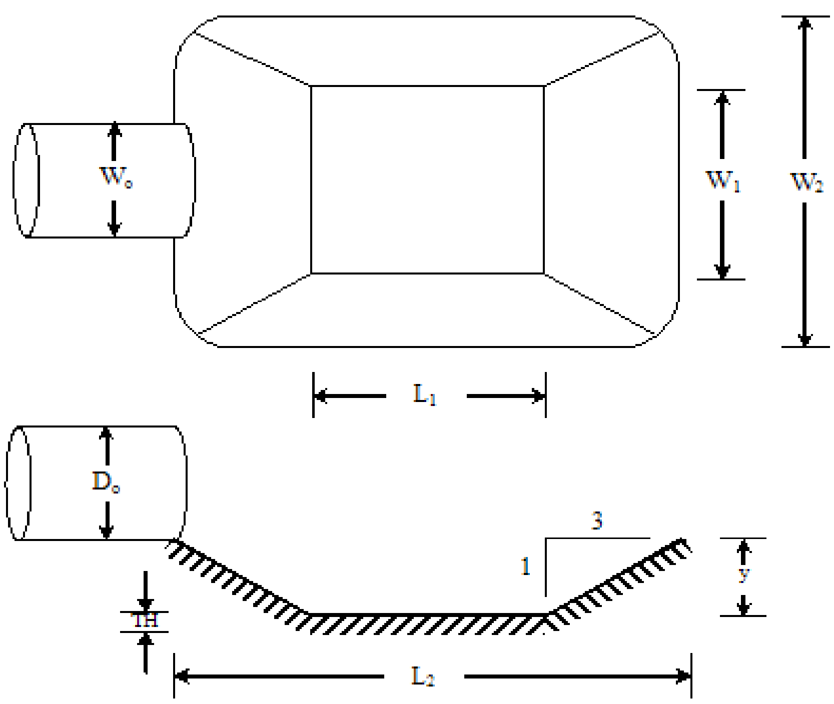
  Median Stone, $d_{50} = \dfrac{0.0125\, q^{1.33}}{TW}$ = 4.03 in   Therefore, use ***d50* = 6 in**

  Apron Thickness, $TH = 2 \times d_{50}$ with filter fabric . . . . . ***TH* = 12 in**

- **Case II: $y = D_o$**

  Median Stone, $d_{50} = \dfrac{0.0082\, q^{1.33}}{TW}$ =

  Apron Thickness, $TH = 2 \times d_{50}$ with filter fabric . . . . .



Notes:

1. The side slopes shall be 3:1 or flatter.
2. The bottom grade shall be 0.0% (level).
3. There shall be no overfall at the end of the apron or at the end of the culvert.
4. Fifty (50) percent by weight of the rip-rap mixture shall be smaller than the median size stone designated as d_{50}. The largest stone size in the mixture shall be 1.5 times the d_{50} size. The rip-rap shall be reasonably well graded.
5. The thickness of the rip-rap apron may be two (2) times the median stone diameter provided that the apron is constructed on a bedding of four (4) inches of 3/4 inch clean stone on approved filter fabric material.
6. Rip-rap and filter fabric shall meet the standards of the governing Soil Conservation District as well as the requirements of the local municipality.
7. Where the scour hole is to be placed within an existing or proposed waterway:
   a. The scour hole sidewalls should be eliminated to maintain a smooth hydraulic line along the waterway bottom to avoid inviting turbulent flow from a sudden depression in the waterway.
   b. If the flow in the waterway is greater than the flow from the proposed outlet, the rip-rap used to construct the scour hole should be sized based on the greater flow value according to the standard rip-rap.

Footnote:

1. Tailwater depth shall be the 2 year storm if discharging into a detention basin. For areas where tailwater cannot be computed, use $TW = 0.2D_o$.

BOHLER //
30 Independence Boulevard, Warren, NJ 07059
(908) 668-8300

Date: 8/17/2022
Project: Metuchen, NJ
Project No: J190904

Calculated By: AT
Checked By: JZ / BC

Conduit Outlet Protection Calculations

Scour Hole # 2

Design Parameters:

Design Storm Flow for 25 Year, Q	32.19	cfs
Vertical Dimension of Outlet Pipe, D_o	36	in
Horizontal Dimension of Outlet Pipe, W_o	36	in
Tailwater Depth, TW[1]	0.60	ft
Scour Hole Depth, y (1/2 D_o or D_o)	18	in

Apron Dimension Calculations:

Minimum Bottom Width, $W_1 = 2W_o$	W_1 = 6.00 ft
Minimum Bottom Length, $L_1 = 3D_o$	L_1 = 9.00 ft
Minimum Top Width *(max side slope of 3:1)*, W_2	W_2 =15.00 ft
Minimum Top Length *(max side slope of 3:1)*, L_2	L_2 =18.00 ft

Rip Rap Stone Size Calculations:

Unit Dicharge, $q = Q/D_o$ = 10.73 cfs per foot

- **Case I: $y = 1/2\ D_o$**

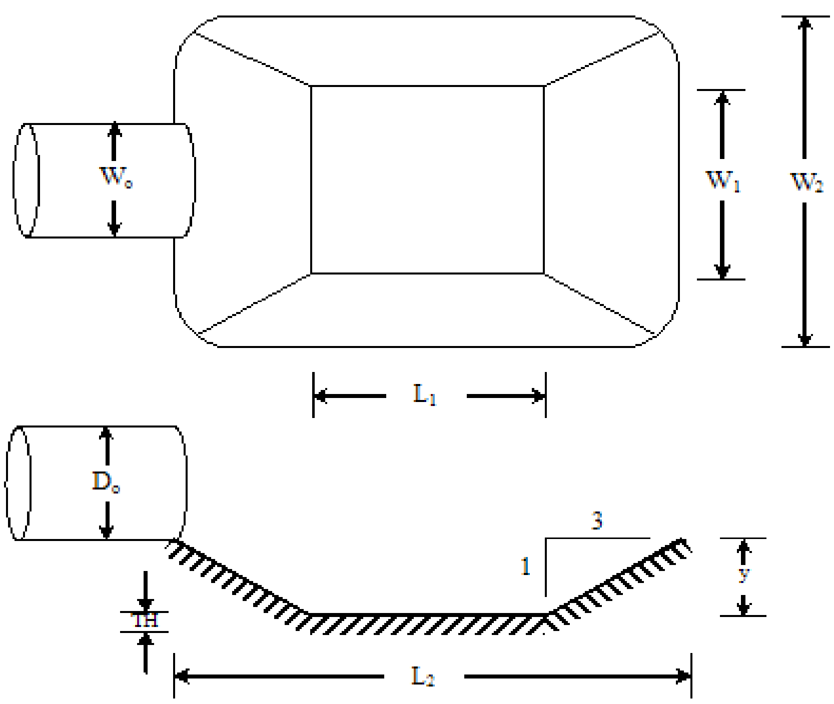
  Median Stone, $d_{50} = \dfrac{0.0125\ q^{1.33}}{TW}$ = 5.87 in Therefore, use ***d50 =*** **6 in**

  Apron Thickness, $TH = 2 \times d_{50}$ with filter fabric . . . . . . ***TH =*** **12 in**

- **Case II: $y = D_o$**

  Median Stone, $d_{50} = \dfrac{0.0082\ q^{1.33}}{TW}$ =

  Apron Thickness, $TH = 2 \times d_{50}$ with filter fabric . . . . . .



Notes:

1. The side slopes shall be 3:1 or flatter.
2. The bottom grade shall be 0.0% (level).
3. There shall be no overfall at the end of the apron or at the end of the culvert.
4. Fifty (50) percent by weight of the rip-rap mixture shall be smaller than the median size stone designated as d_{50}. The largest stone size in the mixture shall be 1.5 times the d_{50} size. The rip-rap shall be reasonably well graded.
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Footnote:

1. Tailwater depth shall be the 2 year storm if discharging into a detention basin. For areas where tailwater cannot be computed, use $TW = 0.2D_o$.

NJGRS CALCULATION

New Jersey Groundwater Recharge Spreadsheet Version 2.0 November 2003

Annual Groundwater Recharge Analysis (based on GSR-32)

Select Township ↓	Average Annual P (in)	Climatic Factor
MIDDLESEX CO., METUCHEN BORO	48.6	1.55

Project Name:	Prop. Multi-Family Development
Description:	Klein Enterprises
Analysis Date:	07/21/22

Pre-Developed Conditions

Land Segment	Area (acres)	TR-55 Land Cover	Soil	Annual Recharge (in)	Annual Recharge (cu.ft)
1	1.17	Impervious areas	PSAMMENTS	0.0	-
2	0.75	Open space	PSAMMENTS	0.0	-
3	2.55	Woods	PSAMMENTS	0.0	-
4	1	Impervious areas	Lansdowne	0.0	-
5	0.08	Open space	Lansdowne	13.4	3,883
6	3.78	Impervious areas	Dunellen	0.0	-
7	0.86	Open space	Dunellen	15.6	48,820
8	0.46	Woods	Dunellen	15.9	26,532
9	2.53	Impervious areas	Udorthents	0.0	-
10	0.04	Open space	Udorthents	0.0	-
11	0.22	Woods	Udorthents	0.0	-
12	0				
13	0				
14	0				
15	0				
Total =	13.4			Total Annual Recharge (in)	Total Annual Recharge (cu-ft)
				1.6	79,236

Post-Developed Conditions

Land Segment	Area (acres)	TR-55 Land Cover	Soil	Annual Recharge (in)	Annual Recharge (cu.ft)
1	0.36	Impervious areas	PSAMMENTS	0.0	-
2	0.27	Gravel, dirt	PSAMMENTS	0.0	-
3	1.97	Open space	PSAMMENTS	0.0	-
4	1.87	Woods	PSAMMENTS	0.0	-
5	0.68	Impervious areas	Lansdowne	0.0	-
6	0.41	Open space	Lansdowne	13.4	19,902
7	3.71	Impervious areas	Dunellen	0.0	-
8	0.03	Gravel, dirt	Dunellen	9.9	1,082
9	1.35	Open space	Dunellen	15.6	76,636
10	1.19	Impervious areas	Udorthents	0.0	-
11	0.04	Gravel, dirt	Udorthents	0.0	-
12	1.51	Open space	Udorthents	0.0	-
13	0.05	Woods	Udorthents	0.0	-
14	0				
15	0				
Total =	13.4			Total Annual Recharge (in)	Total Annual Recharge (cu.ft)
				2.0	97,620
				Total Impervious Area (sq.ft)	258,746

Annual Recharge Requirements Calculation ↓

% of Pre-Developed Annual Recharge to Preserve =	100%	
Post-Development Annual Recharge Deficit=	*-18,384*	(cubic feet)

Recharge Efficiency Parameters Calculations (area averages)

RWC=	2.80	(in)	DRWC=	2.80	(in)
ERWC =	0.63	(in)	EDRWC=	0.63	(in)

Procedure to fill the Pre-Development and Post-Development Conditions Tables

For each land segment, first enter the area, then select TR-55 Land Cover, then select Soil. Start from the top of the table and proceed downward. Don't leave blank rows (with A=0) in between your segment entries. Rows with A=0 will not be displayed or used in calculations. For impervious areas outside of standard lots select "Impervious Areas" as the Land Cover. Soil type for impervious areas are only required if an infiltration facility will be built within these areas.

CALCULATION PER McCuen-Spiess EQUATION

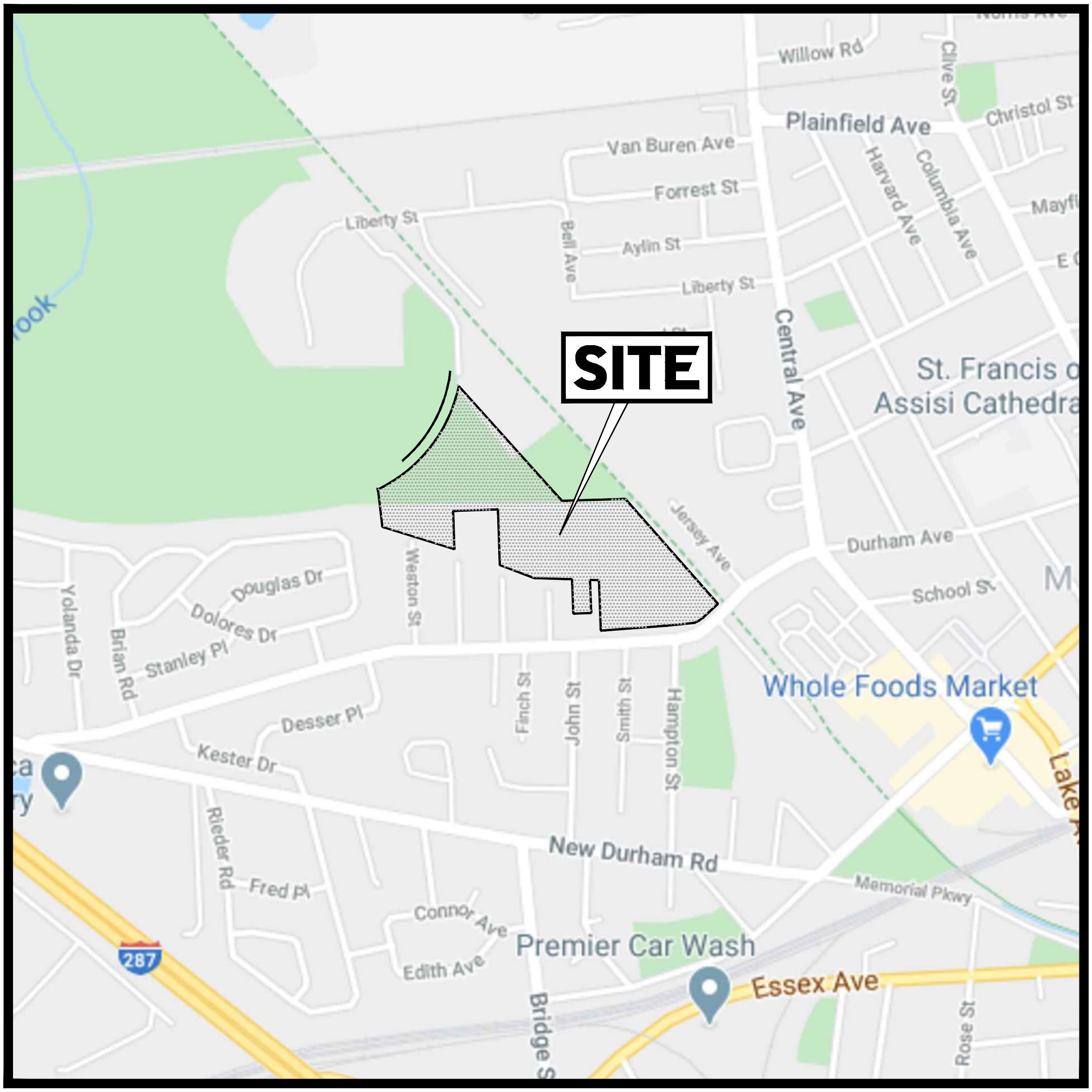
Calculation per McCuen-Spiess Equation

Flow Length	Time of concentration	2-Year rainfall
L = 100* (S)^0.5/n	Tc = 0.007*(n*L)^0.8/((P2)^0.5*s^0.4)	P2= 3.35

	Slope	Mannings' No.	Flow Length	Flow Length		
	S	n	L (max)	L (used)	Tc (hr.)	Tc (min.)
PDA-1 (Imp.)	0.035	0.011	1701	50	0.0091	0.5
PDA-1 (Per.)	0.01	0.24	42	42	0.1532	9.2

C. MAPS & DOCUMENTATION

- ♦ **Site Location Map**
- ♦ **Tax Map**
- ♦ **USGS Map**
- ♦ **Aerial Map**
- ♦ **Soil Map**
- ♦ **Drainage Area Maps**
  - **Existing Drainage Area Map**
  - **Proposed Drainage Area Map**
  - **Inlet Area Map**



N

SITE LOCATION MAP

SCALE: 1" = 1,000'

SOURCE: GOOGLE MAPS

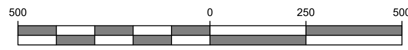
1000 0 500 1000

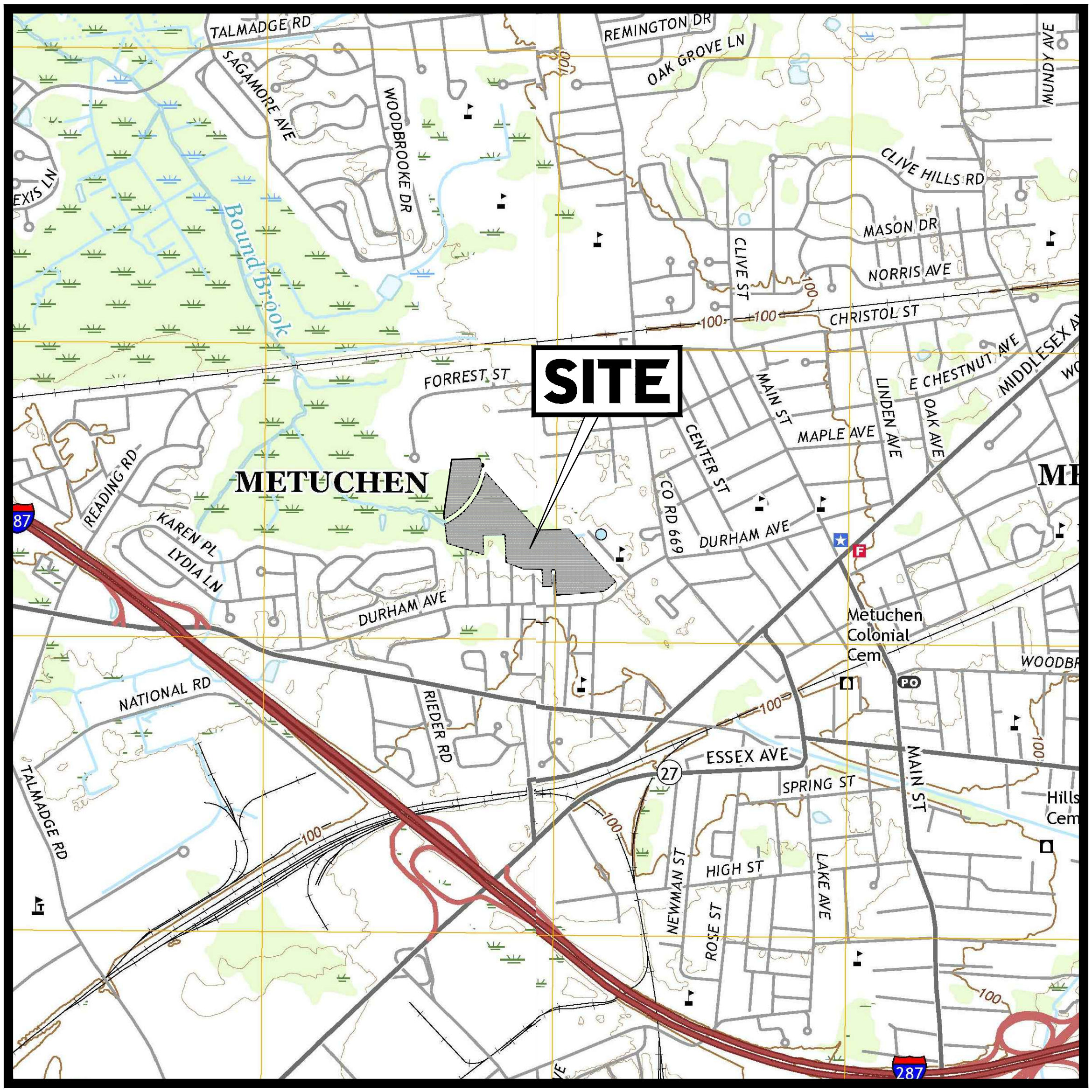
GRAPHIC SCALE 1 INCH = 1000 FEET

TAX MAP

SCALE: 1" = 500'

SOURCE: GIS PARCEL DATA MAPS





USGS MAP

SCALE: 1" = 2,000'

SOURCE: USGS QUADRANGLE - PERTH AMBOY & PLAINFIELD

2000 0 1000 2000

GRAPHIC SCALE 1 INCH = 2000 FEET

AERIAL MAP

SCALE: 1" = 500'

SOURCE: NJGIN INFORMATION WAREHOUSE (2015)

500 0 250 500

GRAPHIC SCALE 1 INCH = 500 FEET


74° 22' 58" W
74° 22' 3" W
40° 32' 50" N
40° 32' 22" N
552300
552400
552500
552600
552700
552800
552900
553000
553100
553200
553300
553400
553500
4488600
4488500
4488400
4488300
4488200
4488100
4488000
4487900
UdwuB
PbtAr
MakAt
PbtAr
UdwuB
PsuB
DuyB
Dolores Dr
Martin St
DuyB
Gulton St
Durham Ave
Park Sq
UdwuB
DuxA
LbuB
UR
PsuB
Desser Pl
Soil Map may not be valid at this scale.
Map Scale: 1:5,950 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0 50 100 200 300
Feet
0 250 500 1000 1500
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Middlesex County, New Jersey
Survey Area Data: Version 16, Jun 1, 2020

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

Date(s) aerial images were photographed: Jun 22, 2019—Jul 13, 2019

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
DuxA	Dunellen moderately well drained variant sandy loam, 0 to 2 percent slopes	A	4.1	2.4%
DuyB	Dunellen moderately well drained variant-Urban land complex, 0 to 6 percent slopes	A	31.7	18.5%
LbuB	Lansdowne-Urban land complex, 0 to 6 percent slopes	C	22.7	13.2%
MakAt	Manahawkin muck, 0 to 2 percent slopes, frequently flooded	A/D	15.9	9.2%
PbtAr	Parsippany very poorly drained variant silt loam, 0 to 3 percent slopes, rarely flooded	D	31.8	18.6%
PsuB	Psamments, waste substratum, 0 to 8 percent slopes	A	9.4	5.5%
UdwuB	Udorthents, wet substratum-Urban land complex, 0 to 8 percent slopes	D	44.5	25.9%
UR	Urban land		11.5	6.7%
Totals for Area of Interest			**171.6**	**100.0%**

Description

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

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

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

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

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

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

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

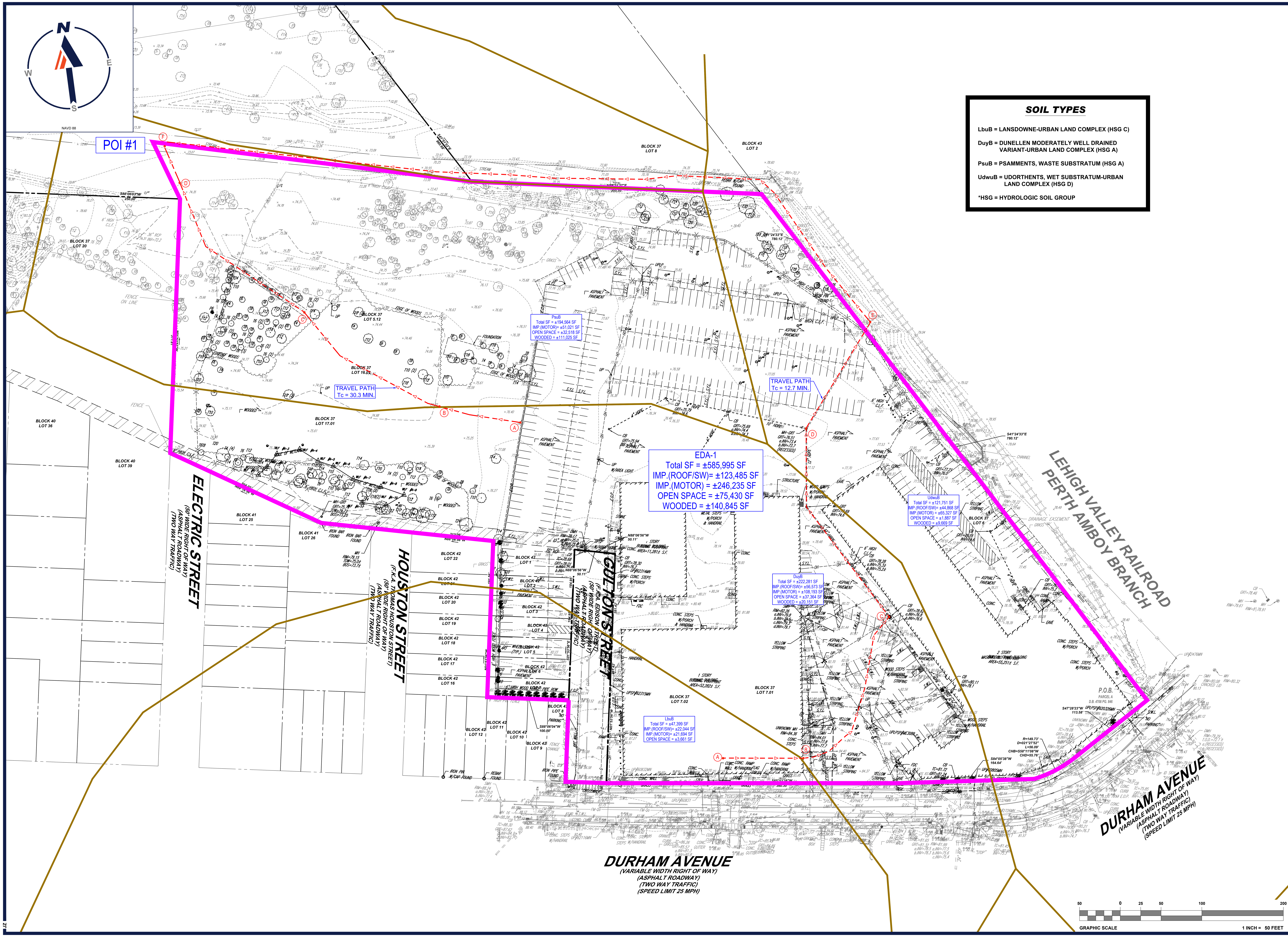
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

DRAINAGE AREA MAPS



SOIL TYPES

LbuB = LANSDOWNE-URBAN LAND COMPLEX (HSG C)

DuyB = DUNELLEN MODERATELY WELL DRAINED VARIANT-URBAN LAND COMPLEX (HSG A)

PsuB = PSAMMENTS, WASTE SUBSTRATUM (HSG A)

UdwuB = UDORTHENTS, WET SUBSTRATUM-URBAN LAND COMPLEX (HSG D)

*HSG = HYDROLOGIC SOIL GROUP

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REV	DATE	COMMENT	DRAWN BY / CHECKED BY

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PROJECT No.:	J190904
DRAWN BY:	AT
CHECKED BY:	NHA/BC
DATE:	08/09/2022
CAD I.D.:	J190904-EDAM-0B

PROJECT:

PRELIMINARY & FINAL MAJOR SITE PLAN

FOR

212 DURHAM URBAN RENEWAL ENTITY, LLC

PROPOSED
MULTI-FAMILY DEVELOPMENT

BLOCK 37, LOTS 5.12, 5.22, 6, 7.01, 7.02, 13, 14, 15.01, 16.02, 16.03, 17.01, 17.02
BLOCK 42, LOTS 1-7
212 DURHAM AVENUE
BOROUGH OF METUCHEN
MIDDLESEX COUNTY, NEW JERSEY
TAX MAP SHEET: 8.01

BOHLER
BOHLER ENGINEERING NJ, LLC
30 INDEPENDENCE BLVD., SUITE 200
WARREN, NJ 07059
Phone: (908) 668-8300
Fax: (908) 754-4401
www.BohlerEngineering.com
NJ CERT. OF AUTHORIZATION No. 24GA28161700 & MH000122

B.S. CROWDER
PROFESSIONAL ENGINEER
NEW JERSEY LICENSE No. 52263
PENNSYLVANIA LICENSE No. 086764
NEW YORK LICENSE No. 100602

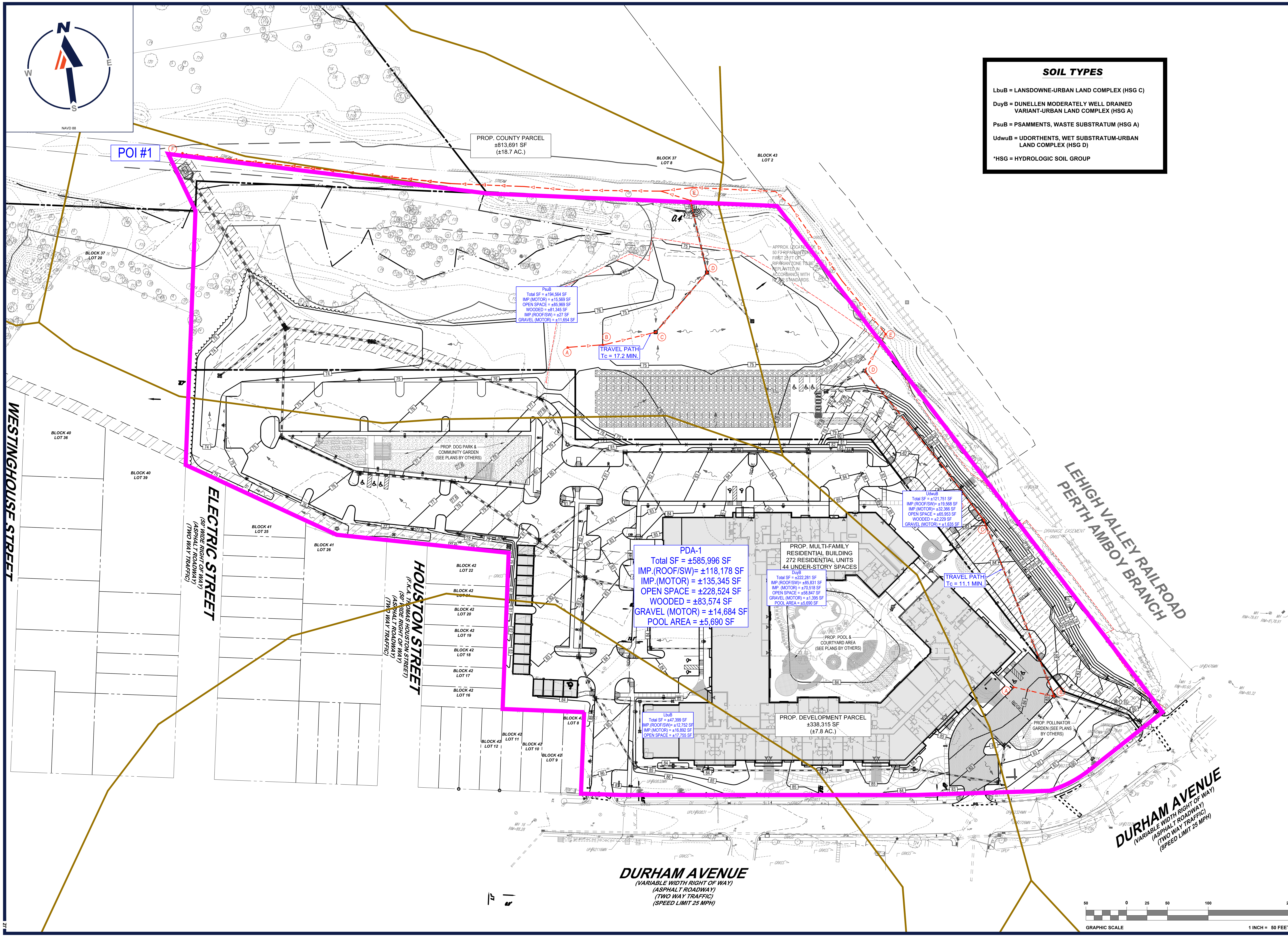
SHEET TITLE:

EXISTING DRAINAGE AREA MAP

SHEET NUMBER:

1

ORG. DATE - 08/09/2022



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REV	DATE	COMMENT	DRAWN BY / CHECKED BY

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DRAWN BY:	AT
CHECKED BY:	NHA/BC
DATE:	08/09/2022
CAD I.D.:	J190904-PDAM-0B

PROJECT:
PRELIMINARY & FINAL MAJOR SITE PLAN
FOR
212 DURHAM URBAN RENEWAL ENTITY, LLC
PROPOSED
MULTI-FAMILY DEVELOPMENT
BLOCK 37, LOTS 5.12, 5.22, 6, 7.01, 7.02, 13, 14, 15.01, 16.02, 16.03, 17.01, 17.02
BLOCK 42, LOTS 1-7
212 DURHAM AVENUE
BOROUGH OF METUCHEN
MIDDLESEX COUNTY, NEW JERSEY
TAX MAP SHEET: 8.01

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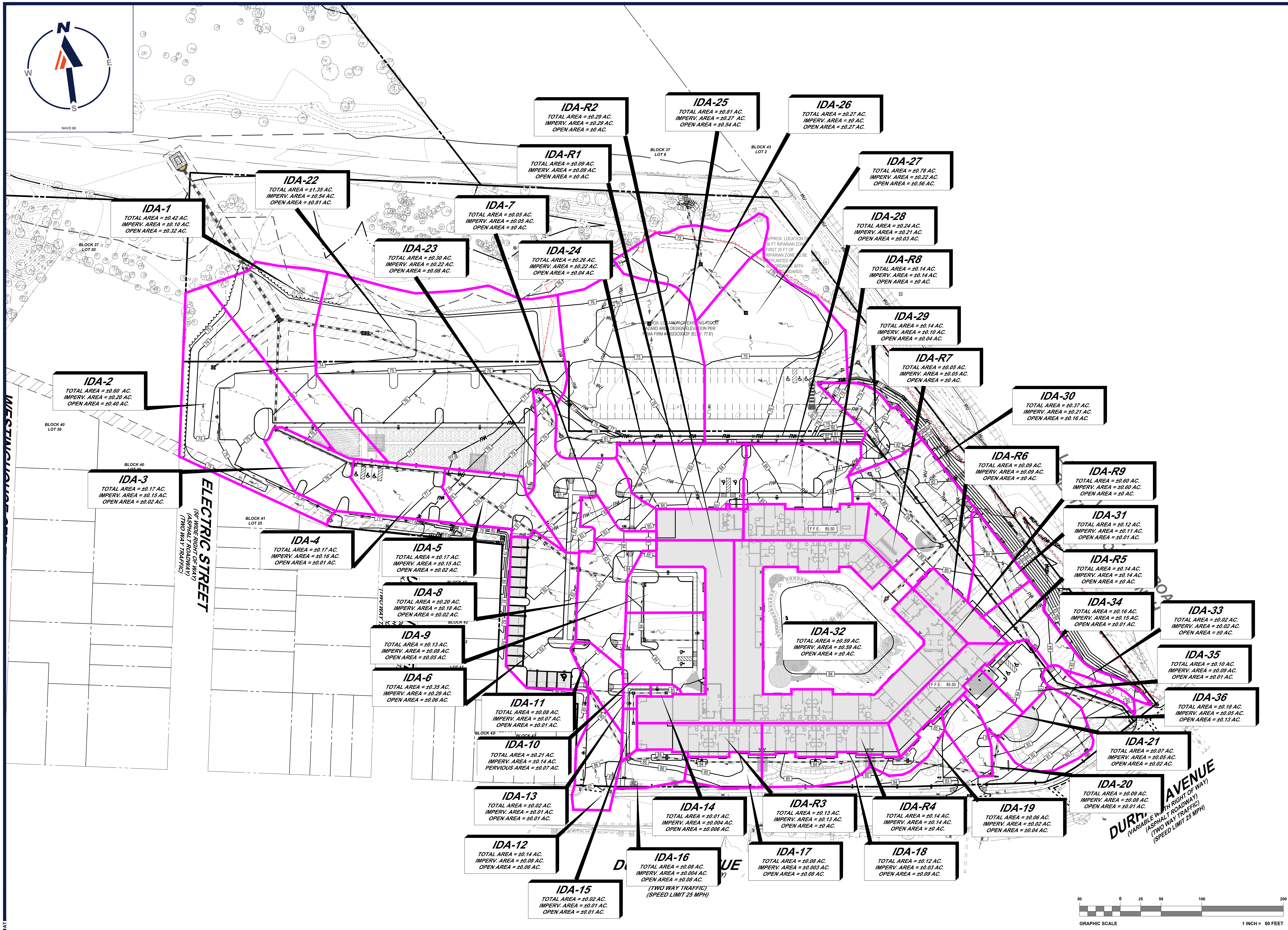
NEW YORK LICENSE No. 100802

SHEET TITLE:
PROPOSED DRAINAGE AREA MAP

SHEET NUMBER:
2

ORG. DATE - 08/09/2022



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REV	DATE	COMMENT	DRAWN BY / CHECKED BY

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PROJECT No.:	J190904
DRAWN BY:	AT
CHECKED BY:	NHA/BC
DATE:	08/24/2022
CAD I.D.:	J190904-IDAM-0B

PROJECT:

PRELIMINARY & FINAL MAJOR SITE PLAN

FOR

212 DURHAM URBAN RENEWAL ENTITY, LLC

PROPOSED MULTI-FAMILY DEVELOPMENT

BLOCK 37, LOTS 5.12, 5.22, 6, 7.01, 7.02, 13, 14, 15.01, 16.02, 16.03, 17.01, 17.02
BLOCK 42, LOTS 1-7
212 DURHAM AVENUE
BOROUGH OF METUCHEN
MIDDLESEX COUNTY, NEW JERSEY
TAX MAP SHEET: 8.01

BOHLER//
BOHLER ENGINEERING NJ, LLC
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WARREN, NJ 07059
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PROFESSIONAL ENGINEER
NEW JERSEY LICENSE No. 52263
PENNSYLVANIA LICENSE No. 086764
NEW YORK LICENSE No. 100602

SHEET TITLE:

INLET DRAINAGE AREA MAP

SHEET NUMBER:

3

ORG. DATE - 08/24/2022