FROELICH ENGINEERS

Preliminary Stormwater Drainage Report

IHI - Lincoln City Affordable Housing

2510 NE HWY 101
Lincoln City, OR

For

Innovative Housing Inc.

Regular maintenance and inspection are required on all components of the stormwater system. This plan provides instruction on how to maintain and inspect the system.

Prepared by: Evan Eykelbosch, PE and Ben Ullmann, PE
Froelich Engineers
17700 SW Upper Boones Ferry Rd, Suite 115
Portland, OR 97224
Froelich Project Number: 21-C018
Date: February 24, 2022

Designer's Certification and Statement

"I hereby certify that this Preliminary Stormwater Management Report for this project has been prepared by me or under my supervision and meets the minimum standards of the City of Lincoln City and normal standards of engineering practice. I hereby acknowledge and agree that the jurisdiction does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities design by me."

Evan Eykelbosch, PE

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I. Project Overview and Description

This stormwater report has been prepared in accordance with the 2021 Lincoln City Public Works Design Standards and Details, adopted in January 2021, and the Lincoln City Stormwater Best Management Practices for Site Development guideline, to support the land use application for the proposed project improvements.

IHI - Lincoln City Affordable Housing is a new low-income apartment complex located at the corner of NW Hwy 101 and NE 25th St (See Appendix A: Vicinity Map).

Existing Conditions

The existing site is a combination of tax lots (4301, 4302, and 4300) from tax map NW 1/4 NW 1/4 Section 11, Township 7S, Range 11W BB Lincoln County. The existing topography of tax lot 4301 is relatively flat with minor slopes from south to north and east to west. The existing soil of tax lot 4301 is Urban land-Nelscott complex, 0 to 12 percent slopes based on a Soil Resource Report from the NRCS (See Appendix D: Soil Resource Report). The topography of tax lots 4302 and 4300 has a high point along the middle of the south property line with steep slopes to ravines along the north and east portions of the property. The eastern portion of the north property line has a large 40’ tall cliff. The western portion of the north property line is a drainage ravine that runs down to the bottom of the hill. The existing soil for these two tax lots is primarily Winema-Fendall silt loams, 3 to 15 percent slopes based on a Soil Resource Report from the NRCS.

The existing condition of the site is undeveloped, and all the existing runoff is shed offsite to three different disposal points. Approximately 8% of the site surface drains to the west and discharges into the HWY 101. Approximately 66% of the site drains to the north. The topographic survey indicates that most of the northern runoff collects at the base of the cliff prior to “overflowing” across the northern property line. Downstream of the northern property is a series of drainage ravines and culverts that discharge runoff in the Friends of Wildwood Open Space. It is our understanding that manmade modifications to the natural drainageway has caused localized flooding downstream of our site. Approximately 26% of the site drains to the east. This runoff sheds down the eastern hillside and collects within a stormwater detention pond. Overflow from this pond runs through a creek out into the Friends of Wildwood Open Space.

An existing condition Basin Map is provided in Appendix B.

Proposed Conditions

The proposed condition of the site is a large 107-unit apartment complex with 8 buildings located across a 4.42-acre property. Due to the existing steep slopes and strict ADA requirements, the property is going to require a significant amount of cut/fill and retaining walls. The stormwater system will collect pervious and impervious runoff from a majority of the site with a series of catch basins, trench drains, and roof downspouts. Additionally, runoff will be managed with both water quality and flow control structures as required by code. Due to the significant topographic modifications to the site, the project will be modifying the disposal areas draining to each disposal location. Approximately 3% of the site will discharge to the west, 40% of the site will discharge to the north, and 57% of the site will discharge to the east.

A proposed condition Basin Map is provided in Appendix B.

‘Table 1: Catchment Basins’ provides the basin characteristics for the various catchment areas under the existing and proposed conditions.

The facilities are to be maintained by owner’s representative. The preparer has designed a system that can be easily maintained by maintenance staff. A copy of the O&M shall be provided to all property owners and tenants.

II. Methodology

The following stormwater management system complies with the 2021 Lincoln City Public Works Design Standards and Details, Chapter 3.

Lincoln City requires stormwater treatment for all pollution generating surfaces. This includes vehicular areas and those areas mixing with the vehicular runoff. Non-pollution generating services include pervious areas and impervious areas that do not mix with the pollution generating surfaces (such as roofs and walkways). Per the Lincoln City Stormwater Best Management Practices for Site Development guideline and communication with the city, proprietary treatment devices are allowed to address stormwater treatment. Lincoln City does not have a specific contaminant removal benchmark that treatment facilities are required to meet, but has a goal that developments are to provide a higher level of treatment than is provided by simply using a lynch style catch basin or sediment manhole. The city has a list of allowable treatment facilities from which this project has chosen from. Water quality facilities were designed to meet 1/2 of the 2-year, 24-hour storm event (2.1 in/24-hr). A summary of the water quality facilities is provided in 'Table 2: Catchment and Facility Table'.

Lincoln City requires that all commercial, planned unit developments and subdivision projects shall provide flow control such that the post developed and predeveloped match at the 2-year, the 10-year, and the 25-year stormwater events (4.2 in/24-hr, 5.7 in/24-hr, and 6.5 in/24-hr respectively). If stormwater detention or flow control requirements cannot be met, then a downstream analysis is required for a distance of 400-yards or the nearest ocean/lake outfall, whichever is closer, to demonstrate that there are no adverse downstream impacts. Due to the known downstream stormwater issues of the northern disposal location, the project has provided a flow control structure to reduce the rate of runoff leaving the site. A downstream analysis will be provided to address the additional runoff draining to the eastern disposal location. A summary of the detention and flow control facilities is provided in 'Table 2: Catchment and Facility Table' and a summary of the flow rate results is provided in 'Table 3: Stormwater Flow Rate Table'.

The conveyance calculations were designed for the 25-year storm event (6.5 in/24-hr) per the Lincoln City Public Works Design Standards and Details. See Appendix G for conveyance sizing calculations.

III. Analysis

The analysis of the site is based on the Santa Barbara Urban Hydrograph (SBUH) Method and was implemented using a NRCS Type 1A rainfall distribution for a 24-hour storm. The system was designed using HydroCAD software (See Appendix F: HydroCAD Report).

Conveyance calculations are based on the Manning Formula for uniform pipe flow (See Appendix G: Stormwater Conveyance Calculations).

West Disposal Basin
Due to the topographic site constraints on the site, it was not possible to collect treat, detain, and dispose of the runoff from a small portion of driveway and landscaping along the western edge of the project site. This area of runoff is significantly reduced from the existing area that drains into HWY 101. There are no known downstream capacity issues with this reduced rate of runoff entering the street stormwater system.

North Disposal Basin
The north disposal basin is comprised of 3 developed basins and the existing undeveloped vegetative basin along the northern portion of the site. The existing vegetated basin will continue to drain to the north as it currently does. The Basin N2 and N4 will be collected in a series of catch basins and pipes and will be routed through a treatment and detention facility. Basin N3 is completely non-pollution generating and is connected directly to the stormwater system without treatment or detention. Runoff will outfall into the drainage ravine on the downhill side of the retaining wall. The outfall will be constructed with a large

riprap energy dissipater to minimize the erosion discharge effects. As part of the site design, the areas draining to the north was reduced by nearly 39%.

East Disposal Basin
The east disposal location is comprised of 11 developed basins and the existing undeveloped vegetative basin along the eastern portion of the site. The existing vegetative basin will continue to drain as it currently does. A majority of the developed basins are collected and routed to the water quality facility. Basin E2 will bypass water quality treatment facility due to all the runoff begin generated from a non-pollution generating surface. Runoff will outfall into the drainage ravine on the downhill side of the retaining wall. The outfall will be constructed with a large riprap energy dissipater to minimize the erosion discharge effects.

Downstream Analysis

A downstream analysis is required for the East Disposal Basin as the development of a stormwater detention and flow control system that meets the existing conditions is not possible. The East Disposal Basin discharges along the hillside into an existing drainageway that leads to the Friends of the Wildwood Open Space. The drainageway is a heavily wooded and steep sloped area that is incapsulated by residential development on NE 27th Dr to the north, the project site to the west, and Kirtsis Park to the south. The site runoff will flow down the hill into an existing detention pond. Downstream of the detention pond is a channelized stream with wide embarkments. The stream discharges into Friends of the Wildwood Open Space which is connected to Devils Lake.

Based on our site visit, the drainage way has sufficient capacity to collect and convey the runoff from the site.

Table 1: Catchment Basins

Existing Conditions				Proposed Conditions			
Basin	**Drainage Source**	**Area (sf)**	**Curve #**	**Basin**	**Drainage Source**	**Area (sf)**	**Curve #**
West	Woods, Good, HSG C	14,588	70	West	Parking Lot / Landscape	5,532	74 / 98
North	Woods, Good, HSG C	127,624	70	North	Parking Lot / Building Roof	77,818	74 / 98
East	Woods, Good, HSG C	50,482	70	East	Parking Lot / Building Roof	109,343	74 / 98
Total	--	192,694	70	Total	--	192,693	74 / 98

Table 2: Catchment and Facility Table

Catchment/ Facility ID	Drainage Source	Impervious Area (sf)	Ownership (private/public)	Facility Type	Facility Size (sf)
CDS-1	North	38,987	Private	Water Quality Structure	CDS2015-4
Chambers -1	CDS-1	38,987	Private	Underground Detention System	50.00’x17.00’x4.50’ ADS N-12 36” Dia
CDS-2	East	83,573	Private	Water Quality Structure	CDS-2020-5

Table 3: Stormwater Flow Rate Table

Storm Event	2-Year (4.2 in)		10-Year (5.7 in)		25-Year (6.5 in)	
Basin	Pre-Developed	Post-Developed	Pre-Developed	Post-Developed	Pre-Developed	Post-Developed
West	0.097	0.075	0.193	0.117	0.250	0.141
North	0.851	0.847	1.690	1.287	2.184	1.881
East	0.336	1.952	0.668	2.813	0.864	3.282

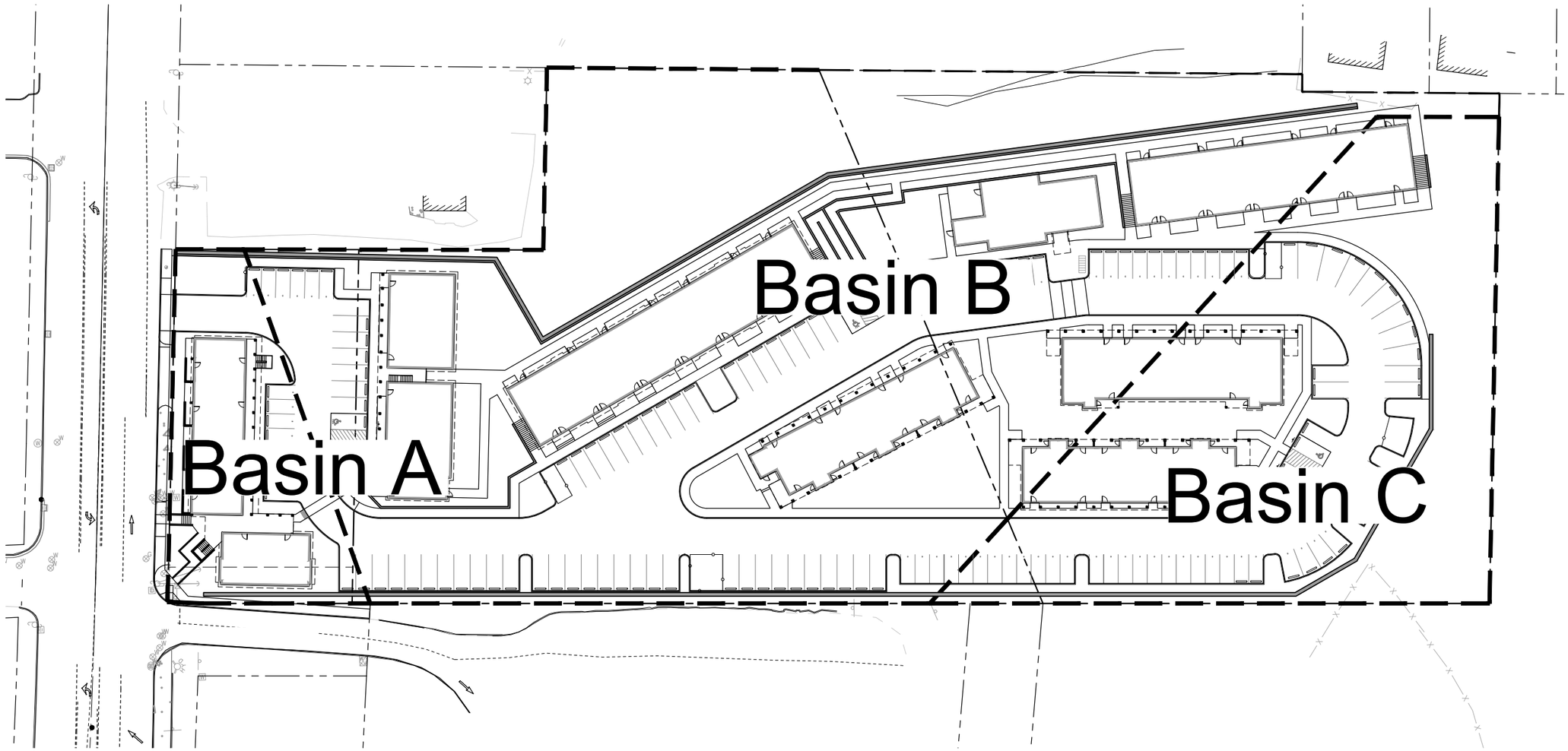
IV. Engineering Conclusion

Based on the requirements of the 2021 Lincoln City Public Works Design Standards and Details and the Lincoln City Stormwater Best Management Practices guideline, all facilities and conveyance components have enough capacity to manage the runoff from the required storm event and should be approved as designed.

V. Appendices

Appendix A: Vicinity Map

Appendix B: Basin Map and Areas



LRS ARCHITECTS

PRELIMINARY
NOT FOR
CONSTRUCTION

CONSULTANT:

FROELICH
ENGINEERS
CIVIL · STRUCTURAL
Portland, OR. | Bend, OR. | Denver, CO.
(503) 624-7005

PROJECT NUMBER: *XXXXXX*

LINCOLN CITY AFFORDABLE HOUSING

2510 NE HWY 101
LINCOLN CITY, OR
97367

SHEET TITLE:

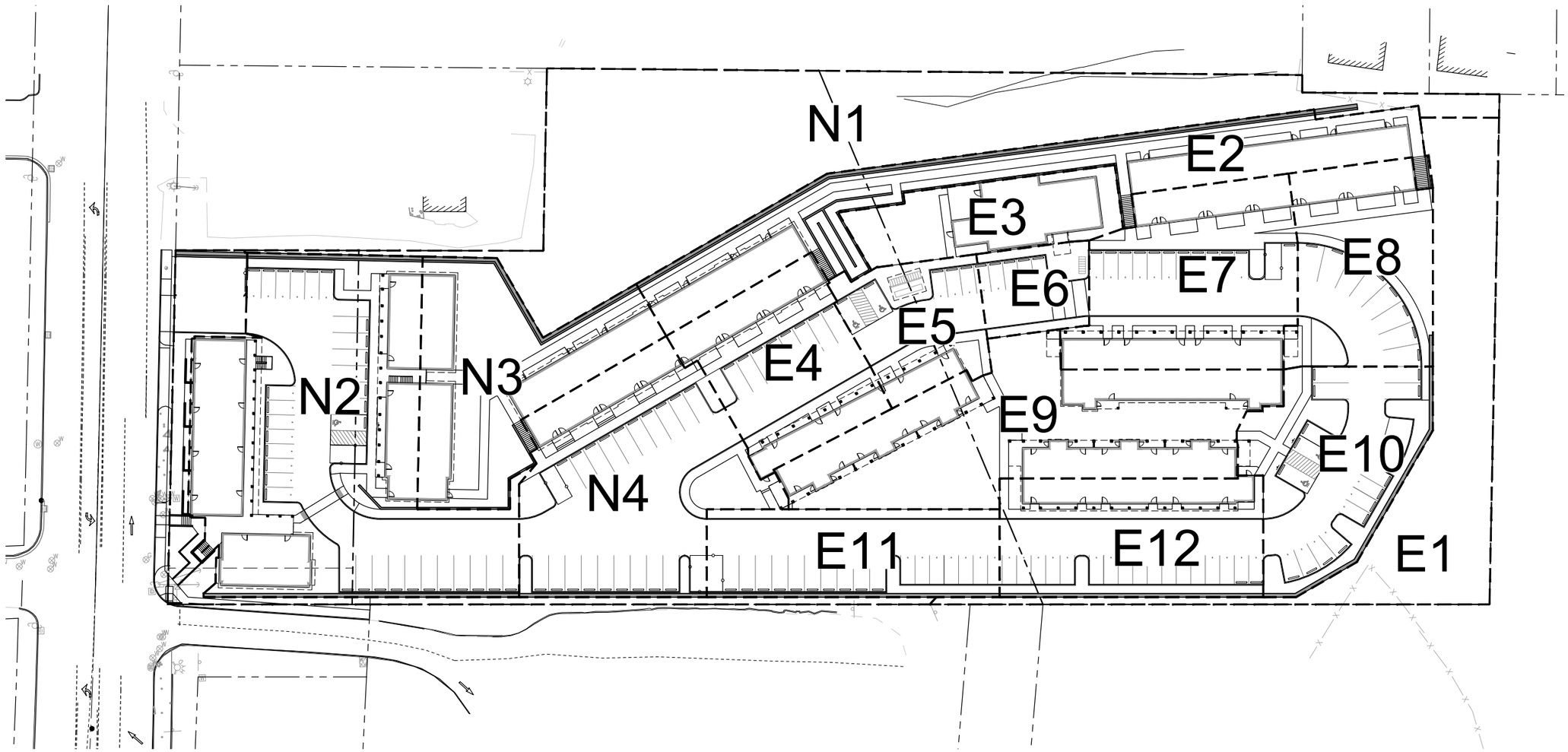
EXISTING BASIN MAP

DRAWN BY: *Author*

SHEET:

EXISTING

DEVELOPMENT REVIEW
01/31/2022



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(503) 624-7005

PROJECT NUMBER: *XXXXXX*

LINCOLN CITY AFFORDABLE HOUSING

2510 NE HWY 101
LINCOLN CITY, OR
97367

SHEET TITLE:

PROPOSED BASIN MAP

DRAWN BY: *Author*

SHEET:

PROPOSED

DEVELOPMENT REVIEW
01/31/2022

Existing

Disposal	Basins	Pervious		Impervious		total	
		sf	ac	sf	ac	sf	ac
West	Basin A	14,588	0.335	0	0.000	14,588	0.335
North	Basin B	127,624	2.930	0	0.000	127,624	2.930
East	Basin C	50,482	1.159	0	0.000	50,482	1.159
	Total	192,694	4.42	0	0.00	192,694	4.42

Proposed

Disposal	Basins	Pervious		Impervious		total		Flow Q (25-YR)
		sf	ac	sf	ac	sf	ac	cfs
West	West 1	1,983	0.046	3,549	0.081	5,532	0.127	0.141
North	North 1	28,293	0.650	0	0.000	28,293	0.650	0.484
	North 2	2,336	0.054	22,535	0.517	24,871	0.571	0.844
	North 3	4,379	0.101	6,159	0.141	10,538	0.242	0.305
	North 4	1,881	0.043	12,235	0.281	14,116	0.324	0.470
East	East 1	12,987	0.298	0	0.000	12,987	0.298	0.222
	East 2	2,529	0.058	10,254	0.235	12,783	0.293	0.413
	East 3	2,535	0.058	2,996	0.069	5,531	0.127	0.156
	East 4	543	0.012	7,451	0.171	7,994	0.184	0.274
	East 5	532	0.012	4,506	0.103	5,038	0.116	0.170
	East 6	96	0.002	2,707	0.062	2,803	0.064	0.098
	East 7	869	0.020	10,361	0.238	11,230	0.258	0.384
	East 8	2,463	0.057	5,972	0.137	8,435	0.194	0.260
	East 9	7,488	0.172	8,223	0.189	15,711	0.361	0.439
	East 10	2,933	0.067	6,526	0.150	9,459	0.217	0.289
	East 11	439	0.010	7,391	0.170	7,830	0.180	0.270
	East 12	913	0.021	8,629	0.198	9,542	0.219	0.323
	Total	73,199	1.68	119,494	2.74	192,693	4.42	

Appendix C: Assumptions

Santa Barbara Unit Hydrogragh (SBUH) Assumptions:
(used for Water Quality Sizing, Flow Control, and Conveyance Pipe Sizing)

NRCS Type IA Storm Event

WQ Storm Event =	**2.1**	in/24-hours per 2021 Lincoln City PW Dept. Design Standards Chp 3.
2-year Storm Event =	**4.2**	in/24-hours per 2021 Lincoln City PW Dept. Design Standards Chp 3.
10-year Storm Event =	**5.7**	in/24-hours per 2021 Lincoln City PW Dept. Design Standards Chp 3.
25-year Storm Event =	**6.5**	in/24-hours per 2021 Lincoln City PW Dept. Design Standards Chp 3.
Time of Concentration =	**5.0**	minutes
Roughness Coefficient =	**0.013**	

Curve Number Assumptions

Impervious Area =	**98**	Per NRCS Runoff Curve Numbers
Pervious Area =	**74**	Per NRCS Runoff Curve Numbers
Pervious Area (existing) =	**70**	Per NRCS Runoff Curve Numbers

NRCS Soil Group

Upper Site =	**C**	Per Soil Resource Report
Lower Site =	**C**	Per Soil Resource Report

Infiltration Rate

Site =	**N/A**	Per Geotech Report

Appendix D: Soil Resource Report

Map Scale: 1:1,470 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 20 40 80 120

Feet
0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N 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 1:20,000.

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: Lincoln County Area, Oregon
Survey Area Data: Version 17, Jun 11, 2020

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

Date(s) aerial images were photographed: May 28, 2020—Jun 22, 2020

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
19E	Fendall-Winema silt loams, 15 to 35 percent slopes	C	0.2	2.9%
59C	Urban land-Nelscott complex, 0 to 12 percent slopes		1.9	27.1%
64C	Winema-Fendall silt loams, 3 to 15 percent slopes	C	4.9	70.0%
Totals for Area of Interest			**6.9**	**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

Appendix E: Geotechnical Report

Earth Engineers, Inc.

2411 Southeast 8th Avenue • Camas • WA 98607
Phone: 360-567-1806
www.earth-engineers.com

December 6, 2021 **DRAFT**

Innovative Housing, Inc.
219 Northwest 2nd Avenue
Portland, Oregon 97209
Attention: Julie Garver

Phone: (503) 226-4368, ext.3
E-mail: jgarver@innovativehousinginc.com

Subject: **Geotechnical Investigation Report**
Proposed Apartment Complex
Lincoln County Tax Lots 07-11-11-BB-04301, 07-11-11-BB-04302-00, and 07-11-11-BB-04300-00
Northeast corner of Northeast 25th Street and Highway 101
Lincoln City, Lincoln County, Oregon
EEI Report No. 20-047-2

Dear Ms. Garver:

Earth Engineers, Inc. (EEI) is pleased to transmit our Geotechnical Investigation Report for the above referenced project. This report replaces EEI Report Nos. 20-047-1 and 20-047-1-R1. The attached report includes the results of our original field and laboratory testing conducted in 2020, the results of our supplemental field and laboratory testing conducted recently, an evaluation of geotechnical factors that may influence the proposed development, and geotechnical recommendations for the proposed structures and general site development based on the most recent project information provided to us. This report is being issued as a draft for the project's land use submittal and will be updated and finalized at a later date, prior to final project engineering design.

We appreciate the opportunity to perform this geotechnical study and look forward to continued participation during the design and construction phases of this project. If you have any questions pertaining to this report, or if we may be of further service, please contact our office.

Respectfully submitted,
Earth Engineers, Inc.

Ken Andrieu, R.G.
Senior Geologist

Troy Hull, P.E., G.E.
Principal Geotechnical Engineer

Attachment: Geotechnical Investigation Report

Distribution (electronic copy only): Addressee
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Evan Eykelbosch, P.E., Froelich Engineers (eeykelbosch@froelich-engineers.com)
Ben Ullmann, Froelich Engineers (bullmann@froelich-engineers.com)

DRAFT

GEOTECHNICAL INVESTIGATION REPORT

for the

Proposed Northeast 25th Street Apartment Complex
Lincoln County Tax Lots:
07-11-11-BB-04301-00, 07-11-11-BB-04302-00,
and 07-11-11-BB-04300-00
Northeast corner of Northeast 25th Street and Highway 101
Lincoln City, Lincoln County, Oregon

Prepared for

IHI

INNOVATIVE HOUSING, INC.

CREATING SOLUTIONS TO UNMET HOUSING NEEDS

219 Northwest 2nd Avenue
Portland, Oregon 97209

Prepared by

Earth Engineers, Inc.
2411 Southeast 8th Avenue
Camas, Washington 98607
Telephone (360) 567-1806

EEI Report No. 20-047-2

December 6, 2021

Earth Engineers, Inc.

REGISTERED PROFESSIONAL ENGINEER
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JULY 15, 1997
TROY M. HULL

EXPIRES: 6/30 23

Troy Hull, P.E., G.E.
Principal Geotechnical Engineer

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EXP: 12/1/2022

Ken Andrieu, R.G.
Senior Geologist

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1.0 PROJECT INFORMATION

1.1 Project Authorization

Earth Engineers, Inc. (EEI) originally completed Geotechnical Investigation Report No. 20-047-1-R1. That report was authorized by Julie Garver on February 19, 2020 by signing EEI Proposal No. 20-P032 dated February 11, 2020. The report addressed the proposed apartment project to be located on 2 Lincoln County Tax Lots (#07-11-11-BB-04302-00 and 07-11-11-BB-04300-00).

Since that report was issued, the project has changed. Another tax lot has been added to the project and the layout of the apartment buildings has been revised. As such, an updated geotechnical investigation report has been requested to address the currently proposed project. On October 1, 2021, Ms. Garver authorized this updated geotechnical report, which addresses an additional tax lot (#07-11-11-BB-04301-00) and also addresses the updated project design, by authorizing EEI's Geotechnical Scope of Services Amendment, Number 20-P032-A1 dated September 30, 2021.

1.2 Project Description

Our original understanding of the project was based on the information provided in an e-mail to EEI Principal Geotechnical Engineer Troy Hull from Julie Garver with Innovative Housing, Inc. on January 31, 2020. Briefly, the plan was to develop a low-rise, garden-style apartment complex on the currently undeveloped 4-acre property located on 2 tax lots.

We were provided the following documents:

- Undated aerial photo outlining the property
- March 14, 2018 proposed site plan indicating there will be 6 buildings; with a total of 89 housing units and 127 parking spaces, as well as a driveway circling through the project. See Figure 1 below.
- An undated topographic property plan.
- Topographic survey prepared by Emerio Design, dated April 10, 2020.
- Preliminary site plan prepared by LRS Architects, received April 27, 2020. This site plan incorporates the slope and cliff setback recommendations in this report.

Figure 1: Original preliminary site plan prepared by LRS Architects (not applicable now).

During a September 28, 2021 virtual meeting, we were provided with the following updated project information from Spencer Deinard with LRS Architects and Evan Eykelbosch with Froelich Engineers.

- The size of the project site has been expanded. The project has acquired an additional lot between the 2 original project lots and Highway 101. The added lot reportedly once contained a gas station with underground tanks that have been removed. The number and location of tanks is not currently known by EEI. The quality (i.e. material and compaction) of the tank excavation backfill is also not known.

- The apartment buildings are each planned for 3 stories and wood frame construction.

- The grading on this project will be more significant than originally assumed. Cut and fills will be up to 20 feet. The volume of cut will be approximately 28,000 cubic yards. The volume of fill will be approximately 8,000 cubic yards.

- It is assumed that the earthwork will occur during the drier summer weather (i.e. June to October).

- The project would like to re-use the native soils for structural fill. The design team is open to amending the native soil with Portland cement or lime if the soils are too wet or plastic in their natural condition, in order to make them workable as structural fill.

- A retaining wall is planned along the south property line. The design team is considering a soldier pile or soil nail wall. The front face of the south wall to the south property line is either 6.5 or 10 feet, depending on the parking stall type.

- The design team would like to reduce the 30-foot horizontal slope setback for structures that was recommended in EEI Report No. 20-047-1-R1. Reducing the horizontal slope setback would allow the proposed buildings and retaining wall at the north side of the project to be moved further to the north, which is the desire of the design team.

- The proposed retaining wall at the north end of the project is currently planned to be an Ultrablock wall.

- Stormwater disposal options considered are drywells and/or the ravine to the east. It is known that stormwater taken to the north of the property just pools and can cause issues for the neighboring properties to the north.

On November 30 and December 2, 2021, we were provided the following updated drawings from Froelich Engineers:

- **Sheet C302, marked "draft set" and "preliminary not for construction," and dated September 10, 2021.** This drawing shows the 5 walls (Wall 1 through Wall 5) planned to be installed to significantly regrade the project site.

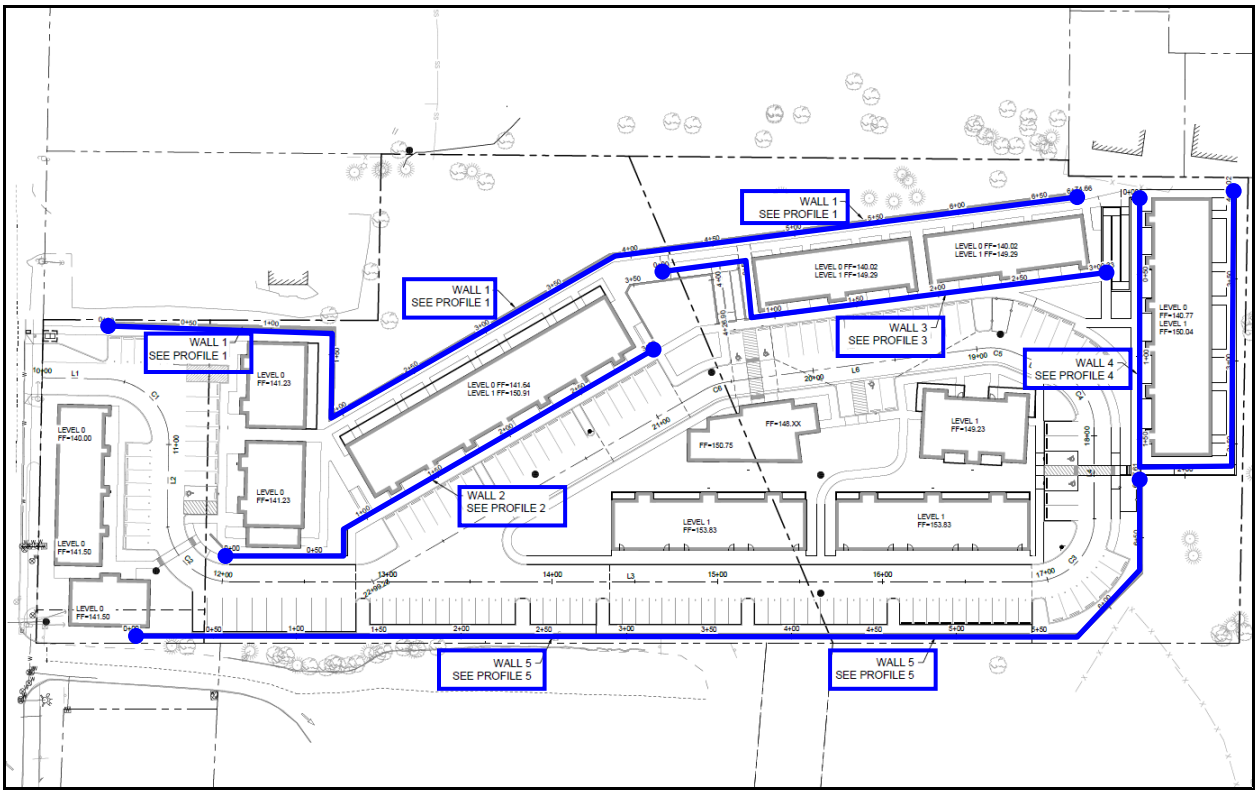

Figure 2: Current preliminary retaining wall layout plan.

- **Sheets C300 through C304, marked "draft set" and "preliminary not for construction," and dated September 10, 2021.** These drawings include existing and proposed topography information, as well as wall profile views.

- Wall 1 is planned for heights ranging from 1 to 24 feet, and the wall type has not been determined yet but it will not be a conventional cast-in-place concrete cantilevered wall (CIP).
- Walls 2, 3, and 4 are all planned for heights of approximately 10 feet (exposed) and the wall type will be CIP.
- Wall 5 is planned for heights ranging from 8 to 23 feet, and the wall type has not been determined but it will not be CIP.

We have not been provided detailed building construction drawings or foundation loading for the proposed apartment complex construction. For the purposes of this report, we are assuming typical residential foundation loads of 4 kips per linear foot for wall footings, 50 kips per column footing, and 150 psf for floor slabs. We have assumed that the apartment buildings will be constructed in accordance with the 2019 Oregon Structural Specialty Code (OSSC) and ASCE 7-16.

1.3 Purpose and Scope of Services

The purpose of our services was to perform a geotechnical investigation of the property in order to provide geotechnical recommendations for the proposed apartment complex. Our original site investigation (documented in EEI Report No. 20-047-1-R1) consisted of advancing 10 test pits using a Zaxis 40U excavator subcontracted from Dan J Fischer Excavating, Inc. of Forest Grove, Oregon. Grab samples from the test pit excavations were collected at the discretion of the Senior Geologist conducting the subsurface investigation.

Each soil sample collected in the test pits was screened for possible environmental contamination using a Photoionization detector (PID). The PID detects a broad range of volatile organic compounds (VOCs) such as formaldehyde, methane, benzene, as well as hydrocarbons that typically occur in oil and gas. The PID readings are included on our exploration logs. We consider a positive reading for VOCs to be greater than about 5 ppm. Our testing should be considered an initial site screening tool and does not replace a study by a qualified environmental professional.

On October 1, 2021 EEI was authorized to conduct additional subsurface explorations to address the new project information provided by the design team (reference EEI Geotechnical Scope of Services Amendment #20-P032-A1). The supplemental investigations consisted of 5 drilled Standard Penetration Test (SPT) borings, 2 hand auger borings with drive probe testing, and 2 drive probe tests.

The soil samples were tested in our laboratory to determine the material properties for our evaluation. Laboratory testing was accomplished in general accordance with ASTM procedures.

This report briefly outlines the testing procedures, presents available project information, describes the site and subsurface conditions, and presents recommendations regarding the following:

- A discussion of subsurface conditions encountered including pertinent soil and groundwater conditions.
- Geotechnical related recommendations for foundation recommendations, including allowable bearing pressure; depth to bearing; minimum widths, estimated total and differential settlements.
- Seismic design parameters in accordance with ASCE 7-16.
- Structural fill recommendations, including an evaluation of whether the existing site soils can be used as structural fill.
- General retaining wall recommendations, including earth pressures and coefficient of friction soil parameters, as well as retaining wall backfill recommendations.
- Evaluation of appropriate retaining wall types at the north, east and south sides of the project.
- General floor slab support recommendations.
- General discussion on site grading and drainage.
- Pavement section thickness recommendations based on as assumed CBR value and assumed traffic loading conditions.
- Results of the in-situ soil percolation testing.
- Results of the PID soil sample testing.
- Discussions on geotechnical issues that may impact the project.

Other than the PID testing of the soil samples obtained in our test pit explorations, our scope of services did not include an environmental assessment for determining the presence or absence of wetlands or hazardous or toxic materials in the soil, bedrock, surface water, groundwater, or air on or below, or around this site. Any statements in this report or on the exploration logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes. Prior to development of the site, an environmental assessment is typically advisable.

2.0 SITE AND SUBSURFACE CONDITIONS

2.1 Site Location and Description

The subject property is located on Lincoln County tax lots 07-11-11-BB-04301-00, 07-11-11-BB-04302-00 and 07-11-11-BB-04300-00 off of Northeast 25th Street in Lincoln City, Oregon. The property is generally surrounded by Highway 101 to the west; vacant lots to the north and east; a residential subdivision to the northeast; commercial properties to the northwest and southwest; and a church and baseball fields to the south. See Figure 3 below.

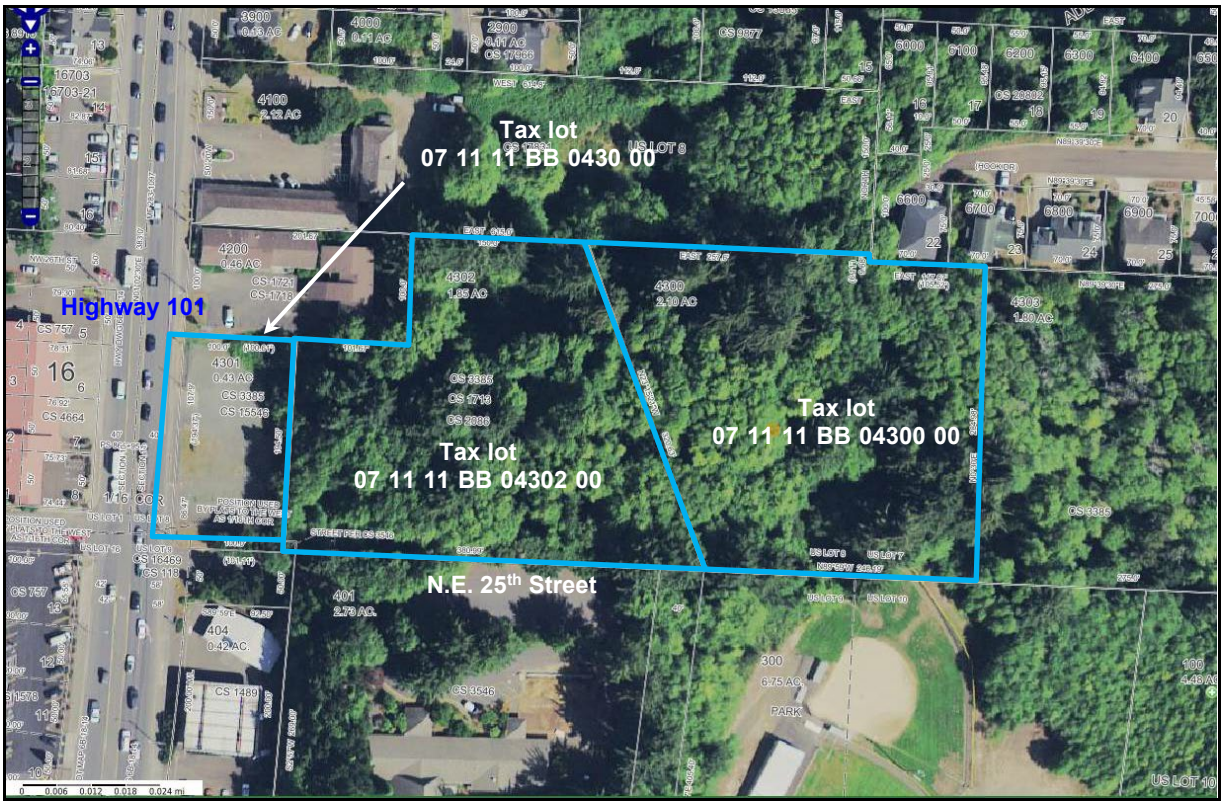

Figure 3: Lincoln County tax map with the project property outlined in blue.

As discussed above, the western-most tax lot was previously developed as a gas station with underground tanks. The station and tanks have since been demolished, although it appears at least some of the slabs/pavement from the gas station development are still in place (see Photo 1 below for existing conditions).

Photo 1: Looking east at the north end of the western-most lot.

The 2 eastern-most tax lots are vacant with remnants of past site development in the form of concrete retaining walls and rockery walls. There are also buried in-situ concrete slabs, asphalt pavement and gravel surfacing. The site is densely vegetated with a mix of coniferous and deciduous trees, shrubs, and grasses. The exposed features are noted on the Topographic Survey prepared by Emerio Design (see Figure 11).

The site was originally developed as an estate by Charles Walker who built and operated the Dorchester House located on the west side of Highway 101 a short distance north of the property. In 1950's the property was briefly converted into a hospital, and then into a retirement home. A series of aerial photos illustrates the development of the property from 1939 until it became overgrown with vegetation in 1984 (see Figures 4 to 9 below).

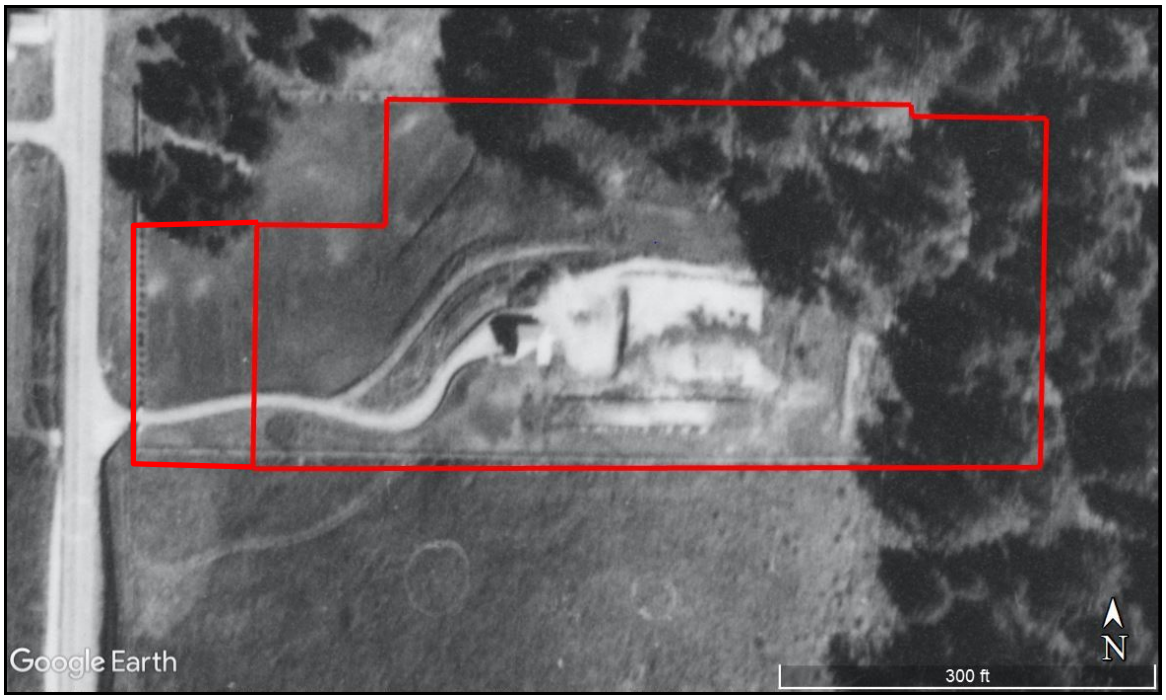

Figure 4: 1939 – The Estate appears to still be under construction. The main house and retaining walls are visible, but no buildings have been constructed in the area east of the main house which appears to be graded.

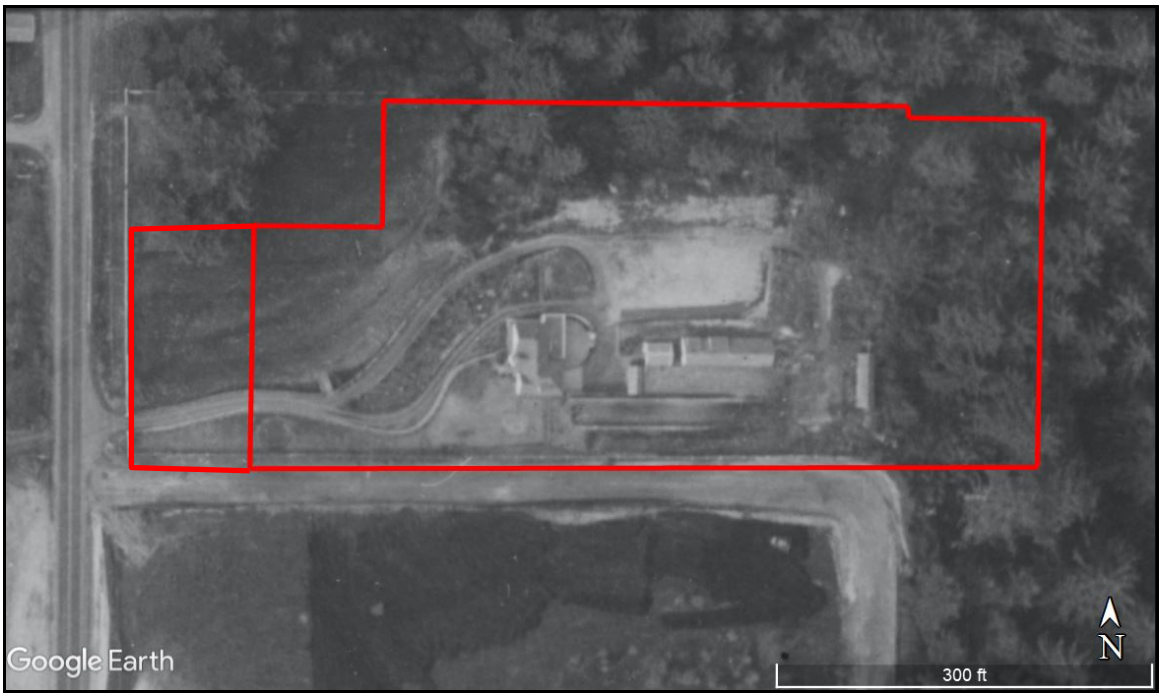

Figure 5: 1945 – The landscaping and outbuildings are more developed. We observed a concrete slab with floor tile in the area of the long building during our site investigation.

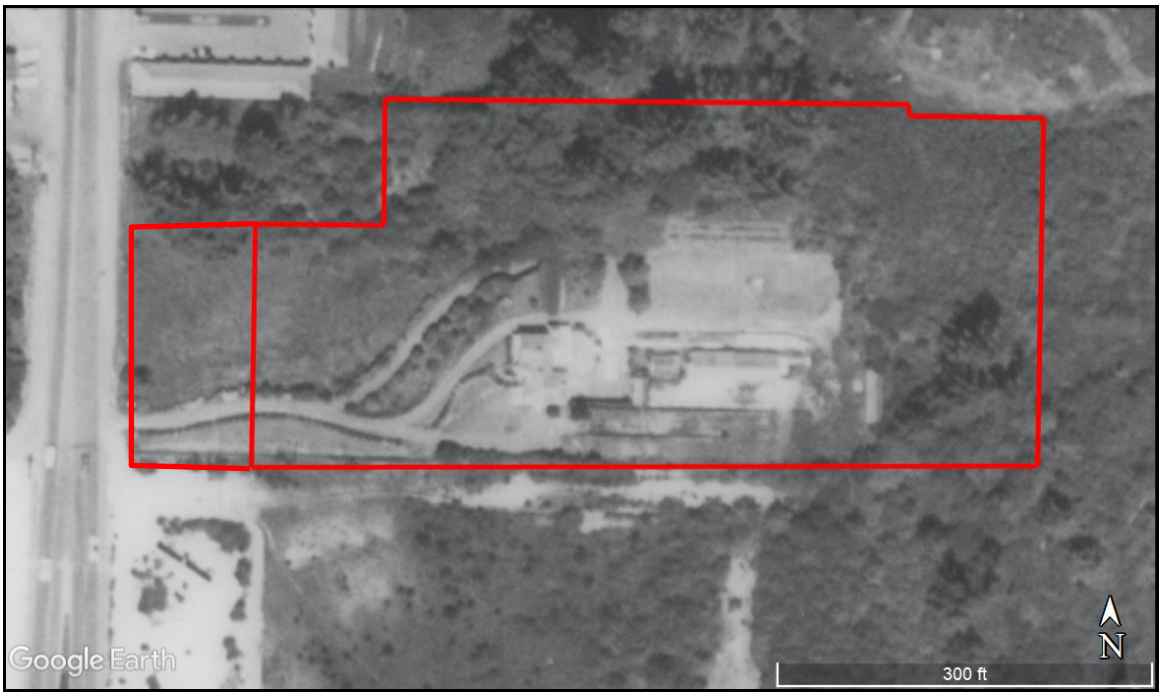

Figure 6: 1958 – The trees are more mature and the large open area/parking lot has been expanded. At this time the property would have been a retirement home.

Figure 7: 1969 – A gas station has been built on the western-most lot, truncating the driveway. The lower driveway has been removed. The parking lot has been reduced in size. Mature vegetation is encroaching around the developed areas.

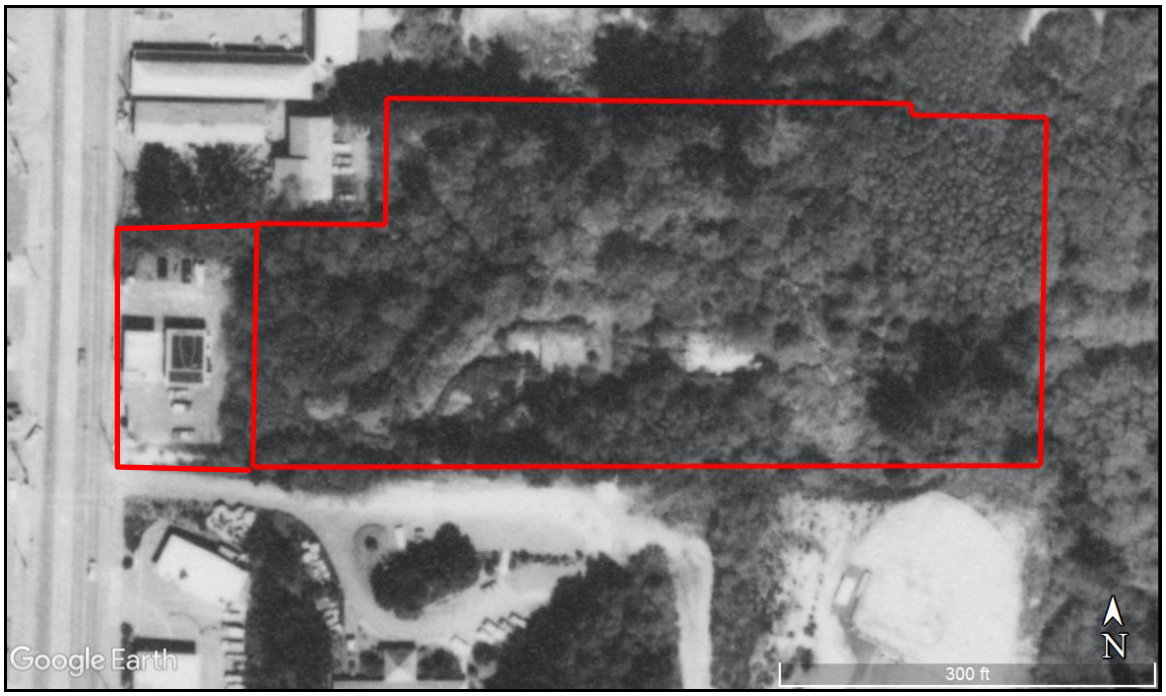

Figure 8: 1979 – The buildings appear to have been removed from the 2 eastern-most lots. Some retaining walls and open spaces are still visible through the vegetation.

Figure 9: 1984 – The 2 eastern-most lots are completely overgrown with vegetation; the gas station is still present on the western lot.

The above historical aerial photos were obtained from the University of Oregon map library.

Figure 10: Postcard of the Walker estate viewed from Highway 101.

The property generally slopes down to the north from an elevation of 172 feet MSL at the southern property line to an elevation of 89 feet MSL at the northern property line. The maximum topographic relief on the property is about 83 feet. The central portion of the property, above an elevation of 150 feet, is mostly level with terraces rising to the south property line, separated by retaining walls. This upper area also has many hard surface areas (concrete, asphalt and gravel) buried under a shallow veneer of soil (less than 2 inches) and shallow-rooted vegetation. The slopes to the north and east are irregular, mostly sloping at 15 to 50 percent grades. Along the north property line there is a roughly 100-foot long cliff that drops about 35 feet from approximate elevations of 125 to 90 feet MSL. The slope to the west is crossed with the remains of the driveways and retaining walls, many of which are showing signs of severe distress and failure. The fir trees on the property are mostly straight trunked; however, there are some leaning or toppled trees due to close proximity to the top of the cliff and shallow root systems.

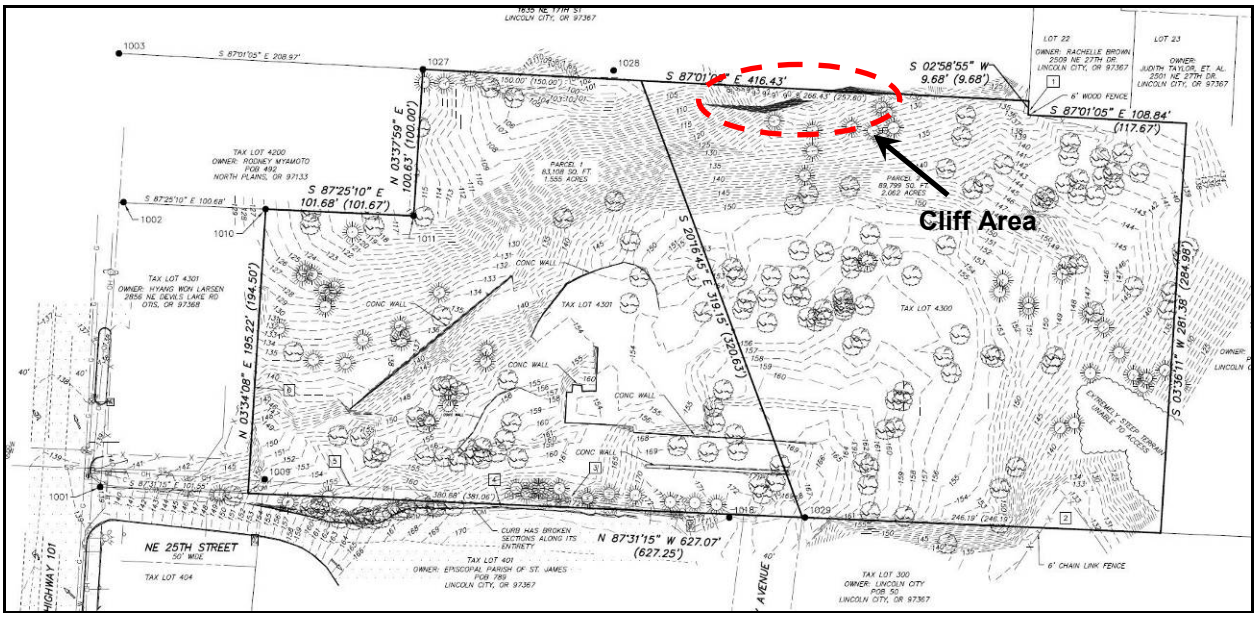

Figure 11: Topographic survey prepared by Emerio Design, dated April 10, 2020.

Photo 2: Upper area, terraced with retaining walls (near TP-5).

Photo 3: Looking west along slope above the cliff.

Photo 4: Looking west along the top of the cliff.

Photo 5: Level area in the central area of the property (near TP-7).

Photo 6: The top of the driveway coming onto the level area. Probe rod is touching asphalt.

Photo 7: Retaining wall with a large drain pipe near where old residence had been.

Photo 8: Looking southeast at failed retaining wall near where driveway had entered property from the west.

Photo 9: Lower driveway area with buttressed retaining wall covered in vegetation.

Photo 10: Siltstone exposed in upper cliff face.

Photo 11: Upper slope on eastern portion of site (near TP-1).

Photo 12: Tiled floor buried under veneer of soil.

2.2 Mapped Soils and Geology

The United States Department of Agriculture (USDA) Soil Survey provides geographical information of the soils in Lincoln County as well as summarizing various properties of the soils. The USDA shows the native soils on the site mapped as Winema-Fendall silt loams on 3 to 15 percent slopes. This soil unit is well drained and occurs on hillslopes with a parent material of colluvium derived from sedimentary rock[1].

The project area was mapped by Snavely, Macleod and Wagner (1972) of the U.S. Geological Survey as the Yamhill Formation[2]. The Yamhill Formation is described as a massive to thinly-bedded concretionary siltstone with interbeds of arkosic sandstone.

As a part of our due diligence, we reviewed the Oregon Department of Geology and Mineral Industries (DOGAMI) Statewide Geohazards Information Database for Oregon (HazVu) website (https://gis.dogami.oregon.gov/hazvu/). This database maps the property to have a severe Cascadia earthquake shaking hazard, a very strong earthquake shaking hazard, a low liquefaction hazard, and a high landslide hazard although no landslide deposits are mapped on the property.

The USGS U.S. Quaternary Faults Interactive Map (https://usgs.maps.arcgis.com) database indicates there are no mapped Quaternary faults in the immediate vicinity of the property, but maps the Cascadia Fold and Thrust Belt 6.5 miles northwest of the site, and the Siletz Bay faults 4.0 miles south of the site.

2.3 Subsurface Materials

As stated earlier, the site was initially explored with 10 test pit excavations (TP-1 through TP-10). The test pits were then supplemented with 5 drilled SPT borings, 2 hand auger borings with drive probe testing, and 2 stand-alone drive probe tests. For the approximate exploration locations, see the “Exploration Location Plan” in Appendix B.

The test pit excavations were advanced to depths ranging from 4 to 10 feet. Excavation equipment consisted of a Zaxis 40U excavator equipped with a 2-foot wide toothed bucket. Grab samples were obtained at the discretion of the Senior Geologist for laboratory testing. The soil samples were tested for indication of potential environmental contamination with a PID meter. The results for all of the samples tested were 0.0 ppm. We consider a positive reading for VOCs to be greater than about 5 ppm.

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[1] Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/ accessed February 11, 2020.

[2] Snavely, P.D., MacLeod, N.S., and Wagner, H.C., 1972, Preliminary bedrock geologic map of the Cape Foulweather and Euchre Mountain quadrangles, Oregon: U.S. Geological Survey, Open-File Report OF-72-350, scale 1:48,000

Photo 12: Excavating TP-4.

Photo 13: TP-4 Excavation.

The drilled borings were advanced to depths ranging from 19.5 to 31 feet using a T26 tracked drill rig subcontracted from PLi Systems.

Select soil samples were tested in the laboratory to determine material properties for our evaluation. Laboratory testing was accomplished in general accordance with ASTM procedures. The testing performed included moisture content tests (ASTM D2216), the amount of material in the soils finer than the #200 sieve (ASTM D1140) and Atterberg limits (ASTM D4318). The test results have been included in the Exploration Logs in Appendix C.

The same general subsurface strata were encountered in each of our explorations, which generally consisted of topsoil overlying fill, clayey silt, and a terminal layer of siltstone and mudstone.

Topsoil: The surficial layer consisted of a dark brown silty clay with some siltstone fragments and organics. Where present, the stratum thickness ranged from 18 inches to 2 feet across the site. Other surficial layers encountered included fill soils in TP-6 and TP-8, as well as 2-inches of asphalt over 4-inches of gravel in TP-9.

Fill: Fill soils were encountered in TP-5, TP-6, TP-8, and TP-9 and generally consisted of organic topsoil mixed with brown clayey silt and weathered siltstone. Stratum thickness ranged from 1 foot to the terminal depth of 8.5 feet in TP-8. The measured moisture contents in this stratum ranged from 52 to 70 percent, indicating the soil is wet.

Elastic Silt with Sand (MH): Underlying the topsoil in TP-1, TP-2, TP-3, TP-4, and TP-10, and underlying the fill in TP-7 and TP-9 was a dark brown elastic silt with siltstone fragments. This stratum ranged in thickness from 1.5 to 9.5 feet across the site. Measured moisture contents in this stratum ranged from 46 to 71 percent, indicating it is wet. The measured fines contents (passing the #200 sieve) in this stratum ranged from 79 to 94 percent. Two Atterberg limits tests were run, and both resulted in a liquid limit of 80 and a plastic limit of 56, indicating the soil has high plasticity and is potentially expansive. Based on pocket penetrometer readings ranging from 1.5 to 2.0, this stratum is stiff

Siltstone/Mudstone: Beneath the above strata we encountered siltstone in test pits TP-1 through TP-6; this was the terminal stratum in each of aforementioned test pits. This siltstone is described as tan with rust staining, friable, moderately fractured, and highly weathered. The siltstone is excavatable with a toothed bucket. The measured moisture contents in this stratum ranged from 59 to 78 percent.

The classifications noted above were made in accordance with the Unified Soil Classification System (USCS) as shown in Appendix D. The above subsurface description is of a generalized nature to highlight the major subsurface stratification features and material characteristics. The exploration logs included in Appendix C should be reviewed for specific information at specific locations. These records include soil descriptions, stratifications, and locations of the samples. The stratifications shown on the logs represent the conditions only at the actual exploration

locations. As described, we encountered fill/debris/topsoil in our explorations. It should be noted that the explorations performed are not adequate to accurately identify the full extent of existing fill across the site. Consequently, the actual fill extent may be much greater than that shown on the exploration logs and discussed herein. Variations may occur and should be expected between locations. The stratifications represent the approximate boundary between subsurface materials and the actual transition may be gradual. Water level information obtained during field operations is also shown on these logs. The samples that were not altered by laboratory testing will be retained for 60 days from the date of this report and then will be discarded.

2.4 Groundwater Information

Groundwater was not encountered in any of the explorations. Based on well logs from tax lot 07-11-11-BB-04301-00 (with an address of 2510 Highway 101), groundwater was first encountered at depths of 23 feet below the ground surface. This is the vacant lot (former gas station) that comprises the western boundary of the proposed development, which is at an average elevation of about 140 feet msl. It should be noted that the groundwater elevation can fluctuate seasonally and annually, especially during periods of extended wet or dry weather or from changes in land use. The historic water well logs discussed are attached in Appendix E.

2.5 Seismicity

In accordance with the 2019 OSSC and ASCE 7-16, we recommend a Site Class D (stiff soil profile) for this site when considering the average of the upper 100 feet of bearing material beneath the foundations. This recommendation is based on the results of our subsurface investigation as well as our understanding of the local geology.

Inputting our recommended Site Class as well as the site latitude and longitude into the Seismic Design Maps (SEAOC/OSHPD) website (http://seismicmaps.org), we obtained the seismic design parameters shown in Table 1 below. The return interval for these ground motions is 2 percent probability of exceedance in 50 years.

Table 1: Seismic Design Parameter Recommendations (ASCE 7-16)

PARAMETER	RECOMMENDATION
S_s	1.320g
S_1	0.684g
F_a	1
F_v	Null – See ASCE 7-16 Section 11.4.8
S_{MS} (=S_s x F_a)	1.320g
S_{M1} (=S_1 x F_v)	Null – See ASCE 7-16 Section 11.4.8
S_{DS} (=2/3 x S_s x F_a)	0.880g
Design PGA (=S_{DS}/2.5)	0.352g
MCE_G PGA	0.654g
F_{PGA}	1.100
PGA_M= (MCE_G PGA x F_{PGA})	0.719g

Note: Site latitude = 44.983689, longitude = -124.005885

Per Section 11.4.8 of ASCE 7-16 a site-specific seismic site response analysis (i.e. SHAKE software or equivalent) is required for structures on Site Class D and E sites with S_1 greater than or equal to 0.2g. The S_1 value for this site is greater than 0.2g as shown in Table 1 above. Therefore, a site response analysis is required as part of the design phase. However, Section 11.4.8 does provide an exception for not requiring a site response analysis (reference Sections 11.4.8.1, 11.4.8.2 and 11.4.8.3). The project Structural Engineer should determine if the proposed buildings will meet any of the exceptions – if the buildings do not meet the exception requirements then EEI should be retained to perform a site-specific site response analysis.

We understand a Supplement 1 dated December 12, 2018 has been issued for ASCE 7-16 to correct some issues in the original publication. One of the corrections in the Supplement pertains to Table 11.4-2 (see table below) for determining the value of the Long-Period Site Coefficient, F_V, which is then used to calculate the value of T_S. The T_S value is needed for one of the exceptions in Section 11.4.8. Without the correction in Supplement 1, it would not be possible to determine F_V and calculate T_s. Based on Supplement 1, the F_V value may be determined from the following corrected table.

Table 2: Long-Period Site Coefficient, F_V (corrected Table 11.4-2 in ASCE 7-16).

	Mapped Risk-Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameter at 1-s Period					
Site Class	S_1<=0.1	S_1<=0.2	S_1<=0.3	S_1<=0.4	S_1<=0.5	S_1>=0.6
A	0.8	0.8	0.8	0.8	0.8	0.8
B	0.8	0.8	0.8	0.8	0.8	0.8
C	1.5	1.5	1.5	1.5	1.5	1.4
D	2.4	**2.2[a]**	**2.0[a]**	**1.9[a]**	**1.8[a]**	**1.7[a]**
E	4.2	**3.3[a]**	**2.8[a]**	**2.4[a]**	**2.2[a]**	**2.0[a]**
F	See Section 11.4.8	See Section 11.4.8	See Section 11.4.8	See Section 11.4.8	See Section 11.4.8	See Section 11.4.8

Note: use linear interpolation for intermediate values of S_1.

[a] See requirements for site-specific ground motions in Section 11.4.8. These values of F_V shall be used only for calculation of T_S.

2.6 Infiltration Testing Results

The infiltration testing was conducted in general accordance with the 1980 EPA single ring falling head test method. One test (consisting of 3 trial holes) was conducted for the proposed apartment complex. The location of the infiltration test can be seen in Appendix B.

Each of the 3 trials consisted of placing one 6-inch diameter PVC pipe and seating it at least 6-inches into the bottom of an excavated trench. Soil samples were taken from the bottom of the trial locations and returned to our laboratory for testing which included grain size and fines content analysis. After seating the pipes, approximately 2 to 3-inches of clean gravel was placed in the bottom of the pipes to prevent scouring. Twelve inches of water was then placed into the pipe and allowed to drain. Since the water did not drain completely in the first 10-minutes, the holes required a 4-hour minimum presoak period.

After the 4-hour pre-soak, 12-inches of clean water was placed in each of the pipes and the fall of water was timed until consistent results were observed. The results of our infiltration test are shown below in Table 3. **The results should be considered ultimate values and do not include a factory of safety.**

Table 3: Infiltration Test Data

Test #	**Depth (feet)**	**% Fines**	**% Moisture**	**Soil Description**	**Ultimate Infiltration Rate (inches/hour)[1]**
IT-1a	3	85	51	Elastic Silt with Sand	2 1/2
IT-1b	3	84	54	Elastic Silt with Sand	1 5/8
IT-1c	3	79	54	Elastic Silt with Sand	4 1/4

Note 1: No safety factors have been applied to the test rates above.

Based on the low infiltration test rates and moisture sensitive soils, it appears that on-site infiltration is not practical. Infiltrating via drywells has the potential to destabilize the site slopes. Assuming a safety factor of 2 applied to the slowest test rate results in a design infiltration rate of ¾ inch per hour. While the stormwater disposal design is ultimately up to the project Civil Engineer, we anticipate that directing the stormwater to the drainage swale to the east would be more practical.

Photo 12: Infiltration Test

3.0 EVALUATION AND FOUNDATION RECOMMENDATIONS

3.1 Geotechnical Discussion

Based on our subsurface investigation, it is our professional opinion that the primary factors impacting the proposed development include the following:

1. **Previous development on the property.** The property has been extensively developed in the past with buildings, underground gas station tanks, retaining walls and driveways. It was also likely regraded, which probably included cuts and fills. Our report does not document the full extent of previous development and it should be assumed (primarily from a budgeting and scheduling standpoint) that some surprises (i.e. remnants of old construction and earthwork) may be encountered during construction that need to be dealt with.

2. **Presence of existing fill soils throughout the project site.** Fill soils were encountered within some of the test pits and borings. Whenever old fill has been placed without the knowledge that it was tested and inspected by a Geotechnical professional, there is some risk that the fill may not have been placed properly. The presence of such materials could result in excess settlements and unsatisfactory foundation performance for the new construction project. Therefore, we do not recommend supporting the proposed apartment buildings on the apparent fill soils. If fills are encountered within the building footprints, we recommend removing the fill and replacing it with structural fill. The extent of the removal and backfill should extend laterally 6 inches from the footing in all directions for every foot that the excavation extends below the bottom of the footing. As an alternative to removing and replacing the existing fill, pile foundations or rammed aggregate piers (sometimes referred to as “Geopiers”) could be used. The advantage rammed aggregate piers have over piles is that a conventional shallow foundation system (as opposed to more expensive pile caps and grade beams) can be used with the rammed aggregate piers.

   Where encountered in our test pits and borings, the fill ranged in thickness between 2 and 8.5 feet. The deeper fills were encountered at the west end of the project (8 feet thick in B-1), the north end of the project (8.5 feet thick in TP-8 and 5 feet in B-4). Note that given the 3 tax lots have been developed in the past, there is risk that deep fills could be encountered elsewhere on the project site.

3. **Presence of very soft near-surface soils at the east end of the project.** Our supplemental hand auger borings and drive probe testing indicate the upper 4 to 5 feet of soil is very soft. As opposed to overexcavating out all the soft soils from beneath the Building E structure, it may be more prudent to support this building on rammed aggregate piers also.

4. **Presence of fine-grained, moisture sensitive soils throughout the project site.** As stated above we encountered a high plasticity elastic silt in our explorations. This soil should be considered sensitive to changes in moisture content and prone to disturbance/softening

when wet. In our experience, the siltstone may also become soft when exposed to prolonged periods of moisture. Therefore, care should be taken to not allow water to pond on prepared subgrades. If the proposed construction takes place during the wet winter months, we recommend the placement of a compacted granular crushed rock pad to protect the subgrade from soil disturbance and/or softening. We recommend a depth of 4 to 6 inches of crushed rock in foot traffic areas, and a depth of 12 to 18 inches in heavy construction areas.

5. **Presence of potentially expansive soils throughout the project site.** There are low to moderate, potentially expansive, elastic silt soils beneath the proposed apartment building footprints. As such, there is a higher risk of differential movement due to these expansive soils which are highly moisture sensitive. Expansive soils can cause cracks in the foundations when these soils either shrink or swell based on changes in moisture content.

   The expansive soils can be mostly mitigated by moisture control. This mean not allowing the existing silt soils dry out when they are exposed during construction and ensuring that any existing silt soils placed as structural fill are compacted between 0 and 3 percent above optimum moisture content (as determined by ASTM D1557 – Modified Proctor).

   A second mitigation method is to support all shallow foundations on a minimum of 12 inches of well-graded, “dirty” crushed rock (i.e. screenings or reject gravel with at least 15 percent passing the #200 sieve) placed and compacted atop the stiff clayey silt subgrade, with the bottom of the “dirty” crushed rock at least 30 inches below the ground surface. It is our professional opinion that the floor slabs can be grade supported on a minimum of 1 foot of the well-graded “dirty” crushed rock placed and compacted atop of the stiff elastic silt subgrade. Additionally, the potentially expansive elastic silt should be removed from within 4 feet of the back of any conventional retaining walls and replaced with structural wall backfill as described in sections 3.3 and 3.7. This combination will mitigate the potentially expansive soils which could cause excessive settlement and/or expansion/shrinkage based on changes in moisture content. This settlement and/or expansion/shrinkage could result in excessive stresses on the foundation elements leading to cracking and shifting of the foundations and/or slab is not mitigated. Alternatively, the foundations could bear directly on the siltstone without the need for the 12 inches of over excavation and “dirty” crushed rock backfill.

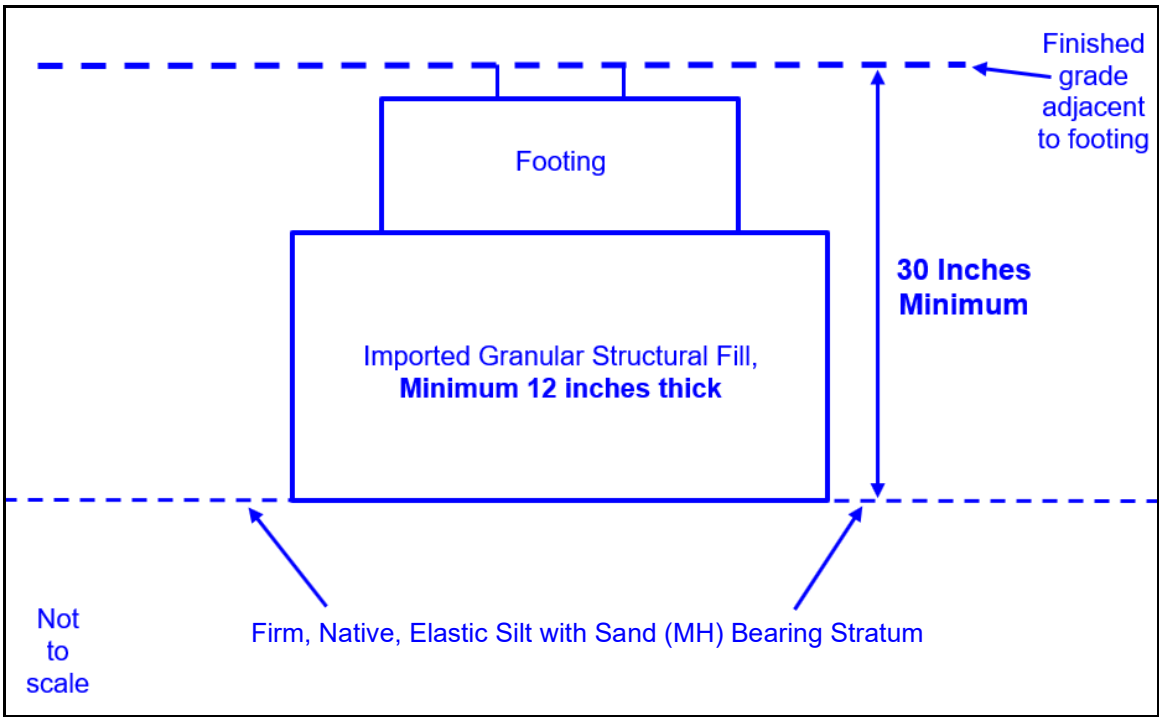


Figure 12: Footing sketch showing minimum structural fill thickness of 12 inches and minimum 30-inch embedment depth recommendation for proposed footings.

6. **Large volume of structural fill material needed to achieve design grades.** It is our understanding that with 28,000 cubic yards of cut and 8,000 cubic yards of fill, there is a desire by the design team to re-use the existing site soils as structural fill. It will be acceptable to reuse the existing site soils as structural fill. However, the moisture content will need to be amended (i.e. we anticipate that it is too wet). This will need to be done by either farming it during warm, dry weather (i.e. typically June to September), or by amending with Portland cement. Based on past experience (not doing a comprehensive lab testing program), we anticipate that somewhere between 5 and 7 percent Portland cement content (by dry weight of soil) should be successful for amending the soil so it can be properly compacted and stable. The more economical way to go should be to farm the soils, but that approach relies on dry and warm weather, which is not reliable at the coast.

7. **Difficult site conditions that impact the ability to dispose of stormwater on-site.** Based on the low infiltration test rates, sloping topography, and moisture sensitive soils, it appears that on-site infiltration is not practical. Infiltrating via drywells has the potential to destabilize the site slopes. Assuming a safety factor of 2 applied to the slowest test rate results in a design infiltration rate of ¾ inch per hour. While the stormwater disposal design is ultimately up to the project Civil Engineer, we anticipate that directing the stormwater to the drainage swale to the east would be more practical.

8. **Close proximity of the building foundation to slopes.** As stated above, the property is sloping with a 35-foot tall cliff along the north property line. We recommend that all structures and driveways be set back 30 feet horizontally from the face of the cliff.

Additionally, the foundation should be embedded such that the downhill face of the footings are a minimum of 10 feet horizontally away from the undisturbed slope face in order to provide sufficient passive earth pressure.

The 30-foot recommended setback may be reduced to 15 feet where structures are supported on the hard siltstone stratum. This approach will need to consider the depth required to excavate to the siltstone stratum to determine if it is practical. In general, the lower in elevation the structures sit, the more practical it becomes.

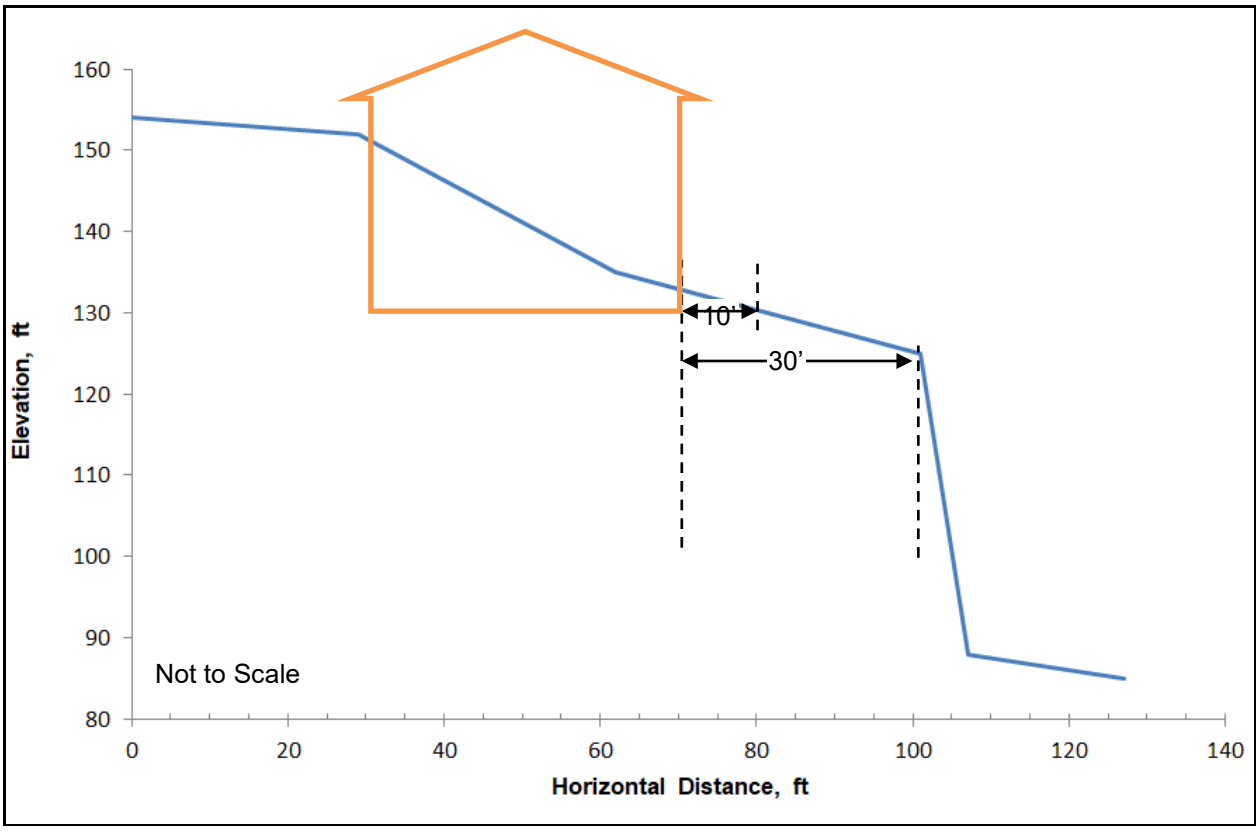


Figure 12: Slope Profile with setbacks

9. **Very large retaining walls planned for regrading the site.** There is a long retaining wall planned for the south end of the project (Wall 5). Where the wall will be 10 feet or less in height, then soldier piles alone should be sufficient. Where more than 10 feet in height, the soldier pile wall will likely require short anchors embedded into the siltstone layer.

   There is also a long retaining wall planned at the north end of the project (Wall 1). No matter how tall, it appears the east section of the wall can be an Ultrablock design (with geogrid reinforcement for taller sections), provided the wall is supported directly on the siltstone stratum. However, an Ultrablock wall with geogrid will require a very large and costly amount earthwork and it may be more practical to install a pile and tieback wall. The west side of the north wall appears to have a significant amount of generally soft fill soil. It appears the west half would need to be a pile and tieback wall because of the significant

depth of the soft soil (17 feet). One advantage of using a pile and tieback wall is that it would allow the buildings to be pushed further to the north—don't need the 30 foot horizontal setback from slopes because the pile and tieback wall would provide the stability for the building.

In summary, assuming that the moderate risks outlined above are acceptable to the property owner, this site appears to be developable provided our recommendations in this report are followed. As a general comment, many of the geotechnical issues identified above are partially or entirely mitigated by lowering the new site grades (i.e. benching the project into the hillside).

3.2 Site Preparation

Prior to starting construction, the contractor should locate the test pits conducted for this study, excavate to the depths shown on the test pit logs, and backfill each excavation with properly compacted granular structural fill under the observation of a representative of the Geotechnical Engineer.

We envision that the vegetation, roots, topsoil, organic laden soils, and any fill soils or deleterious soils will need to be stripped from beneath the proposed construction areas to expose the underlying stiff clayey silt. The topsoil and fill thicknesses ranged from approximately 1.5 to 2 feet within our explorations with the exception of TP-8 where fill soils were found to the terminal depth of 8.5 feet. Topsoil and fill thickness may vary from these depths across the site. A representative of the Geotechnical Engineer should be present to determine the depth of removal of the various soils during construction as well as to check the temporary excavations and fill benching as required.

After stripping and excavating to the proposed subgrade level, as required, the building and pavement areas should be proofrolled with a heavily loaded tandem axle dump truck or similar rubber-tired vehicle where feasible. Soils that are observed to rut or deflect excessively under the moving load, or are otherwise judged to be unsuitable should be undercut and replaced with properly compacted structural fill. The proofrolling and undercutting activities should be witnessed by a representative of the Geotechnical Engineer, and should be performed during a period of dry weather.

Where the expansive elastic silt soils are exposed during earthwork operations, they should not be allowed to dry out. In general, the contractor should plan to conduct a cut and cover operation where the elastic silt soils are covered the same day they are exposed. This is especially important during the dry summer months when the exposed soils are more likely to dry.

Any existing utilities present beneath the proposed construction will need to be located and rerouted as necessary and any abandoned pipes or utility conduits should be removed to inhibit the potential for subsurface erosion. Because the property has been previously developed, we

do expect that there will be old utility pipes to remove and the contractor should budget accordingly. Utility trench excavations should be backfilled with properly compacted structural fill in accordance with Section 4.3.

3.3 Structural Fill

Structural fill should be free of organics or other deleterious materials, have a maximum particle size less than 3 inches, be relatively well graded, and have a liquid limit less than 45 and plasticity index less than 25. Since the native soils have a liquid limit in excess of 45 are likely wet of optimum moisture, ideally, they would not be used as structural fill. However, we understand the project team is considering re-using the site soils as structural fill. As discussed in Section 3.1, it is possible to re-use the site soils provided they are amended. Amendment can be in the form of drying them out (i.e. "farming") to within 0 to 3 percent above optimum moisture content in the warm, dry summer months, or by modifying with Portland cement any time of the year. Based on past experience (not performing a comprehensive lab testing program), we anticipate that somewhere between 5 and 7 percent Portland cement content (by dry weight of soil) should be successful for amending the soil so it can be properly compacted and stable. We anticipate that the more economical way to go should be to farm the soils, but that approach relies on dry and warm weather, which is not reliable at the coast.

If structural fill is imported, we recommend a well-graded "dirty" crushed rock material (i.e. at least 15 percent passing the #200 sieve) to be used. We recommend it have at least 15 percent fines content in order to limit its permeability and lower the risk of stormwater infiltrating down to the potentially expansive native soils below.

We recommend all non-expansive structural fill be moisture conditioned to within 3 percentage points below and 2 percentage points above optimum moisture as determined by ASTM D1557 (Modified Proctor). If water must be added, it should be uniformly applied and thoroughly mixed into the soil by disking or scarifying.

Fill should be placed in relatively uniform horizontal lifts on the prepared subgrade which has been stripped of deleterious materials (i.e. topsoil and fill) and approved by the Geotechnical Engineer or his representative. Each loose lift should be about 1-foot thick. The type of compaction equipment used will ultimately determine the maximum lift thickness. Structural fill should be compacted to at least 95 percent of maximum dry density as determined by ASTM D1557. Each lift of compacted engineered fill should be tested by a representative of the Geotechnical Engineer prior to placement of subsequent lifts.

3.4 Foundation Recommendations

Once the site has been properly prepared as discussed above, the proposed structures can be supported on a conventional shallow foundation system. Again, all foundations should bear on a minimum of 12 inches of compacted structural fill (i.e. "dirty" crushed rock) placed atop the stiff

clayey silt subgrade or directly upon the deeper siltstone. The expansive soils should be covered the same day they are exposed so that they do not dry out.

The base of the dirty rock should be at least 30 inches below adjacent design site grades. Furthermore, as also recommend above, foundations on slopes should be spaced at least 10 feet horizontally away from the undisturbed slope face, and set back at least 30 feet horizontally from the top of the cliff. Conventional shallow foundations bearing directly on the hard siltstone stratum may be setback 15 feet instead of 30 feet.

Spread footings for isolated columns and continuous bearing walls can be designed for an allowable soil bearing pressure of up to 2,000 psf when bearing on the granular structural fill placed upon the native stiff clayey silt stratum typically encountered in our subsurface explorations between 1.5 and 2.5 feet bgs. Foundations bearing directly on the siltstone first encountered at a depth of 1.5 to 4.5 feet bgs can be designed for an allowable soil bearing pressure of up to 4,000 psf. Our recommended allowable bearing capacities are based on dead load plus design live load, and can be increased by one-third when including short-term wind or seismic loads. Building footing dimensions should meet the minimum requirements of the 2019 OSSC.

Lateral frictional resistance between the base of footings and the subgrade can be expressed as the applied vertical load multiplied by a coefficient of friction of 0.36 for concrete foundations bearing granular crushed rock structural fill placed atop native clayey silt and/or directly on siltstone. In addition, lateral loads may be resisted by passive earth pressures based on an equivalent fluid pressure of 250 pounds per cubic foot (pcf) for footings poured “neat” against the native soils, or properly backfilled structural fill. For footings adjacent to slopes, in order to mobilize the full passive earth pressure noted above, the bottom front corner of the footing needs to be a minimum 10 feet laterally from the face of the slope. These are ultimate values—we recommend a factor of safety of 1.5 be applied to the equivalent fluid pressure, which is appropriate due to the amount of movement required to develop full passive resistance. To be clear, no safety factor has been applied to the values discussed above.

Exterior footings and foundations in unheated areas should be located at a depth of at least 12 inches below the final exterior grade to provide adequate frost protection. If the construction is to take place during the winter months or if the foundation soils will likely be subjected to freezing temperatures after foundation construction, then the foundation soils should be adequately protected from freezing. Otherwise, interior foundations can be located at nominal depths compatible with architectural and structural considerations.

Again, variable conditions (i.e. fill soils, etc.) are anticipated to be present during construction. The foundation excavations should be observed by a representative of the Geotechnical Engineer prior to placement of structural fill, steel, or concrete to assess that the foundation materials are capable of supporting the design loads and are consistent with the materials discussed in this report. Unsuitable soil zones encountered at the bottom of the foundation

excavations should be removed to the level of suitable soils or properly compacted structural fill as directed by the Geotechnical Engineer.

After opening, foundation excavations should be observed and structural fill placed as quickly as possible to avoid exposure of the excavation bottoms to wetting and drying. Surface run-off water should be drained away from the excavations and not be allowed to pond. If possible, the structural fill should be placed during the same day the excavation is made. If the soils will be exposed for more than 2 days, consideration should be given to leaving the upper 1 foot of soil above design grade in place to protect the final subgrade from the elements.

Based on the known subsurface conditions we anticipate that properly designed and constructed foundations supported on the recommended materials (as noted above) could experience maximum total and differential settlements on the order of 1-inch and ½-inch, respectively.

The foundation excavations should be observed by a representative of the Geotechnical Engineer prior to steel or concrete placement to assess that the foundation materials are capable of supporting the design loads and are consistent with the materials discussed in this report. Unsuitable soil zones encountered at the bottom of the foundation excavations should be removed to the level of suitable soils or properly compacted structural fill as directed by the Geotechnical Engineer. Cavities formed as a result of excavation of unsuitable soil zones should be backfilled and compacted with structural fill in accordance with Section 3.3 above.

As an alternative to the conventional shallow foundation recommendations above, the deep foundations (i.e. piles) or conventional shallow foundations supported on rammed aggregate piers may be used where relatively deep overexcavations will be necessary to mitigate the presence of soil or existing fill soil. This report does not currently include design-level deep foundation recommendations as we assume the intent is still to use conventional shallow foundations. This report also does not include rammed aggregate pier recommendations as that design comes from a specialty contractor experienced in rammed aggregate pier design-build.

As a general comment, implementing the rammed aggregate pier option may be the most practical of the 3 options. The depth of the rammed aggregate piers can be defined at the time of construction (i.e. it offers flexibility in the design) and it limits the amount and duration of earthwork, which is important in a generally wet coastal climate like Lincoln City.

3.5 Slab on Grade Recommendations

For the purposes of this report, we have assumed that maximum floor slab loads will not exceed 150 psf. Based on the existing soil conditions, the design of slabs-on-grade can be based on a subgrade modulus (k) of 150 pci. This subgrade modulus value represents an anticipated value which would be obtained in a standard in-situ plate test with a 1-foot square plate. Use of this

subgrade modulus for design or other on-grade structural elements should include appropriate modification based on dimensions as necessary.

The floor slabs should not be supported on either the existing fill soils or the expansive, elastic silt soils. We recommend they be supported on at least 12 inches of properly compacted, well-graded "dirty" crushed rock gravel structural fill overlying firm native soils. The expansive soils should be covered the same day they are exposed so that they do not dry out.

The floor slabs should have an adequate number of joints to reduce cracking resulting from any differential movement and shrinkage.

Prior to placing the structural fill, the exposed subgrade surface should be prepared as discussed in Section 3.2. The subgrade will need to be visually evaluated by a representative of the Geotechnical Engineer by means of proof rolling with a fully loaded tandem axle dump truck or a fully loaded water truck. In areas not accessible to a proof roll the subgrade shall be evaluated by means of a ½-inch diameter steel probe rod or by means of density testing with a nuclear density gag. If fill is required, the structural fill should be placed on the prepared subgrade after it has been approved by the Geotechnical Engineer.

We recommend the floor slab areas be topped with 4 inches of cleaner crushed rock gravel (i.e. base course material with no more than 5 percent fines) to provide a capillary break and limit migration of moisture through the slab. If additional protection against moisture vapor is desired, a moisture vapor retarding membrane may also be incorporated into the design. Factors such as cost, special considerations for construction, and the floor coverings suggest that decisions on the use of vapor retarding membranes be made by the project design team, the contractor and the owner.

3.6 Pavement Recommendations

The following pavement section thickness recommendations are presented as preliminary for your consideration. This design is based on assumed apartment complex traffic loading. The Civil Engineer for the project may have more specific traffic and project design data available than is presently known and may wish to modify or refine our pavement section thickness recommendations. We are available, upon request, to provide a more detailed pavement design once more definitive traffic plans are available. Additionally, this design is based off of an assumed California Bearing Ratio (CBR) value of a representative mix of the upper site soils.

The thickness recommendations presented below are considered typical and minimum for the assumed parameters. We understand that budgetary considerations sometimes warrant thinner pavement sections than those presented. However, the client, the owner, and the project principals should be aware that thinner pavement sections might result in increased maintenance costs and lower than anticipated pavement life.

If the local jurisdiction requires a thicker pavement section (i.e. if any public right-of-way work will occur), then the roadway should be constructed to meet their section. We expect that your project Civil Engineer will be able to provide comment on this.

Prior to placing the base or leveling course, paving surfaces should be prepared as discussed in Section 3.2 of this report. Areas found to be soft by the Geotechnical Engineer's representative during the proof-rolling activities (i.e. deflecting/rutting more than about 1-inch under the weight of the fully loaded, rubber tire dump truck or water truck) should be overexcavated to expose firm and unyielding soils and replaced with structural fill as defined by Section 4.3 of this report.

Asphalt pavement base course material should consist of a well-graded, 1½-inch or ¾-inch-minus, crushed rock, having less than 5 percent material passing the No. 200 sieve. The base course and asphaltic concrete materials should conform to the requirements set forth in the latest edition of the State of Oregon's Standard Specifications for Highway Construction. Base course material should be moisture conditioned to within ± 2 percent of optimum moisture content, and compacted to a minimum of 95 percent of the material's maximum dry density as determined in accordance with ASTM D1557 (Modified Proctor). Fill materials should be placed in layers that, when compacted, do not exceed about 8 inches. Asphaltic concrete material should be compacted to at least 91 percent of the material's theoretical maximum density as determined in accordance ASTM D2041 (Rice Specific Gravity).

We have assumed the subgrade soils will be prepared to a California Bearing Ratio (CBR) of at least 8. We have also assumed a pavement life of 20 years, a terminal serviceability of 2.0 (poor condition), and traffic loading of 5 and 25 daily Equivalent 18-kip Single Axle Loads (ESALS) for parking and drive lanes, respectively. The project Civil Engineer should review our traffic loading assumptions and notify us if they need to be revised. Making these assumptions, it is possible to use a locally typical "standard" pavement section consisting of the following:

Table 4: Asphalt Pavement Section Thickness Recommendations for Roadways

	Thickness Recommendations (inches)	
Pavement Materials	Parking	Drive Lanes
Asphalt Surface Course	2.5	3
Crushed Stone Base	8	10

The design pavement section noted above may be placed after the prepared (i.e. compacted) subgrade has been proofrolled and approved. The work should be done in accordance with Oregon Department of Transportation guidelines.

Where the pavement base rock will be placed on silt soils, we recommend consideration of a geotextile fabric (i.e. Mirafi 500X or equivalent) to extend the pavement life. The intent of the geotextile is to reduce the risk of base rock contamination by the underlying fine-grained soils and also to provide additional section strength to resist the effects of the expansive soils. To be clear, the geotextile is optional and not a requirement. Ultimately, the project budget constraints will likely dictate whether the geotextile can be included.

Water should not be allowed to pond behind curbs and saturate the base materials. If the base material consists of granular fill, it should extend through the section and underneath the curb to allow any water entering the base stone a path to exit. Again, as stated above, if water is allowed to sheet flow off of the edge of the pavement; the pavement edges shall be armored to prevent erosion at the edge of the pavement.

3.7 Retaining Wall Recommendations

At this time, we understand retaining wall plans are still being developed. What we do currently know about retaining walls is summarized in Section 1.2 above.

Conventional CIP retaining wall footings should be designed in general accordance with the recommendations contained in Section 3.4 above. Lateral earth pressures on walls, which are not restrained at the top, may be calculated on the basis of an "active" equivalent fluid pressure of 35 pcf for level backfill, and 60 pcf for sloping backfill with a maximum 2H:1V slope. Lateral earth pressures on walls that are restrained from yielding at the top (i.e. stem walls) may be calculated on the basis of an "at-rest" equivalent fluid pressure of 55 pcf for level backfill, and 90 pcf for sloping backfill with a maximum 2H:1V slope. The stated equivalent fluid pressures do not include surcharge loads, such as foundation, vehicle, equipment, etc., adjacent to walls, hydrostatic pressure buildup, or earthquake loading. Surcharge loads on walls should be calculated based on the attached calculations/formulas shown in Appendix H.

For seismic loading on retaining walls with level backfill, new research indicates that the seismic load is to be applied at 1/3 H of the wall instead of 2/3 H, where H is the height of the wall[3]. We recommend that a Mononobe-Okabe earthquake thrust per linear foot of 9.1 psf* H^2 be applied at 1/3 H for level backfill.

Backfill for retaining walls should be select granular material, such as sand or crushed rock with a maximum particle size between ¾ and 1 ½ inches, having less than 5 percent material passing the No. 200 sieve. Because of their fines content, the native soils do not meet this requirement, and it will be necessary to import material to the project for structure backfill. As stated previously, the native elastic silt should be removed from within 4 feet of the back of retaining walls to reduce stresses from potentially expansive soils. **It's possible that we may be able to reduce the 4-foot recommendation during construction if it turns out certain retaining walls are supporting the siltstone stratum instead of the expansive elastic silt soils. This will have to be determined by our geotechnical inspector during construction when the soils behind the new walls are exposed.**

Silty soils can be used for the last 18 to 24 inches of backfill, thus acting as a seal to the granular backfill. All backfill behind retaining walls should be moisture conditioned to within ± 2 percent of optimum moisture content, and compacted to a minimum of 90 percent of the material's

[3] Lew, M., et al (2010). "Seismic Earth Pressures on Deep Building Basements," SEAOC 2010 Convention Proceedings, Indian Wells, CA.

maximum dry density as determined in accordance with ASTM D 1557. Fill materials should be placed in layers that, when compacted, do not exceed about 8 inches. Care in the placement and compaction of fill behind retaining walls must be taken in order to ensure that undue lateral loads are not placed on the walls.

An adequate subsurface drain system will need to be designed and installed behind retaining walls to prevent hydrostatic buildup. A waterproofing system should be designed for any basement walls where moisture intrusion is not desirable.

4.0 CONSTRUCTION CONSIDERATIONS

EEI should be retained to provide observation and testing of construction activities involved in the foundation, earthwork, and related activities of this project. EEI cannot accept any responsibility for any conditions that deviate from those described in this report, nor for the performance of the foundations if not engaged to also provide construction observation for this project.

4.1 Moisture Sensitive Soils/Weather Related Concerns

The upper soils encountered at this site are expected to be sensitive to disturbances caused by construction traffic and to changes in moisture content. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in the soil strength and support capabilities. In addition, soils that become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. It will, therefore, be advantageous to perform earthwork and foundation construction activities during dry weather.

Exposed fine grained soils can be extremely sensitive to moisture and should be protected with a layer granular fill (at least 2 inches thick) if the excavations are to be left open during periods of wet weather.

4.2 Drainage, Groundwater, and Stormwater Considerations

Water should not be allowed to collect in the foundation excavations or on prepared subgrades for the floor slab during construction. Positive site drainage should be maintained throughout construction activities. Undercut or excavated areas should be sloped toward one corner to facilitate removal of any collected rainwater, groundwater, or surface runoff.

The site grading plan should be developed to provide rapid drainage of surface water away from the building areas and to inhibit infiltration of surface water around the perimeter of the buildings, floor slabs, and pavement. As stated previously, we do not recommend using infiltration within 25 feet of slopes 2H:1V or steeper, nor anywhere up-slope of the cliff. The grades should be sloped away from the building areas. We anticipate stormwater runoff will be routed to a detention facility, treated, and then discharged to the seasonal drainage in the northwest corner of the property via a solid pipe. The outlet should be adequately armored to prevent erosion. In no case should stormwater be allowed to point discharge directly onto site slopes. Alternatively, runoff from the building roofs could be discharged upon a paved surface adjacent to the buildings and allowed to sheet flow away from the building. Provided the water stays in a sheet flow condition (and does not require treatment) it may also be allowed to sheet flow off of the pavement, as long as it is not directed toward slopes steeper than 2H:1V or the cliff area. Adequate armoring of the edge of pavement is advised to prevent erosion at the pavement edges.

4.3 Excavations

In Federal Register, Volume 54, No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, Subpart P". This document and subsequent updates were issued to better ensure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that excavations, whether they be utility trenches, basement excavations or footing excavations, be constructed in accordance with the new OSHA guidelines. It is our understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations.

We are providing this information solely as a service to our client. EEI does not assume responsibility for construction site safety or the contractor's compliance with local, state, and federal safety or other regulations.

4.4 Supplemental Geotechnical Services to be Performed during the Design and Construction Phases

We recommend the following geotechnical-related items be performed:

A. During the design phase, review the final design documents. Issue a supplemental geotechnical report stating whether the design complies with our geotechnical recommendations.
B. During construction, verify topsoil stripping has been performed under all structures (i.e. roadways, buildings, retaining walls) and that the test pits conducted during our subsurface investigation have been properly backfilled with structural fill.
C. During construction, inspect all excavated native subgrade for structures (i.e. buildings and pavement).
D. During construction, inspection and test all structural fill.
E. During construction, approve all footing subgrade bearing surfaces just prior to the placement of concrete.
F. During construction, inspect all retaining wall backfill and drainage.

5.0 REPORT LIMITATIONS

As is standard practice in the geotechnical industry, the conclusions contained in our report are considered preliminary because they are based on assumptions made about the soil, rock, and groundwater conditions exposed at the site during our subsurface investigation. A more complete extent of the actual subsurface conditions can only be identified when they are exposed during construction. Therefore, EEI should be retained as your consultant during construction to observe the actual conditions and to provide our final conclusions. If a different geotechnical consultant is retained to perform geotechnical inspection during construction then they should be relied upon to provide final design conclusions and recommendations, and should assume the role of geotechnical engineer of record, as is the typical procedure required by the governing jurisdiction.

The geotechnical recommendations presented in this report are based on the available project information, and the subsurface materials described in this report. If there are any revisions to the plans for this project, or if deviations from the subsurface conditions noted in this report are encountered during construction, EEI should be notified immediately to determine if changes in the foundation recommendations are required. If EEI is not retained to review these changes, we will not be responsible for the impact of those conditions on the project.

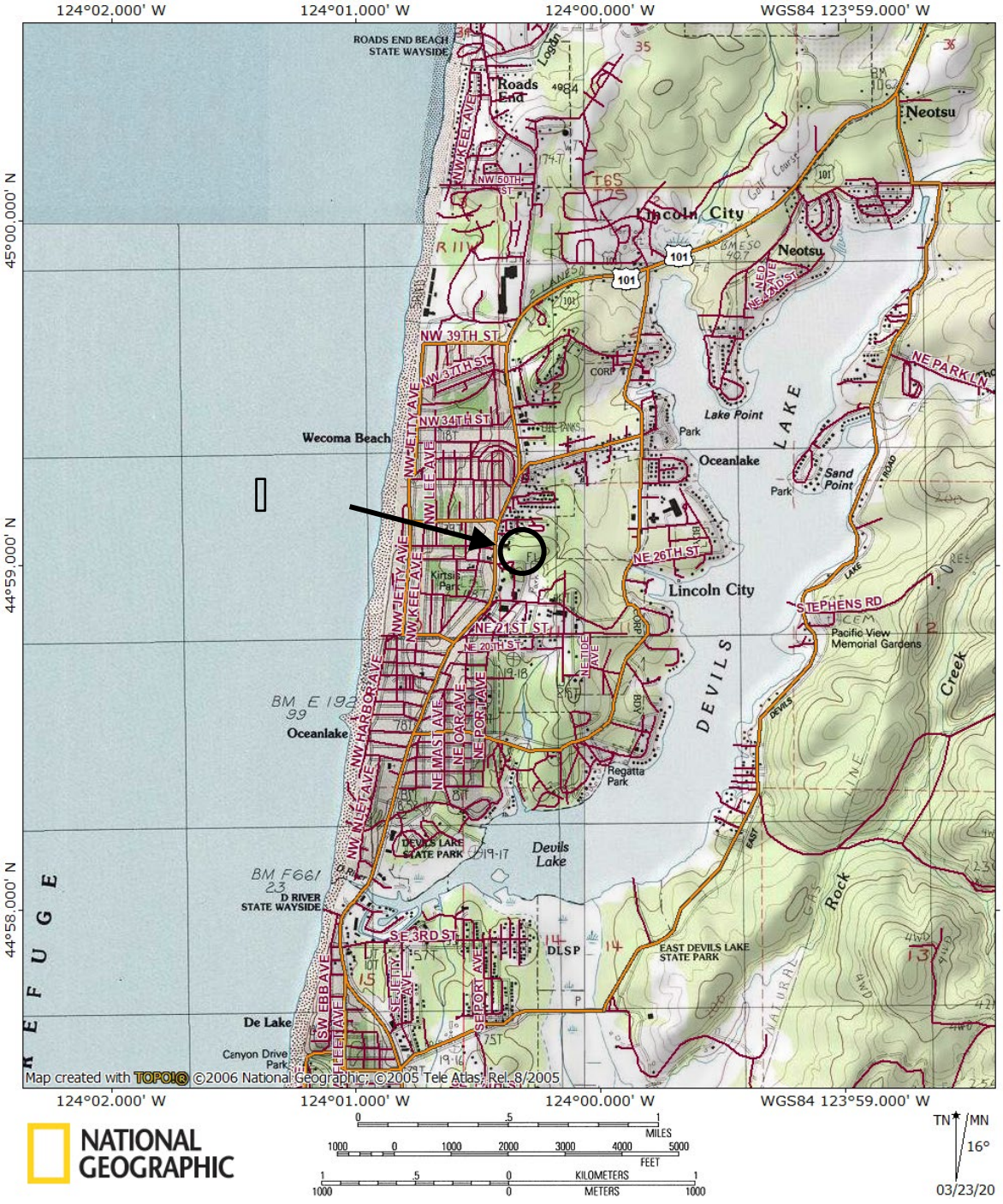
The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are more complete, the Geotechnical Engineer should be retained and provided the opportunity to review the final design plans and specifications to check that our engineering recommendations have been properly incorporated into the design documents.

This report has been prepared for the exclusive use of Innovating Housing, Inc. for the specific application to the proposed apartment complex to be located on Lincoln County tax lots 07-11-11-BB-04302-00, 07-11-11-BB-04302-00, and 07-11-11-BB-04300-00 in Lincoln City, Lincoln County, Oregon. EEI does not authorize the use of the advice herein nor the reliance upon the report by third parties without prior written authorization by EEI.

APPENDICES

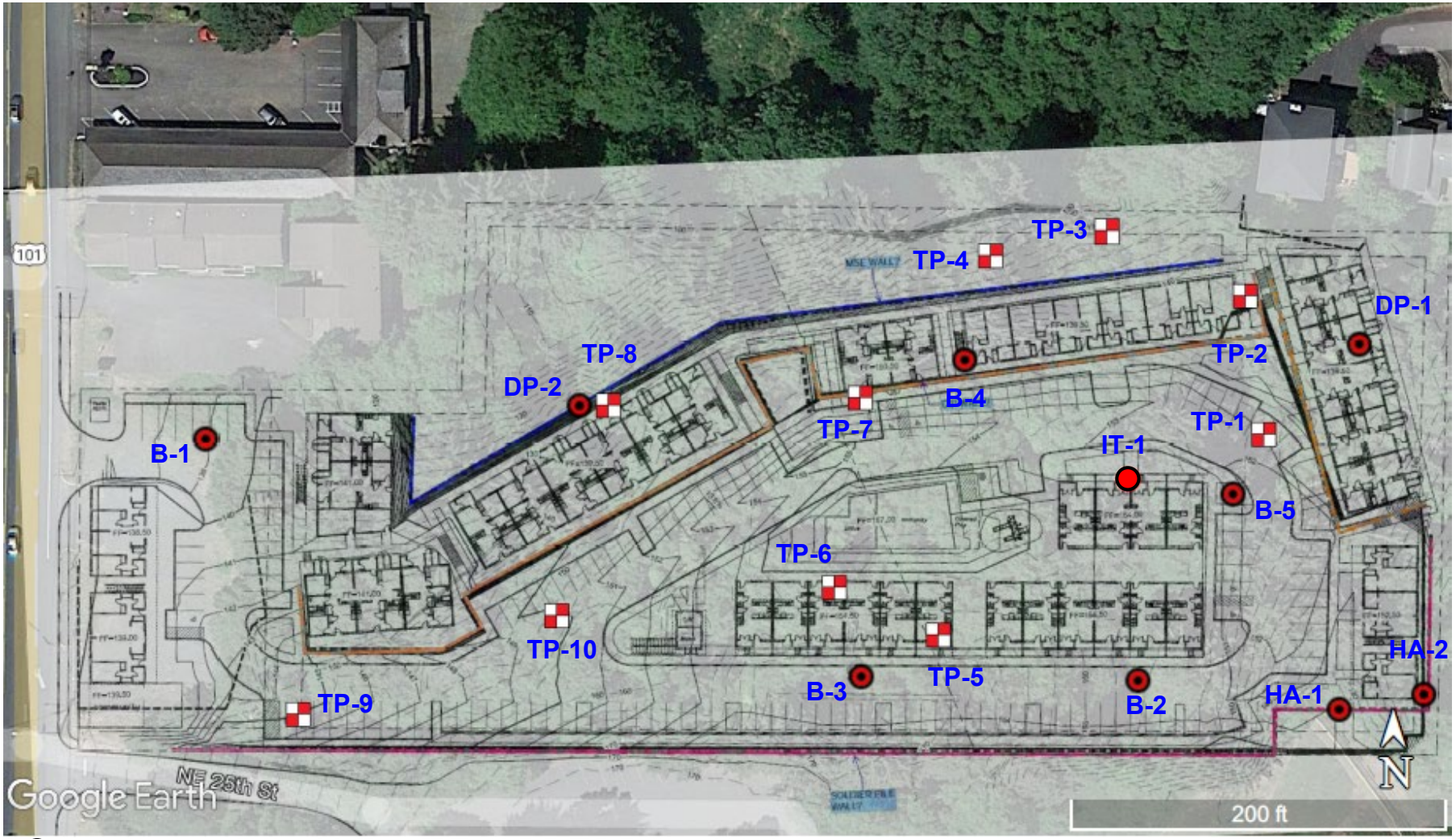
APPENDIX A – SITE LOCATION PLAN



Source: National Geographic TOPO! Software

Earth Engineers, Inc.	**Proposed Apartment Complex** **Lincoln County Tax Lots 07-11-11-BB-04301, 07-11-11-BB-04302-00, and 07-11-11-BB-04300-00** **N.E. corner of Northeast 25th Street & Highway 101** **Lincoln City, Lincoln County, Oregon**	**Report No. 20-047-2 (DRAFT)** **December 6, 2021**

APPENDIX B – EXPLORATION LOCATION PLAN



= Approximate Boring/Drive Probe Location
= Approximate Test Pit Location
= Approximate Infiltration Test Location

Base map source: Topographic Survey prepared by Emerio Design, dated 4/10/2020

Earth Engineers, Inc.	**Proposed Apartment Complex** **Lincoln County Tax Lots 07-11-11-BB-04301, 07-11-11-BB-04302-00, and 07-11-11-BB-04300-00** **Northeast corner of Northeast 25th Street and Highway 101** **Lincoln City, Lincoln County, Oregon**	**Report No. 20-047-2 (DRAFT)**	**December 6, 2021**

Appendix C: Boring B-1

Earth Engineers, Inc.

Client: Innovative Housing, Inc.
Project: 25th Street Apartments
Site Address: Northeast 25th Street
Lincoln City, Oregon
Location of Exploration: See Appendix B
Logged By: Ken Andrieu

Report Number: 20-047-2
Drilling Contractor: PLi Systems
Drilling Method: Hollow Stem Auger
Drilling Equipment: T26 Beretta
Approximate Ground Surface Elevation (ft msl):
Date of Exploration: 10/20/2021

Depth (ft)	Water Level	Lithologic Symbol	Geologic Description of Soil and Rock Strata	Sample Number	Blows per 6 Inches	N_{60} value	Moisture Content (%)	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Pocket Pen (tsf)	Remarks
0			Fill - dark gray silty gravel, wet	SPT-1	13 10 6	19	6					
2												
			Fill - brown sandy silt with tan siltstone fragments, wet	SPT-2	2 2 3	6	64					
4												
6				SPT-3	1 1 1	2	63					
8			Buried Topsoil - black organic silt	SPT-4	0 1 3	5	66					
10			Silty Sand - brown silty sand, wet	SPT-5	2 3	9	73					
			Siltstone - tan with rust mottling siltstone, very soft, intensely fractured, very weathered and friable		5							
12				SPT-6	5 7 9	19	71					
14												
				SPT-7	3 4 4	9	68					
16												
18												drilling stiffer at 18'
20			transitions to gray and tan mottling with rust staining, slightly less weathered	SPT-8	10 13 24	44	45					
22			Sandstone - gray-brown with rust sandstone, intesely fractured, moderately weathered, moderately soft, friable									
24												
26				SPT-9	24 25 50/5"		37					
28												
30												

Notes : Boring terminated at a depth of approximately 26.5 feet below ground surface (bgs). Groundwater was not encountered at the time of our exploration. Boring backfilled with bentonite chips on 10/20/2021. N60 values reported are based on a SPT hammer energy correction factor of 1.187 (i.e. 71.2/60), reference "Report of SPT Hammer Energies" prepared by GeoDesign Inc. dated 6/9/2021. Approximate elevations from Google Earth.

Appendix C: Boring B-2

Earth Engineers, Inc.

Client: Innovative Housing, Inc.
Project: 25th Street Apartments
Site Address: Northeast 25th Street
Lincoln City, Oregon
Location of Exploration: See Appendix B
Logged By: Ken Andrieu

Report Number: 20-047-2
Drilling Contractor: PLi Systems
Drilling Method: Hollow Stem Auger + Coring
Drilling Equipment: T26 Beretta
Approximate Ground Surface Elevation (ft msl):
Date of Exploration: 10/20/2021

Depth (ft)	Water Level	Lithologic Symbol	Geologic Description of Soil and Rock Strata	Sample Number	Blows per 6 Inches	N_{60} value (0 25 50 75 100)	Moisture Content (%)	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Pocket Pen (tsf)	Remarks
0			Silt with Sand - brown silt with sand, moist to wet, with charcoal and siltstone fragments									
2				SPT-1	2 3 5	9	60				1	
4			Silt - tan silt with rust seams, moist to wet, decomposed siltstone	SPT-2	4 4 4	9	70				1.75	
6			Siltstone - tan with rust siltstone, intensely fractured, very thinly bedded, friable, highly weathered									
8				SPT-3	5 10 13	27	71				4.5+	
10				SPT-4	6 11 13	28	65					
12												
14												
16			transitions to grayish brown, harder	SPT-5	19 44 50/2"		33					
18												very hard drilling at 19'
20			Mudstone - dark gray mudstone, slightly weathered, moderately hard, laminated	SPT-6	50 /1"		36					switch to coring
22				CORE-1								core recovery = 77%, RQD = ????
24			transitions to hard									
26												
28												
30												

Notes : Boring terminated at a depth of approximately 25 feet below ground surface (bgs). Groundwater was not encountered at the time of our exploration. Boring backfilled with bentonite chips on 10/20/2021. N60 values reported are based on a SPT hammer energy correction factor of 1.187 (i.e. 71.2/60), reference "Report of SPT Hammer Energies" prepared by GeoDesign Inc. dated 6/9/2021. Approximate elevations from Google Earth.

Appendix C: Boring B-3

Earth Engineers, Inc.

Client: Innovative Housing, Inc.
Project: 25th Street Apartments
Site Address: Northeast 25th Street
Lincoln City, Oregon
Location of Exploration: See Appendix B
Logged By: Ken Andrieu

Report Number: 20-047-2
Drilling Contractor: PLi Systems
Drilling Method: Hollow Stem Auger
Drilling Equipment: T26 Beretta
Approximate Ground Surface Elevation (ft msl):
Date of Exploration: 10/21/2021

Depth (ft)	Water Level	Lithologic Symbol	Geologic Description of Soil and Rock Strata	Sample Number	Blows per 6 Inches	N_{60} value	Moisture Content (%)	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Pocket Pen (tsf)	Remarks
0			Topsoil / Fill									
2			Silt with Sand - brown silt with sand, wet	SPT-1	2 3	8	55				0.5	
4			Siltstone - tan and rust thinly bedded siltstone, friable, very soft, intesely fractured, highly weathered		4							
6				SPT-2	7 10 13	27	58					
8				SPT-3	6 7 5	14	88					
10				SPT-4	5 7 7	17	75					
12												drilling stiffer at 12.5'
14			Mudstone - tan-gray with rust laminated mudstone, friable, moderately weathered, intensely fractured									
16				SPT-5	14 50/3"		43					
18				SPT-6	50 /3"		106					
20												
22												
24												
26												
28												
30												

Notes : Boring terminated at a depth of approximately 19.5 feet below ground surface (bgs). Groundwater was not encountered at the time of our exploration. Boring backfilled with bentonite chips on 10/21/2021. N60 values reported are based on a SPT hammer energy correction factor of 1.187 (i.e. 71.2/60), reference "Report of SPT Hammer Energies" prepared by GeoDesign Inc. dated 6/9/2021. Approximate elevations from Google Earth.

Appendix C: Boring B-4

Earth Engineers, Inc.

Client: Innovative Housing, Inc.
Project: 25th Street Apartments
Site Address: Northeast 25th Street
Lincoln City, Oregon
Location of Exploration: See Appendix B
Logged By: Ken Andrieu

Report Number: 20-047-2
Drilling Contractor: PLi Systems
Drilling Method: Hollow Stem Auger
Drilling Equipment: T26 Beretta
Approximate Ground Surface Elevation (ft msl):
Date of Exploration: 10/21/2021

Depth (ft)	Water Level	Lithologic Symbol	Geologic Description of Soil and Rock Strata	Sample Number	Blows per 6 Inches	N_{60} value	Moisture Content (%)	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Pocket Pen (tsf)	Remarks
0			Fill - brown sandy silt, wet									
2				SPT-1	1 1 0	1	96					
4												
6			Buried Topsoil - dark brown organic silt	SPT-2	1 3 3	7	87					
8			Sandy Silt - brown sandy silt	SPT-3	3 4	11	55					
10			Siltstone - tan and rust thinly bedded siltstone intensely fractured, highly weathered, very soft, friable	SPT-4	5 4 11 13	28	62				4.5+	
12												
14												
16				SPT-5	1 4 4	9	124				3.5	
18												drilling stiffer at 18'
20				SPT-6	6 10 11	25	77					
22												
24												
26				SPT-7	7 5 4	11	100				4.5	
28												
30												

Notes : Boring terminated at a depth of approximately 31 feet below ground surface (bgs). Groundwater was not encountered at the time of our exploration. Boring backfilled with bentonite chips on 10/21/2021. N60 values reported are based on a SPT hammer energy correction factor of 1.187 (i.e. 71.2/60), reference "Report of SPT Hammer Energies" prepared by GeoDesign Inc. dated 6/9/2021. Approximate elevations from Google Earth.

Appendix C: Boring B-4

Earth Engineers, Inc.

Client: Innovative Housing, Inc.
Project: 25th Street Apartments
Site Address: Northeast 25th Street
Lincoln City, Oregon
Location of Exploration: See Appendix B
Logged By: Ken Andrieu

Report Number: 20-047-2
Drilling Contractor: PLi Systems
Drilling Method: Hollow Stem Auger
Drilling Equipment: T26 Beretta
Approximate Ground Surface Elevation (ft msl):
Date of Exploration: 10/21/2021

Depth (ft)	Water Level	Lithology: Lithologic Symbol	Lithology: Geologic Description of Soil and Rock Strata	Sampling Data: Sample Number	Blows per 6 Inches	N_{60} value (0 25 50 75 100)	Moisture Content (%)	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Pocket Pen (tsf)	Remarks
30				SPT-8	22 50/5"		73					
32												
34												
36												
38												
40												
42												
44												
46												
48												
50												
52												
54												
56												
58												
60												

Notes : Boring terminated at a depth of approximately 31 feet below ground surface (bgs). Groundwater was not encountered at the time of our exploration. Boring backfilled with bentonite chips on 10/21/2021. N60 values reported are based on a SPT hammer energy correction factor of 1.187 (i.e. 71.2/60), reference "Report of SPT Hammer Energies" prepared by GeoDesign Inc. dated 6/9/2021. Approximate elevations from Google Earth.

Appendix C: Boring B-5

Earth Engineers, Inc.

Client: Innovative Housing, Inc.
Project: 25th Street Apartments
Site Address: Northeast 25th Street
Lincoln City, Oregon
Location of Exploration: See Appendix B
Logged By: Ken Andrieu

Report Number: 20-047-2
Drilling Contractor: PLi Systems
Drilling Method: Hollow Stem Auger
Drilling Equipment: T26 Beretta
Approximate Ground Surface Elevation (ft msl):
Date of Exploration: 10/21/2021

Depth (ft)	Water Level	Lithologic Symbol	Geologic Description of Soil and Rock Strata	Sample Number	Blows per 6 Inches	N_{60} value (0 25 50 75 100)	Moisture Content (%)	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Pocket Pen (tsf)	Remarks
0			Topsoil - dark brown organic silt	SPT-1	0 2 2	5	93					
2					1							
			Siltstone -	SPT-2	2 3	6	92				4.5+	
4				SPT-3	0 14 12	31	55					
6												
8												
10				SPT-4	14 17 19	43	49					
12												
14												hard drilling at 15'
			Mudstone - gray mudstone	SPT-5	50 /6"		43					
16												
18												
20				SPT-6	50 /3"		42					
22												
24												
26												
28												
30												

Notes : Boring terminated at a depth of approximately 20.5 feet below ground surface (bgs). Groundwater was not encountered at the time of our exploration. Boring backfilled with bentonite chips on 10/21/2021. N60 values reported are based on a SPT hammer energy correction factor of 1.187 (i.e. 71.2/60), reference "Report of SPT Hammer Energies" prepared by GeoDesign Inc. dated 6/9/2021. Approximate elevations from Google Earth.

Appendix C: Test Pit TP-1

Earth Engineers, Inc.

Client: Innovative Housing, Inc.
Project: 25th Street Apartments
Site Address: Tax Lots: 07-11-11-BB-04302-00 and 07-11-11-BB-04300-00, Lincoln Ciry, Lincoln County, Oregon
Location of Test Pit: See Appendix B
Date Excavated: 3/20/2020
Logged By: Ken Andrieu, R.G.

Report Number: 20-047-1
Excavation Contractor: Dan Fisher
Excavation Method: Excavator with 2-foot toothed bucket
Excavation Equipment: ZAXIS 40U
Approximate Elevation (ft msl): 151'

Depth (ft)	Water Level	Lithology: Lithologic Symbol	Lithology: Geologic Description of Soil and Rock Strata	Sampling Data: Sample Number	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Moisture Content (%)	Pocket Pen (tsf)	Torvane Shear (tsf)	Remarks
0			TOPSOIL - dark brown silty clay, moist with some siltstone fragments and organics (2 feet thick).								
2			ELASTIC SILT with Sand (MH) - dark brown, clayey silt with siltstone fragments, moist.	GRAB-1				66	1.50		PID Reading: 0.0
3			SILTSTONE - tan with rust staining siltstone, friable, moderately fractured, highly weathered.								
4				GRAB-2				78			PID Reading: 0.0
7											

Notes : Test pit terminated at a depth of approximately 7 feet bgs. Groundwater was not encountered at the time of our exploration. Test pit loosely backfilled with excavated soil on 3/20/2020. Elevations based on the topographic survey prepared by Emerio Design, Dated 4/10/2020.

Appendix C: Test Pit TP-2

Earth Engineers, Inc.

Client: Innovative Housing, Inc.
Project: 25th Street Apartments
Site Address: Tax Lots: 07-11-11-BB-04302-00 and 07-11-11-BB-04300-00, Lincoln Ciry, Lincoln County, Oregon
Location of Test Pit: See Appendix B
Date Excavated: 3/20/2020
Logged By: Ken Andrieu, R.G.

Report Number: 20-047-1
Excavation Contractor: Dan Fisher
Excavation Method: Excavator with 2-foot toothed bucket
Excavation Equipment: ZAXIS 40U
Approximate Elevation (ft msl): 142'

Depth (ft)	Water Level	Lithology: Lithologic Symbol	Lithology: Geologic Description of Soil and Rock Strata	Sampling Data: Sample Number	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Moisture Content (%)	Pocket Pen (tsf)	Torvane Shear (tsf)	Remarks
0			TOPSOIL - dark brown silty clay, moist with some siltstone fragments and organics (18 inches thick).								
2			ELASTIC SILT with Sand (MH) - dark brown to brown, clayey silt with siltstone fragments, moist.	GRAB-1				71	1.50		PID Reading: 0.0
4			SILTSTONE - tan with rust staining siltstone, friable, moderately fractured, highly weathered.								

Notes : Test pit terminated at a depth of approximately 5 feet bgs. Groundwater was not encountered at the time of our exploration. Test pit loosely backfilled with excavated soil on 3/20/2020. Elevations based on the topographic survey prepared by Emerio Design, Dated 4/10/2020.

Appendix C: Test Pit TP-3

Earth Engineers, Inc.

Client: Innovative Housing, Inc.
Project: 25th Street Apartments
Site Address: Tax Lots: 07-11-11-BB-04302-00 and 07-11-11-BB-04300-00, Lincoln Ciry, Lincoln County, Oregon
Location of Test Pit: See Appendix B
Date Excavated: 3/20/2020
Logged By: Ken Andrieu, R.G.

Report Number: 20-047-1
Excavation Contractor: Dan Fisher
Excavation Method: Excavator with 2-foot toothed bucket
Excavation Equipment: ZAXIS 40U
Approximate Elevation (ft msl): 131'

Depth (ft)	Water Level	Lithology: Lithologic Symbol	Lithology: Geologic Description of Soil and Rock Strata	Sampling Data: Sample Number	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Moisture Content (%)	Pocket Pen (tsf)	Torvane Shear (tsf)	Remarks
0			TOPSOIL - dark brown silty clay, moist with some siltstone fragments and organics (2 feet thick).								
2			ELASTIC SILT with Sand (MH) - dark brown to brown, clayey silt with siltstone fragments, moist.								
3			SILTSTONE - tan with rust staining siltstone, friable, moderately fractured, highly weathered.								
4											
5											
6											
7											
8											
9											
10											

Notes : Test pit terminated at a depth of approximately 4.5 feet bgs. Groundwater was not encountered at the time of our exploration. Test pit loosely backfilled with excavated soil on 3/20/2020. Elevations based on the topographic survey prepared by Emerio Design, Dated 4/10/2020.

Appendix C: Test Pit TP-4

Earth Engineers, Inc.

Client: Innovative Housing, Inc.
Project: 25th Street Apartments
Site Address: Tax Lots: 07-11-11-BB-04302-00 and 07-11-11-BB-04300-00, Lincoln Ciry, Lincoln County, Oregon
Location of Test Pit: See Appendix B
Date Excavated: 3/20/2020
Logged By: Ken Andrieu, R.G.

Report Number: 20-047-1
Excavation Contractor: Dan Fisher
Excavation Method: Excavator with 2-foot toothed bucket
Excavation Equipment: ZAXIS 40U
Approximate Elevation (ft msl): 128'

Depth (ft)	Water Level	Lithology: Lithologic Symbol	Lithology: Geologic Description of Soil and Rock Strata	Sampling Data: Sample Number	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Moisture Content (%)	Pocket Pen (tsf)	Torvane Shear (tsf)	Remarks
0			TOPSOIL - dark brown silty clay, moist with some siltstone fragments and organics (18 inches thick).								
1											
2			ELASTIC SILT with Sand (MH) - medium brown to dark brown, clayey silt with siltstone fragments, moist.								
3				GRAB-1				64	2.00		PID Reading: 0.0
4											
5			SILTSTONE - tan with rust staining siltstone, friable, moderately fractured, highly weathered.								
6				GRAB-2				59			PID Reading: 0.0
7											
8											
9											
10											

Notes : Test pit terminated at a depth of approximately 7 feet bgs. Groundwater was not encountered at the time of our exploration. Test pit loosely backfilled with excavated soil on 3/20/2020. Elevations based on the topographic survey prepared by Emerio Design, Dated 4/10/2020.

Appendix C: Test Pit TP-5

Earth Engineers, Inc.

Client: Innovative Housing, Inc.
Project: 25th Street Apartments
Site Address: Tax Lots: 07-11-11-BB-04302-00 and 07-11-11-BB-04300-00, Lincoln Ciry, Lincoln County, Oregon
Location of Test Pit: See Appendix B
Date Excavated: 3/20/2020
Logged By: Ken Andrieu, R.G.

Report Number: 20-047-1
Excavation Contractor: Dan Fisher
Excavation Method: Excavator with 2-foot toothed bucket
Excavation Equipment: ZAXIS 40U
Approximate Elevation (ft msl): 163'

Depth (ft)	Water Level	Lithology: Lithologic Symbol	Lithology: Geologic Description of Soil and Rock Strata	Sampling Data: Sample Number	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Moisture Content (%)	Pocket Pen (tsf)	Torvane Shear (tsf)	Remarks
0			TOPSOIL - dark brown silty clay, moist with some siltstone fragments and organics (8 inches thick).								
1			FILL - topsoil mixed with brown clayey silt and weatherd siltstone.	GRAB-1				52	1.50		PID Reading: 0.0
2			SILTSTONE - tan with rust staining siltstone, friable, moderately fractured, highly weathered.								
3			Siltstone becomes hard								
4											
5											
6											
7											
8											
9											
10											

Notes : Test pit terminated at a depth of approximately 4 feet bgs. Groundwater was not encountered at the time of our exploration. Test pit loosely backfilled with excavated soil on 3/20/2020. Elevations based on the topographic survey prepared by Emerio Design, Dated 4/10/2020.

Appendix C: Test Pit TP-6

Earth Engineers, Inc.

Client: Innovative Housing, Inc.
Project: 25th Street Apartments
Site Address: Tax Lots: 07-11-11-BB-04302-00 and 07-11-11-BB-04300-00, Lincoln Ciry, Lincoln County, Oregon
Location of Test Pit: See Appendix B
Date Excavated: 3/20/2020
Logged By: Ken Andrieu, R.G.

Report Number: 20-047-1
Excavation Contractor: Dan Fisher
Excavation Method: Excavator with 2-foot toothed bucket
Excavation Equipment: ZAXIS 40U
Approximate Elevation (ft msl): 157'

Depth (ft)	Water Level	Lithology: Lithologic Symbol	Lithology: Geologic Description of Soil and Rock Strata	Sampling Data: Sample Number	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Moisture Content (%)	Pocket Pen (tsf)	Torvane Shear (tsf)	Remarks
0			FILL - topsoil mixed with brown clayey silt.								
2			SILTSTONE - tan with rust staining siltstone, friable, moderately fractured, highly weathered.								
4											
10											

Notes : Test pit terminated at a depth of approximately 4 feet bgs. Groundwater was not encountered at the time of our exploration. Test pit loosely backfilled with excavated soil on 3/20/2020. Elevations based on the topographic survey prepared by Emerio Design, Dated 4/10/2020.

Appendix C: Test Pit TP-7

Earth Engineers, Inc.

Client: Innovative Housing, Inc.
Project: 25th Street Apartments
Site Address: Tax Lots: 07-11-11-BB-04302-00 and 07-11-11-BB-04300-00, Lincoln Ciry, Lincoln County, Oregon
Location of Test Pit: See Appendix B
Date Excavated: 3/20/2020
Logged By: Ken Andrieu, R.G.

Report Number: 20-047-1
Excavation Contractor: Dan Fisher
Excavation Method: Excavator with 2-foot toothed bucket
Excavation Equipment: ZAXIS 40U
Approximate Elevation (ft msl): 152'

Depth (ft)	Water Level	Lithology: Lithologic Symbol	Lithology: Geologic Description of Soil and Rock Strata	Sampling Data: Sample Number	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Moisture Content (%)	Pocket Pen (tsf)	Torvane Shear (tsf)	Remarks
0			TOPSOIL - dark brown, wet, silt with sand, roots and decomposed organics (18 inches thick).								
2				GRAB-1				68	0.75		PID Reading: 0.0
2			ELASTIC SILT with Sand (MH) - brown, clayey silt, moist.								
3				GRAB-2	94	80	56	64			PID Reading: 0.0
9				GRAB-3				61	2.00		PID Reading: 0.0
10											

Notes : Test pit terminated at a depth of approximately 9.5 feet bgs. Groundwater was not encountered at the time of our exploration. Test pit loosely backfilled with excavated soil on 3/20/2020. Elevations based on the topographic survey prepared by Emerio Design, Dated 4/10/2020.

Appendix C: Test Pit TP-8

Earth Engineers, Inc.

Client: Innovative Housing, Inc.
Project: 25th Street Apartments
Site Address: Tax Lots: 07-11-11-BB-04302-00 and 07-11-11-BB-04300-00, Lincoln Ciry, Lincoln County, Oregon
Location of Test Pit: See Appendix B
Date Excavated: 3/20/2020
Logged By: Ken Andrieu, R.G.

Report Number: 20-047-1
Excavation Contractor: Dan Fisher
Excavation Method: Excavator with 2-foot toothed bucket
Excavation Equipment: ZAXIS 40U
Approximate Elevation (ft msl): 131'

Depth (ft)	Water Level	Lithology: Lithologic Symbol	Lithology: Geologic Description of Soil and Rock Strata	Sampling Data: Sample Number	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Moisture Content (%)	Pocket Pen (tsf)	Torvane Shear (tsf)	Remarks
0			FILL - topsoil mixed with brown clayey silt and tan siltstone.								
1											
2											
3											
4											
5											
6											
7				GRAB-1				70			PID Reading: 0.0
8											
9											
10											

Notes : Test pit terminated at a depth of approximately 8.5 feet bgs. Groundwater was not encountered at the time of our exploration. Test pit loosely backfilled with excavated soil on 3/20/2020. Elevations based on the topographic survey prepared by Emerio Design, Dated 4/10/2020.

Appendix C: Test Pit TP-9

Earth Engineers, Inc.

Client: Innovative Housing, Inc.
Project: 25th Street Apartments
Site Address: Tax Lots: 07-11-11-BB-04302-00 and 07-11-11-BB-04300-00, Lincoln Ciry, Lincoln County, Oregon
Location of Test Pit: See Appendix B
Date Excavated: 3/20/2020
Logged By: Ken Andrieu, R.G.

Report Number: 20-047-1
Excavation Contractor: Dan Fisher
Excavation Method: Excavator with 2-foot toothed bucket
Excavation Equipment: ZAXIS 40U
Approximate Elevation (ft msl): 152'

Depth (ft)	Water Level	Lithology: Lithologic Symbol	Lithology: Geologic Description of Soil and Rock Strata	Sampling Data: Sample Number	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Moisture Content (%)	Pocket Pen (tsf)	Torvane Shear (tsf)	Remarks
0			ASPHALT - 2 inches of asphalt over 4 inches of gravel.								
			Fill - mixed of dark brown silt and brown silty clay								
1											
2			ELASTIC SILT with Sand (MH) - brown, clayey silt with siltstone fragments, moist.								
				GRAB-1				42	1.50		PID Reading: 0.0
3											
4											
5											
6			Becomes gray with rust mottling	GRAB-2	91	80	56	53			PID Reading: 0.0
7											
8											
9											
10											

Notes : Test pit terminated at a depth of approximately 7 feet bgs. Groundwater was not encountered at the time of our exploration. Test pit loosely backfilled with excavated soil on 3/20/2020. Elevations based on the topographic survey prepared by Emerio Design, Dated 4/10/2020.

Appendix C: Test Pit TP-10

Earth Engineers, Inc.

Client: Innovative Housing, Inc.
Project: 25th Street Apartments
Site Address: Tax Lots: 07-11-11-BB-04302-00 and 07-11-11-BB-04300-00, Lincoln Ciry, Lincoln County, Oregon
Location of Test Pit: See Appendix B
Date Excavated: 3/20/2020
Logged By: Ken Andrieu, R.G.

Report Number: 20-047-1
Excavation Contractor: Dan Fisher
Excavation Method: Excavator with 2-foot toothed bucket
Excavation Equipment: ZAXIS 40U
Approximate Elevation (ft msl): 154'

Depth (ft)	Water Level	Lithology: Lithologic Symbol	Lithology: Geologic Description of Soil and Rock Strata	Sampling Data: Sample Number	% Passing #200 Sieve	Liquid Limit	Plastic Limit	Moisture Content (%)	Pocket Pen (tsf)	Torvane Shear (tsf)	Remarks
0			TOPSOIL - dark brown, wet, silt with sand, roots and decomposed organics (6 inches thick).								
			ELASTIC SILT with Sand (MH) - dark brown to brown, clayey silt with siltstone fragments, moist.								
1				GRAB-1				65	2.00		PID Reading: 0.0
2											
3											
				GRAB-2				46	2.00		PID Reading: 0.0
4											
5											
6											
7											
8											
9											
10											

Notes : Test pit terminated at a depth of approximately 10 feet bgs. Groundwater was not encountered at the time of our exploration. Test pit loosely backfilled with excavated soil on 3/20/2020. Elevations based on the topographic survey prepared by Emerio Design, Dated 4/10/2020.

APPENDIX D: SOIL CLASSIFICATION LEGEND

APPARENT CONSISTENCY OF COHESIVE SOILS (PECK, HANSON & THORNBURN 1974, AASHTO 1988)				
Descriptor	**SPT N_{60} (blows/foot)***	**Pocket Penetrometer, Qp (tsf)**	**Torvane (tsf)**	**Field Approximation**
Very Soft	< 2	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	2 – 4	0.25 – 0.50	0.12 – 0.25	Easily penetrated several inches by thumb
Medium Stiff	5 – 8	0.50 – 1.0	0.25 – 0.50	Penetrated several inches by thumb w/moderate effort
Stiff	9 – 15	1.0 – 2.0	0.50 – 1.0	Readily indented by thumbnail
Very Stiff	16 – 30	2.0 – 4.0	1.0 – 2.0	Indented by thumb but penetrated only with great effort
Hard	> 30	> 4.0	> 2.0	Indented by thumbnail with difficulty

* Using SPT N_{60} is considered a crude approximation for cohesive soils.

APPARENT DENSITY OF COHESIONLESS SOILS (AASHTO 1988)	
Descriptor	**SPT N_{60} Value (blows/foot)**
Very Loose	0 – 4
Loose	5 – 10
Medium Dense	11 – 30
Dense	31 – 50
Very Dense	> 50

MOISTURE (ASTM D2488-06)	
Descriptor	**Criteria**
Dry	Absence of moisture, dusty, dry to the touch, well below optimum moisture content (per ASTM D698 or D1557)
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table, well above optimum moisture content (per ASTM D698 or D1557)

PERCENT OR PROPORTION OF SOILS (ASTM D2488-06)	
Descriptor	**Criteria**
Trace	Particles are present but estimated < 5%
Few	5 – 10%
Little	15 – 25%
Some	30 – 45%
Mostly	50 – 100%
Percentages are estimated to nearest 5% in the field. Use "about" unless percentages are based on laboratory testing.	

SOIL PARTICLE SIZE (ASTM D2488-06)	
Descriptor	**Size**
Boulder	> 12 inches
Cobble	3 to 12 inches
Gravel - Coarse Fine	¾ inch to 3 inches No. 4 sieve to ¾ inch
Sand - Coarse Medium Fine	No. 10 to No. 4 sieve (4.75mm) No. 40 to No. 10 sieve (2mm) No. 200 to No. 40 sieve (.425mm)
Silt and Clay ("fines")	Passing No. 200 sieve (0.075mm)

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D2488)				
Major Division			**Group Symbol**	**Description**
Coarse Grained Soils (more than 50% retained on #200 sieve)	**Gravel** (50% or more retained on No. 4 sieve)	Clean Gravel	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		Gravel with fines	GM	Silty gravels and gravel-sand-silt mixtures
			GC	Clayey gravels and gravel-sand-clay mixtures
	Sand (> 50% passing No. 4 sieve)	Clean sand	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly-graded sands and gravelly sands, little or no fines
		Sand with fines	SM	Silty sands and sand-silt mixtures
			SC	Clayey sands and sand-clay mixtures
Fine Grained Soils (50% or more passing #200 sieve)	**Silt and Clay** (liquid limit < 50)		ML	Inorganic silts, rock flour and clayey silts
			CL	Inorganic clays of low-medium plasticity, gravelly, sandy & lean clays
			OL	Organic silts and organic silty clays of low plasticity
	Silt and Clay (liquid limit > 50)		MH	Inorganic silts and clayey silts
			CH	Inorganic clays or high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat, muck and other highly organic soils

Earth Engineers, Inc.

GRAPHIC SYMBOL LEGEND		
GRAB		Grab sample
SPT		Standard Penetration Test (2" OD), ASTM D1586
ST		Shelby Tube, ASTM D1587 (pushed)
DM		Dames and Moore ring sampler (3.25" OD and 140-pound hammer)
CORE		Rock coring

APPENDIX E:
HISTORICAL WELL LOGS

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)

LINC 1781

JAN 19 1993
WATER RESOURCES DEPT.
SALEM, OREGON

7S / 11W / 11 bc

Start Card # 44225

(1) OWNER/PROJECT:

WELL NO. MW#9

Name Unocal
Address P.O. Box 76
City Seattle State WA Zip 98111

(2) TYPE OF WORK:

☑ New construction ☐ Repair ☐ Recondition
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable
☑ Hollow Stem Auger ☐ Other

(4) BORE HOLE CONSTRUCTION

Special Standards Yes ☐ No ☑ Depth of completed well 25 ft.

Land surface

Vault 0 ft. TO 1 ft.
Water-tight cover
Surface flush vault
Locking cap
Casing diameter 2" in. material PVC
Welded ☐ Threaded ☑ Glued ☐
Liner diameter N/A in. material N/A
Welded ☐ Threaded ☐ Glued ☐
Seal 1 ft. TO 4 ft.
Well seal: Material Bentonite Amount 5 50LB SACKS
Borehole diameter 8" in.
Bentonite plug at least 2 ft. thick
Filter pack 4 ft. TO 25 ft.
Screen material PVC
interval(s): From 5 To 25
From To
Slot size .020 in.
Filter pack: Material Silica Sand
Size 8/12 in.

(5) WELL TEST:

☐ Pump ☑ Bailer ☐ Air ☐ Flowing Artesian
Permeability Yield GPM
Conductivity PH
Temperature of water 14°C F/C Depth artesian flow found ft.
Was water analysis done? ☑ Yes ☐ No
By whom? Geo. Engineers
Depth of strata to be analyzed. From 23 ft. to 25 ft.
Remarks:

Name of supervising Geologist/Engineer Nancy EAST

(6) LOCATION OF WELL By legal description

Well Location: County Lincoln
Township 7S (N or S) Range 11W (E or W) Section 11
1. SW 1/4 of NW 1/4 of above section.
2. Street address of well location 2510 U.S. Hwy 101 Lincoln City, OR
3. Tax lot number of well location 2204300100
4. ATTACH MAP WITH LOCATION IDENTIFIED.

(7) STATIC WATER LEVEL:

23' Ft. below land surface. Date 12-28-92
Artesian Pressure lb/sq. in. Date

(8) WATER BEARING ZONES:

Depth at which water was first found 23'

From	To	Est. Flow Rate	SWL
23'	25'	?	23'

(9) WELL LOG:

Ground elevation

Material	From	To	SWL
MEDIUM CRUSHED GRAVEL, Loose, MOIST	0"	7'	
Dark Brown silt w/trace organics, medium stiff moist	7'	14'	
Mottled tan and orange fractured siltstone, hard, moist weathered bedrock	14'	23'	
Gray siltstone, hard, moist to wet	23'	25'	23'

Date started 12-28-92 Completed 12-28-92

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.

MWC Number
Signed Date

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.

MWC Number 10013
Signed Randey L. Crisman Date 1-14-93

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)

LINC 1782

JAN 19 1993

WATER RESOURCES DEPT
SALEM, OREGON

7S/ 11W/ 11 bc

Start Card # 44226

(1) OWNER/PROJECT:

WELL NO. MW#10

Name Unocal

Address P.O. Box 76

City Seattle State WA Zip 98111

(2) TYPE OF WORK:

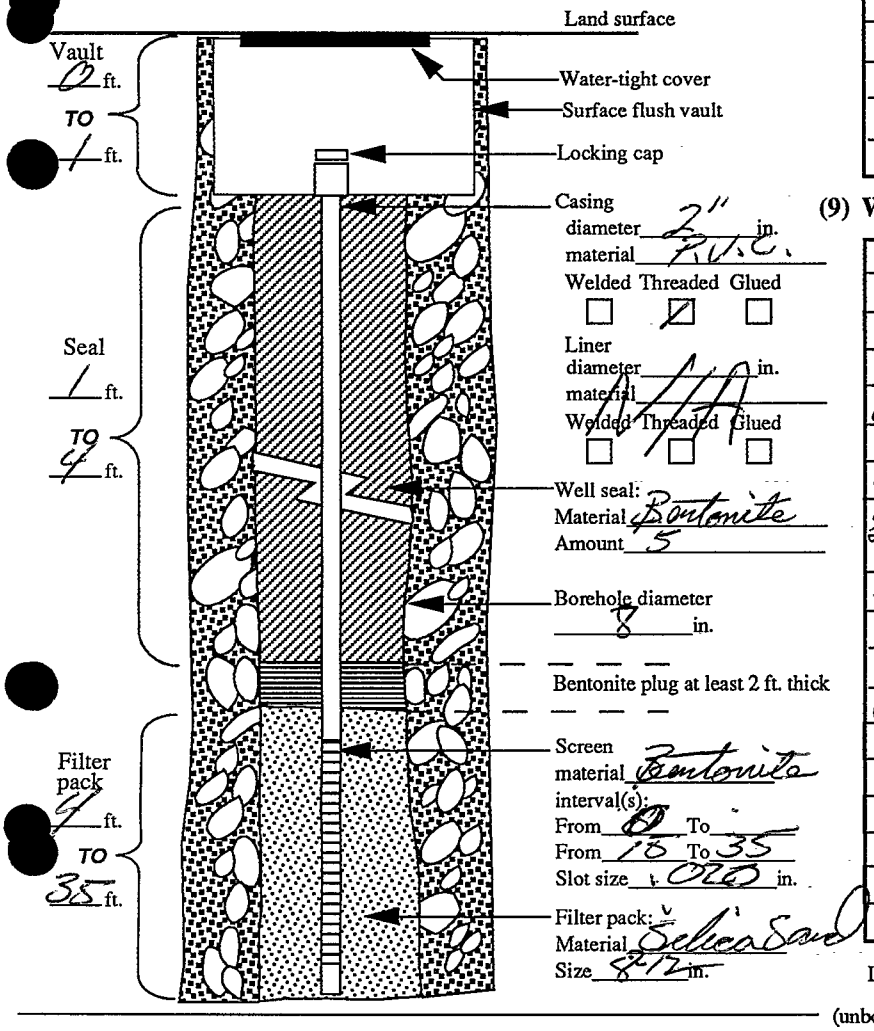
- [x] New construction
- [ ] Repair
- [ ] Recondition
- [ ] Conversion
- [ ] Deepening
- [ ] Abandonment

(3) DRILLING METHOD

- [ ] Rotary Air
- [ ] Rotary Mud
- [ ] Cable
- [x] Hollow Stem Auger
- [ ] Other

(4) BORE HOLE CONSTRUCTION

Special Standards Yes [ ] No [x] Depth of completed well 35 ft.



(5) WELL TEST:

- [ ] Pump
- [x] Bailer
- [ ] Air
- [ ] Flowing Artesian

Permeability Yield GPM

Conductivity PH

Temperature of water 14°C F/C Depth artesian flow found ft.

Was water analysis done? [x] Yes [ ] No

By whom? Geo. Engineers

Depth of strata to be analyzed. From 23 ft. to 35 ft.

Remarks:

Name of supervising Geologist/Engineer Nancy EAST

(6) LOCATION OF WELL By legal description

Well Location: County Lincoln

Township 7S (N or S) Range 11W (E or W) Section 11

1. SW 1/4 of NW 1/4 of above section.
2. Street address of well location 2510 U.S. Hwy 101 Lincoln City, OR
3. Tax lot number of well location 22043000
4. ATTACH MAP WITH LOCATION IDENTIFIED.

(7) STATIC WATER LEVEL:

23' Ft. below land surface. Date 12-28-92

Artesian Pressure lb/sq. in. Date

(8) WATER BEARING ZONES:

Depth at which water was first found 23'

From	To	Est. Flow Rate	SWL
23'	30'	?	23'

(9) WELL LOG:

Ground elevation

Material	From	To	SWL
Asphalt pavement	0"	6"	
Crushed medium to	6"	3'	
large angular gravel			
dense, moist			
Dark Brown silt w/	3'	8'	
trace organics, very			
stiff, moist			23'
Mottled tan & orange	8'	26'	
fractured siltstone			
very stiff to hard, moist			
weathered bedrock			
Gray Siltstone	26'	30'	
hard, wet			

Date started 12-28-92 Completed 12-28-92

(unbonded) Monitor Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.

MWC Number

Signed Date

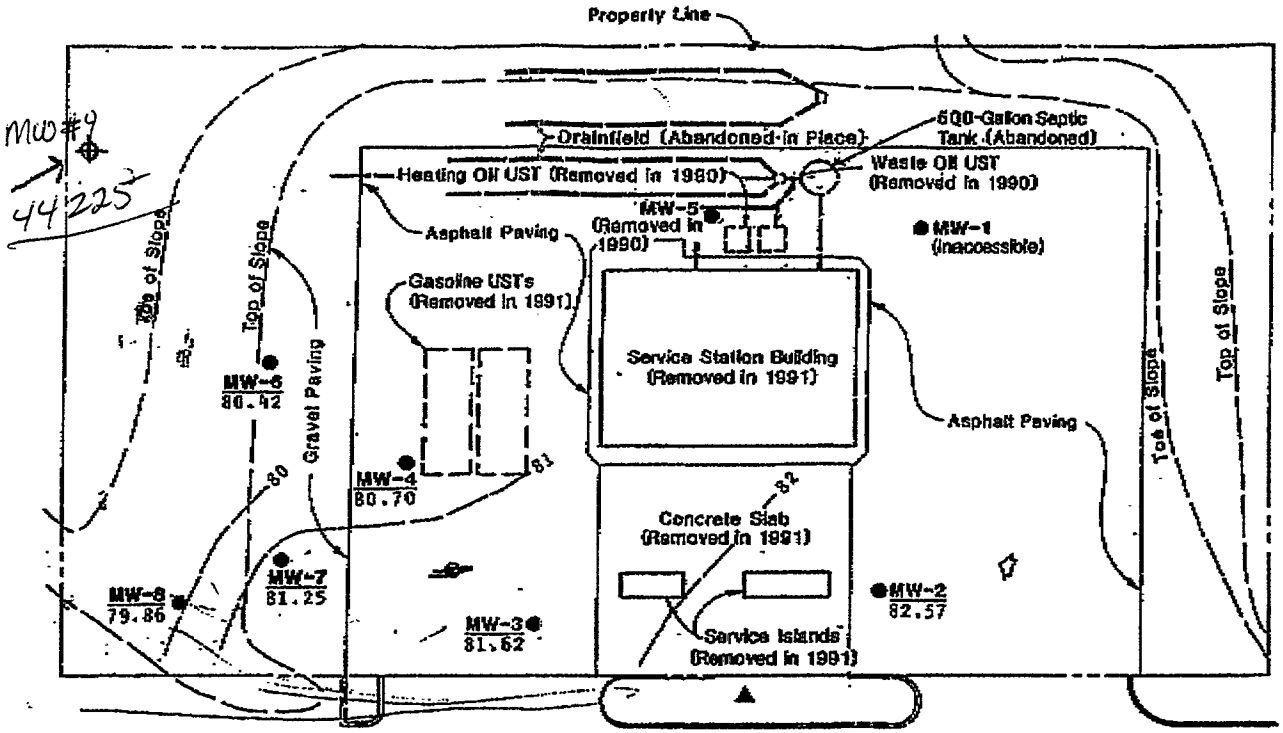
(bonded) Monitor Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon well construction standards. This report is true to the best of my knowledge and belief.

MWC Number 1001B

Signed Randy L. Ciuman Date 1-14-93

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER



0 20 40

SCALE IN FEET

EXPLANATION:

~~PROPOSED TEST WELL~~

PROPOSED MONITORING WELL

MW-4 / 80.70 MONITORING WELL GROUND WATER ELEVATION ON 04/10/92 (IN FEET)

APPROXIMATE DIRECTION OF GROUND WATER FLOW

BENCHMARK AT BASE OF METAL PIPE. ASSUMED ELEVATION AT 100.00 FEET.

82 GROUND WATER CONTOURS BASED ON 04/10/92 MEASUREMENTS

REFERENCE: DRAWING ENTITLED "GENERAL ARRANGEMENT, SERVICE STATION 4946, HWY 101 & SCENIC STREET, LINCOLN CITY, ORE.," DATED 7/2/62, BY UNOCAL.

GeoEngineers

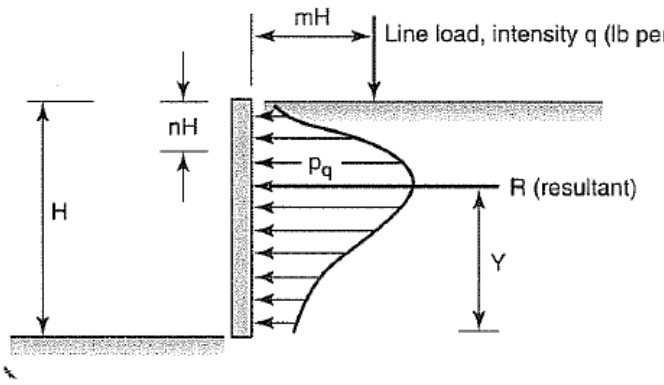
SITE PLAN

FIGURE 2

APPENDIX F:
LATERAL EARTH PRESSURES FOR WALL DESIGN

APPENDIX F: SURCHARGE-INDUCED LATERAL EARTH PRESSURES FOR WALL DESIGN

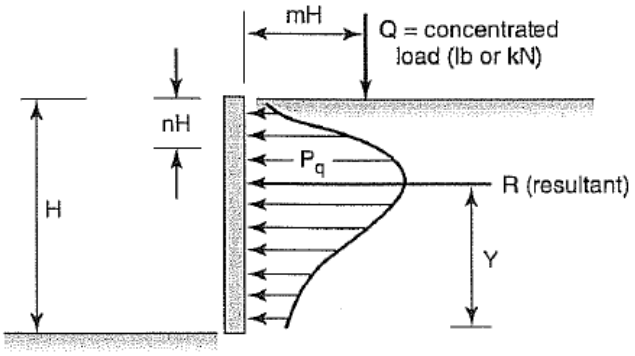
LINE LOAD (applicable for retaining walls not exceeding 20 feet in height):



m	R	Y
0.2	0.55q	0.60 H
0.4	0.55q	0.58 H
0.6	$\frac{0.64q}{m^2+1}$	0.52 H

Figure 16-28 Pressure distribution against vertical wall resulting from line load of intensity *q*.

CONCENTRATED POINT LOAD (applicable for retaining walls not exceeding 20 feet in height):



m	R	Y
0.2	$0.78\frac{Q}{H}$	0.59 H
0.4	$0.78\frac{Q}{H}$	0.59 H
0.6	$0.48\frac{Q}{H}$	0.48 H

Figure 16-27 Pressure distribution against vertical wall resulting from point load, *Q*.

AREAL LOAD:

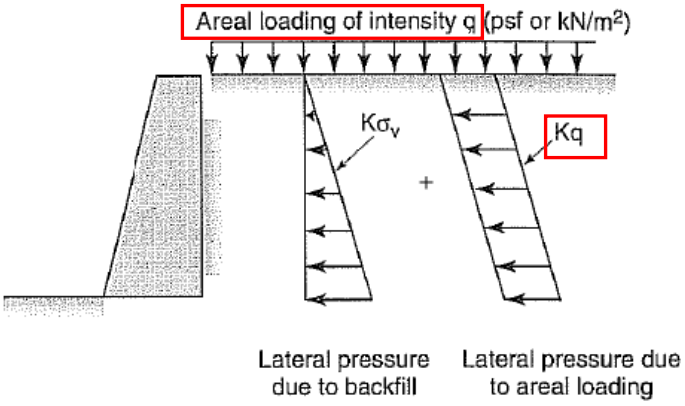
Figure 16-26 Influence of areal loading on wall pressures.

use K=0.4 for active condition (i.e. top of wall allowed to deflect laterally)

use K=0.9 for at-rest condition (i.e. top of wall not allowed to deflect laterally)

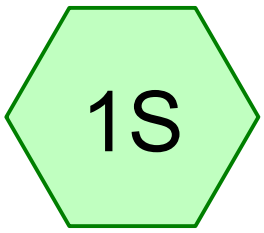
Resultant, R = K * q * H

Where H = wall height (feet)

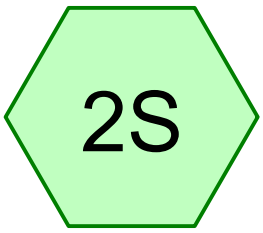


Source of Figures: McCarthy, D.F., 1998, "Essentials of Soil Mechanics and foundations, Basic Geotechnics, Fifth Edition."

Appendix F: HydroCAD Report



Existing Basin West



WEST 1

Subcat Reach Pond Link

Routing Diagram for 21-C018 (IHI - Lincoln City) - Discharge West
Prepared by Froelich Engineers, Printed 2/21/2022

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type IA 24-hr		Default	24.00	1	4.20	2
2	10-Year	Type IA 24-hr		Default	24.00	1	5.70	2
3	25-Year	Type IA 24-hr		Default	24.00	1	6.50	2

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: Existing Basin West Runoff Area=14,588 sf 0.00% Impervious Runoff Depth=1.46"
Tc=5.0 min CN=70/0 Runoff=0.097 cfs 1,781 cf

Subcatchment2S: WEST 1 Runoff Area=5,532 sf 35.85% Impervious Runoff Depth=2.54"
Tc=5.0 min CN=74/98 Runoff=0.075 cfs 1,171 cf

Total Runoff Area = 20,120 sf Runoff Volume = 2,952 cf Average Runoff Depth = 1.76"
90.14% Pervious = 18,137 sf 9.86% Impervious = 1,983 sf

Summary for Subcatchment 1S: Existing Basin West

~27% west

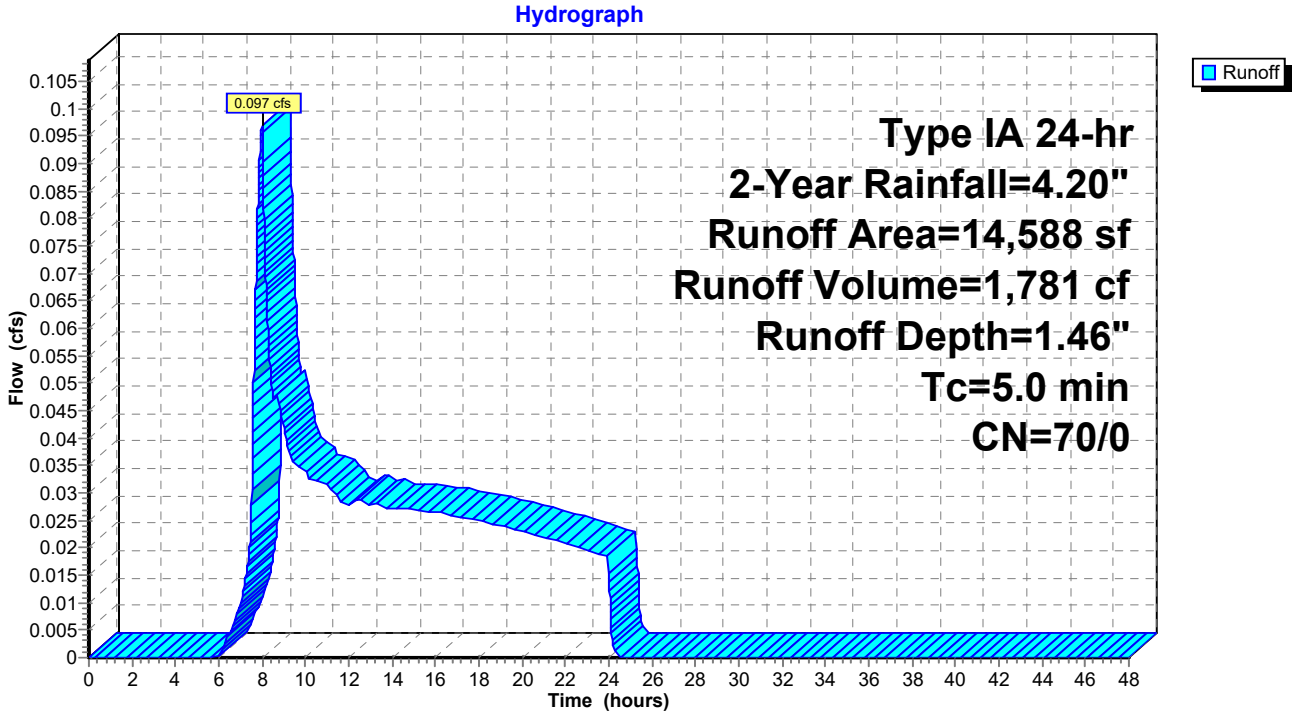
Runoff = 0.097 cfs @ 8.00 hrs, Volume= 1,781 cf, Depth= 1.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=4.20"

	Area (sf)	CN	Description
*	14,588	70	
	14,588	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Existing Basin West



Summary for Subcatchment 2S: WEST 1

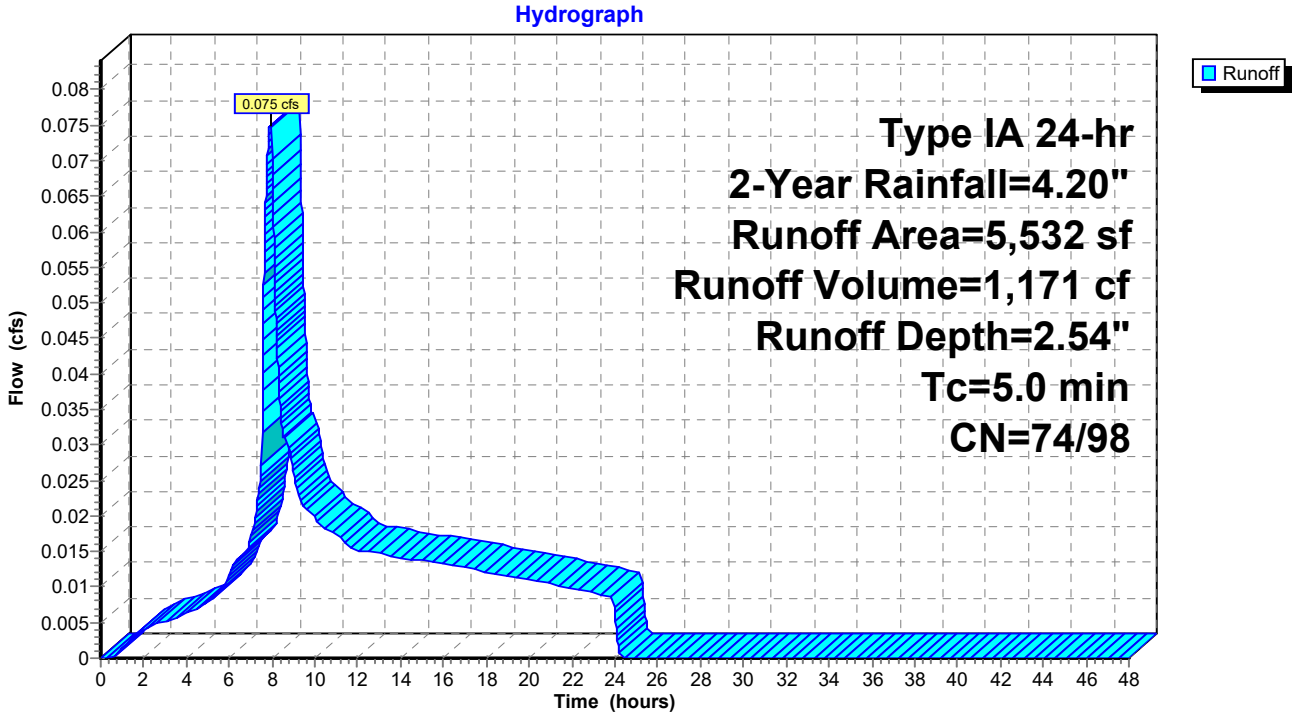
Runoff = 0.075 cfs @ 7.93 hrs, Volume= 1,171 cf, Depth= 2.54"
Routed to nonexistent node 4p

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=4.20"

Area (sf)	CN	Description
1,983	98	Paved parking, HSG C
3,549	74	>75% Grass cover, Good, HSG C
5,532	83	Weighted Average
3,549	74	64.15% Pervious Area
1,983	98	35.85% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: WEST 1



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: Existing Basin West Runoff Area=14,588 sf 0.00% Impervious Runoff Depth=2.57"
Tc=5.0 min CN=70/0 Runoff=0.193 cfs 3,123 cf

Subcatchment2S: WEST 1 Runoff Area=5,532 sf 35.85% Impervious Runoff Depth=3.84"
Tc=5.0 min CN=74/98 Runoff=0.117 cfs 1,770 cf

Total Runoff Area = 20,120 sf Runoff Volume = 4,894 cf Average Runoff Depth = 2.92"
90.14% Pervious = 18,137 sf 9.86% Impervious = 1,983 sf

Summary for Subcatchment 1S: Existing Basin West

~27% west

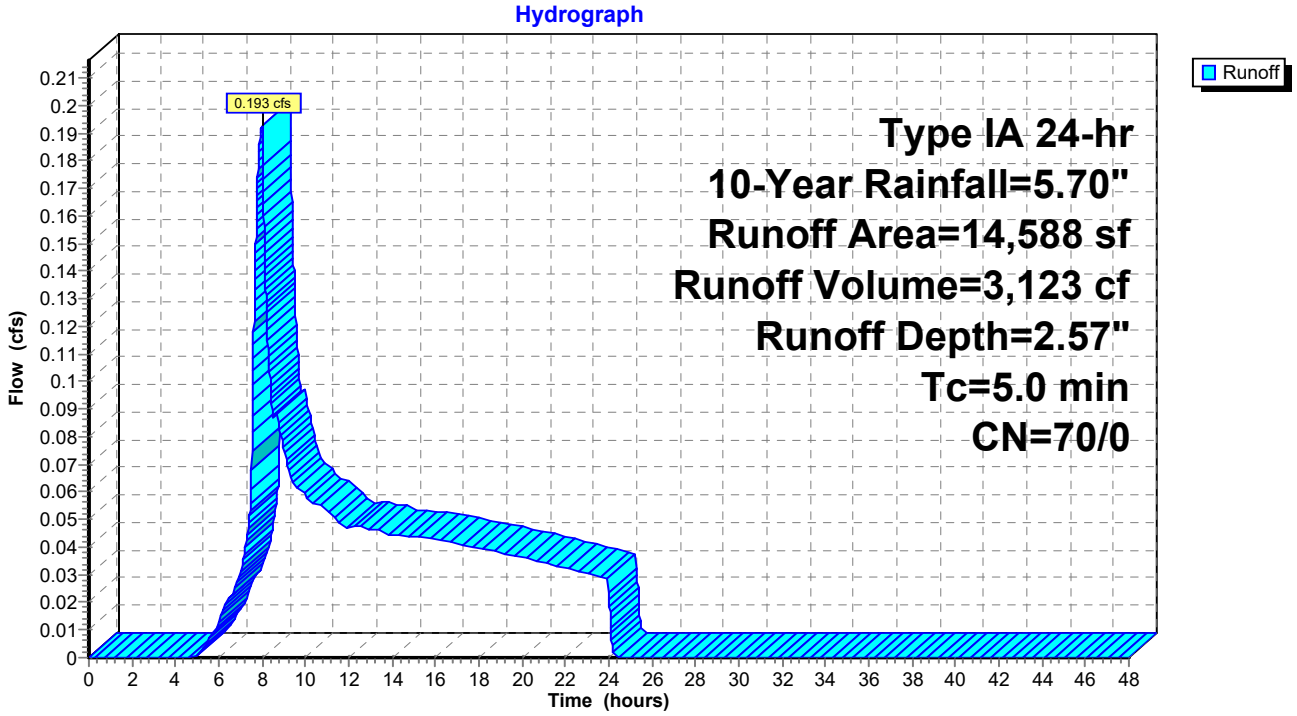
Runoff = 0.193 cfs @ 7.99 hrs, Volume= 3,123 cf, Depth= 2.57"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=5.70"

	Area (sf)	CN	Description
*	14,588	70	
	14,588	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Existing Basin West



Summary for Subcatchment 2S: WEST 1

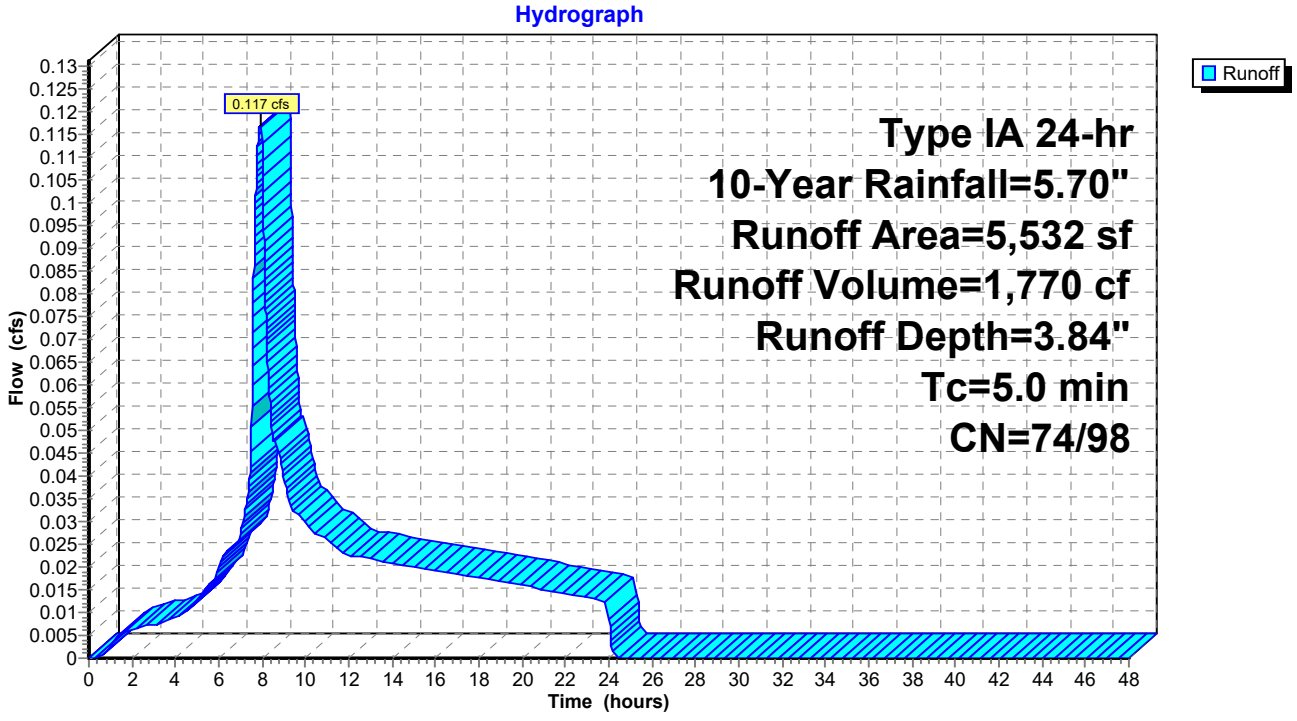
Runoff = 0.117 cfs @ 7.92 hrs, Volume= 1,770 cf, Depth= 3.84"
Routed to nonexistent node 4p

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=5.70"

Area (sf)	CN	Description
1,983	98	Paved parking, HSG C
3,549	74	>75% Grass cover, Good, HSG C
5,532	83	Weighted Average
3,549	74	64.15% Pervious Area
1,983	98	35.85% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: WEST 1



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: Existing Basin West Runoff Area=14,588 sf 0.00% Impervious Runoff Depth=3.21"
Tc=5.0 min CN=70/0 Runoff=0.250 cfs 3,899 cf

Subcatchment2S: WEST 1 Runoff Area=5,532 sf 35.85% Impervious Runoff Depth=4.56"
Tc=5.0 min CN=74/98 Runoff=0.141 cfs 2,102 cf

Total Runoff Area = 20,120 sf Runoff Volume = 6,001 cf Average Runoff Depth = 3.58"
90.14% Pervious = 18,137 sf 9.86% Impervious = 1,983 sf

Summary for Subcatchment 1S: Existing Basin West

~27% west

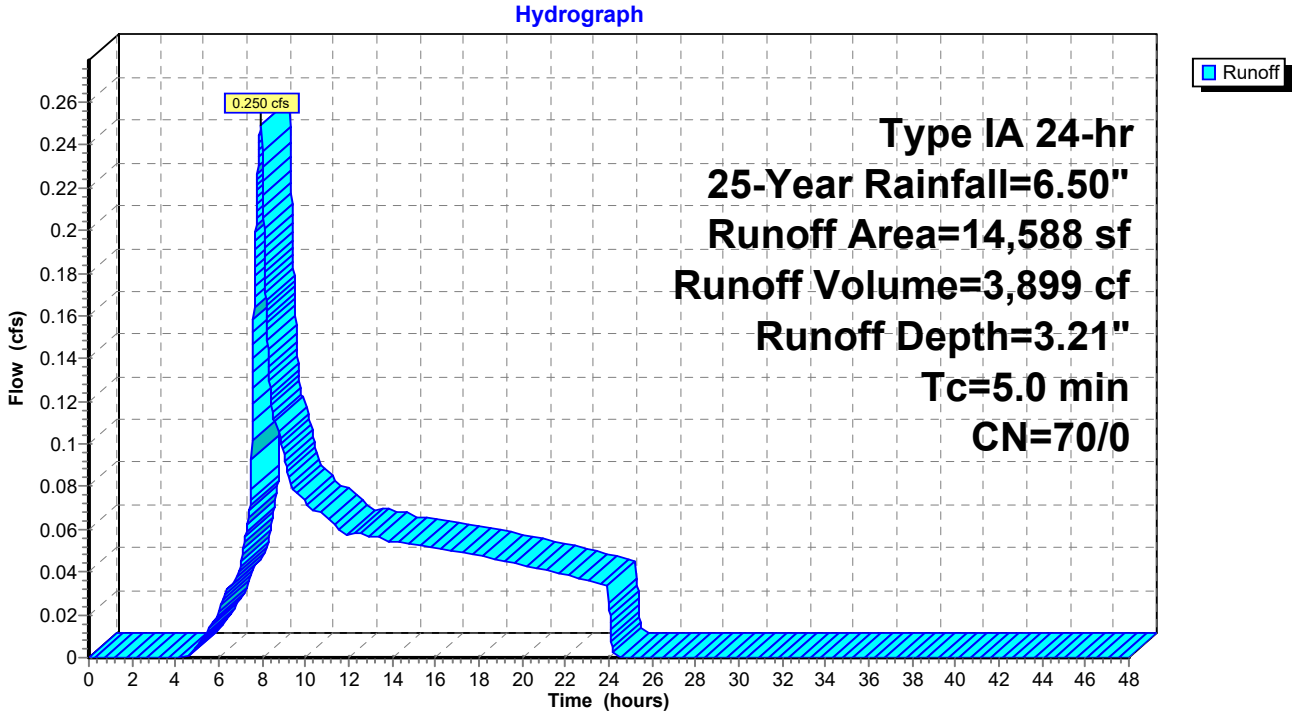
Runoff = 0.250 cfs @ 7.97 hrs, Volume= 3,899 cf, Depth= 3.21"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	14,588	70	
	14,588	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Existing Basin West



Summary for Subcatchment 2S: WEST 1

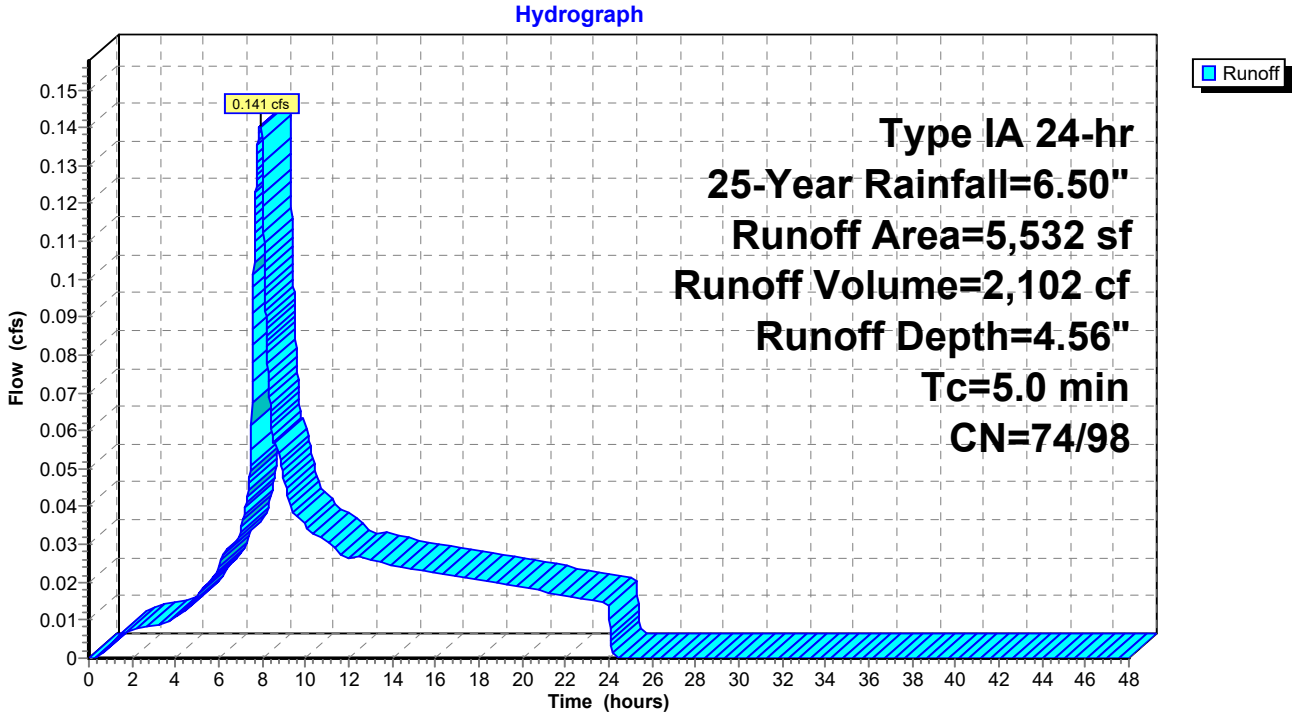
Runoff = 0.141 cfs @ 7.92 hrs, Volume= 2,102 cf, Depth= 4.56"
Routed to nonexistent node 4p

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

Area (sf)	CN	Description
1,983	98	Paved parking, HSG C
3,549	74	>75% Grass cover, Good, HSG C
5,532	83	Weighted Average
3,549	74	64.15% Pervious Area
1,983	98	35.85% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: WEST 1

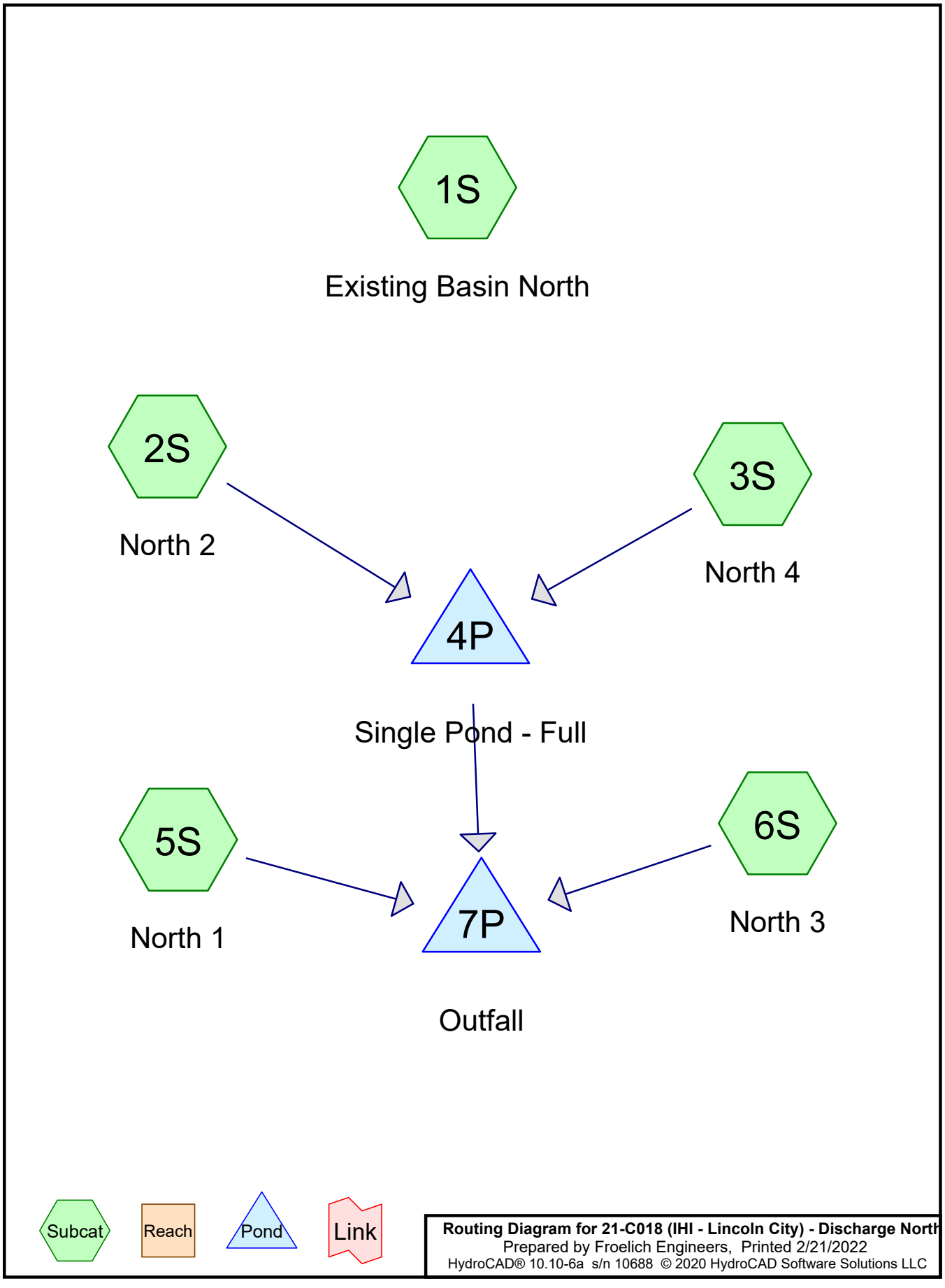


Events for Subcatchment 1S: Existing Basin West

Event	Rainfall (inches)	Runoff (cfs)	Volume (cubic-feet)	Depth (inches)
2-Year	4.20	0.097	1,781	1.46
10-Year	5.70	0.193	3,123	2.57
25-Year	**6.50**	**0.250**	**3,899**	**3.21**

Events for Subcatchment 2S: WEST 1

Event	Rainfall (inches)	Runoff (cfs)	Volume (cubic-feet)	Depth (inches)
2-Year	4.20	0.075	1,171	2.54
10-Year	5.70	0.117	1,770	3.84
25-Year	**6.50**	**0.141**	**2,102**	**4.56**



Routing Diagram for 21-C018 (IHI - Lincoln City) - Discharge North
Prepared by Froelich Engineers, Printed 2/21/2022

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type IA 24-hr		Default	24.00	1	4.20	2
2	10-Year	Type IA 24-hr		Default	24.00	1	5.70	2
3	25-Year	Type IA 24-hr		Default	24.00	1	6.50	2

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: Existing Basin North Runoff Area=127,624 sf 0.00% Impervious Runoff Depth=1.46"
Tc=5.0 min CN=70/0 Runoff=0.851 cfs 15,579 cf

Subcatchment2S: North 2 Runoff Area=24,871 sf 90.61% Impervious Runoff Depth=3.76"
Tc=5.0 min CN=74/98 Runoff=0.531 cfs 7,785 cf

Subcatchment3S: North 4 Runoff Area=14,116 sf 86.67% Impervious Runoff Depth=3.67"
Tc=5.0 min CN=74/98 Runoff=0.293 cfs 4,316 cf

Pond 4P: Single Pond - Full Peak Elev=2.03' Storage=896 cf Inflow=0.824 cfs 12,101 cf
Outflow=0.505 cfs 12,100 cf

Subcatchment5S: North 1 Runoff Area=28,293 sf 0.00% Impervious Runoff Depth=1.46"
Tc=5.0 min CN=70/0 Runoff=0.189 cfs 3,454 cf

Subcatchment6S: North 3 Runoff Area=10,538 sf 58.45% Impervious Runoff Depth=3.04"
Tc=5.0 min CN=74/98 Runoff=0.176 cfs 2,671 cf

Pond 7P: Outfall Inflow=0.847 cfs 18,225 cf
Primary=0.847 cfs 18,225 cf

Total Runoff Area = 205,442 sf Runoff Volume = 33,805 cf Average Runoff Depth = 1.97"
80.08% Pervious = 164,513 sf 19.92% Impervious = 40,929 sf

Summary for Subcatchment 1S: Existing Basin North

~27% west

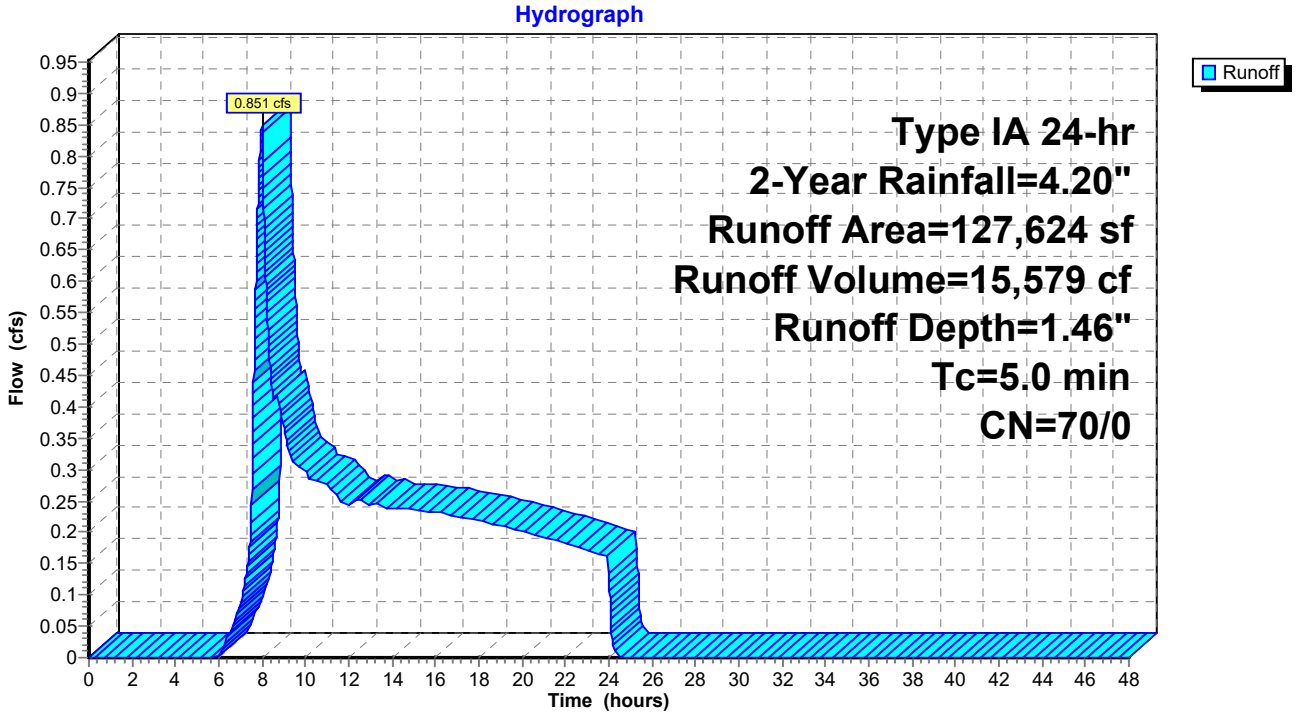
Runoff = 0.851 cfs @ 8.00 hrs, Volume= 15,579 cf, Depth= 1.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=4.20"

Area (sf)	CN	Description
127,624	70	Woods, Good, HSG C
127,624	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Existing Basin North



Summary for Subcatchment 2S: North 2

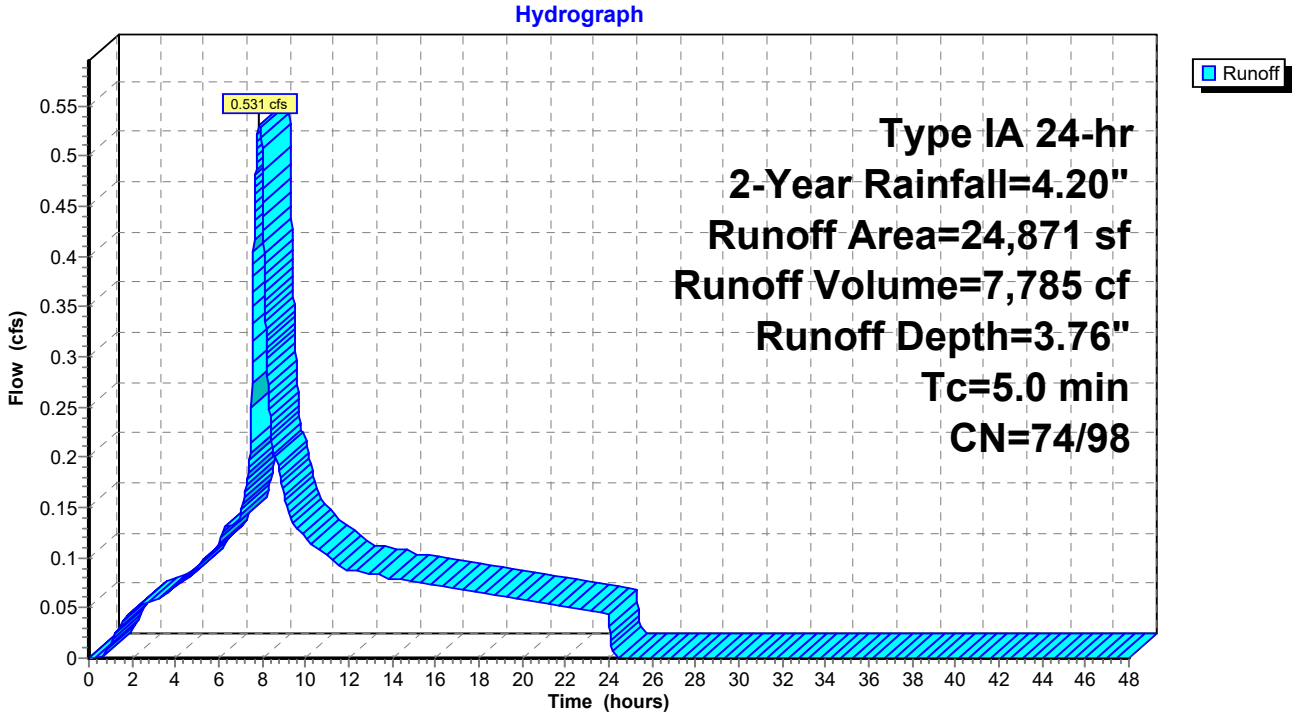
Runoff = 0.531 cfs @ 7.88 hrs, Volume= 7,785 cf, Depth= 3.76"
Routed to Pond 4P : Single Pond - Full

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=4.20"

	Area (sf)	CN	Description
*	2,336	74	
*	22,535	98	
	24,871	96	Weighted Average
	2,336	74	9.39% Pervious Area
	22,535	98	90.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: North 2



Summary for Subcatchment 3S: North 4

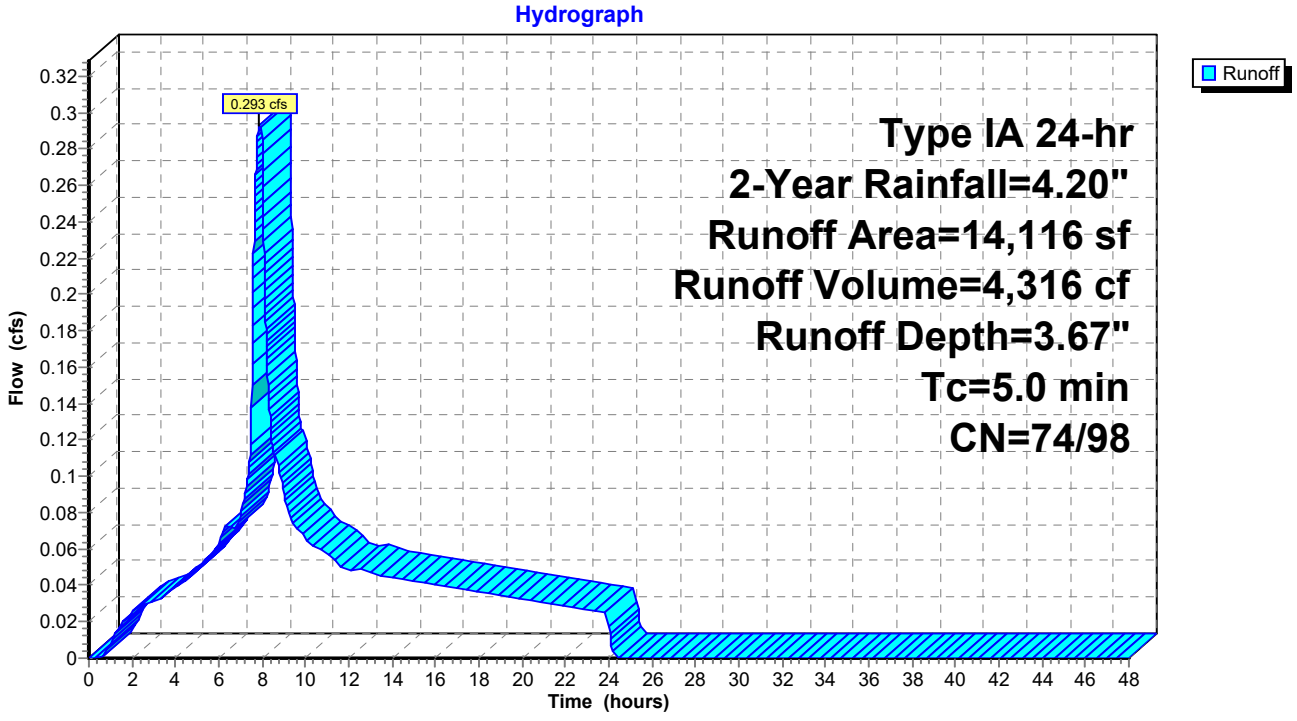
Runoff = 0.293 cfs @ 7.88 hrs, Volume= 4,316 cf, Depth= 3.67"
Routed to Pond 4P : Single Pond - Full

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=4.20"

	Area (sf)	CN	Description
	1,881	74	
*	12,235	98	
	14,116	95	Weighted Average
	1,881	74	13.33% Pervious Area
	12,235	98	86.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: North 4



Summary for Pond 4P: Single Pond - Full

Inflow Area = 38,987 sf, 89.18% Impervious, Inflow Depth = 3.72" for 2-Year event
Inflow = 0.824 cfs @ 7.88 hrs, Volume= 12,101 cf
Outflow = 0.505 cfs @ 8.17 hrs, Volume= 12,100 cf, Atten= 39%, Lag= 17.5 min
Primary = 0.505 cfs @ 8.17 hrs, Volume= 12,100 cf
Routed to Pond 7P : Outfall

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 2.03' @ 8.17 hrs Surf.Area= 850 sf Storage= 896 cf

Plug-Flow detention time= 15.9 min calculated for 12,100 cf (100% of inflow)
Center-of-Mass det. time= 15.8 min (682.8 - 667.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	1,005 cf	**17.00'W x 50.00'L x 4.50'H Field A** 3,825 cf Overall - 1,311 cf Embedded = 2,514 cf x 40.0% Voids
#2A	0.50'	1,051 cf	**ADS N-12 36"** x 6 Inside #1 Inside= 36.1"W x 36.1"H => 7.10 sf x 20.00'L = 142.0 cf Outside= 42.0"W x 42.0"H => 8.86 sf x 20.00'L = 177.2 cf 6 Chambers in 3 Rows 14.00' Header x 7.10 sf x 2 = 198.8 cf Inside
		2,056 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**3.75" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	2.75'	**6.00" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.505 cfs @ 8.17 hrs HW=2.03' TW=0.00' (Dynamic Tailwater)
1=Orifice/Grate (Orifice Controls 0.505 cfs @ 6.58 fps)
2=Orifice/Grate (Controls 0.000 cfs)

Pond 4P: Single Pond - Full - Chamber Wizard Field A

Chamber Model = ADS N-12 36" (ADS N-12® Pipe)
Inside= 36.1"W x 36.1"H => 7.10 sf x 20.00'L = 142.0 cf
Outside= 42.0"W x 42.0"H => 8.86 sf x 20.00'L = 177.2 cf

42.0" Wide + 21.0" Spacing = 63.0" C-C Row Spacing

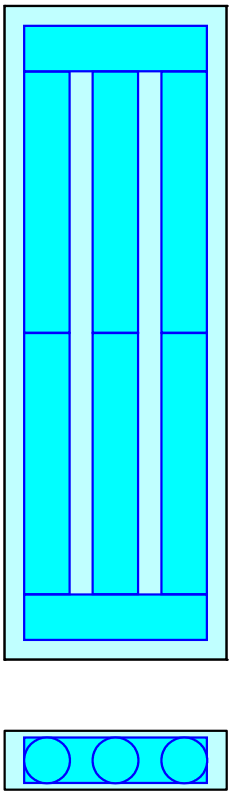
2 Chambers/Row x 20.00' Long +3.50' Header x 2 = 47.00' Row Length +18.0" End Stone x 2 = 50.00' Base Length
3 Rows x 42.0" Wide + 21.0" Spacing x 2 + 18.0" Side Stone x 2 = 17.00' Base Width
6.0" Stone Base + 42.0" Chamber Height + 6.0" Stone Cover = 4.50' Field Height

6 Chambers x 142.0 cf + 14.00' Header x 7.10 sf x 2 = 1,050.8 cf Chamber Storage
6 Chambers x 177.2 cf + 14.00' Header x 8.86 sf x 2 = 1,311.4 cf Displacement

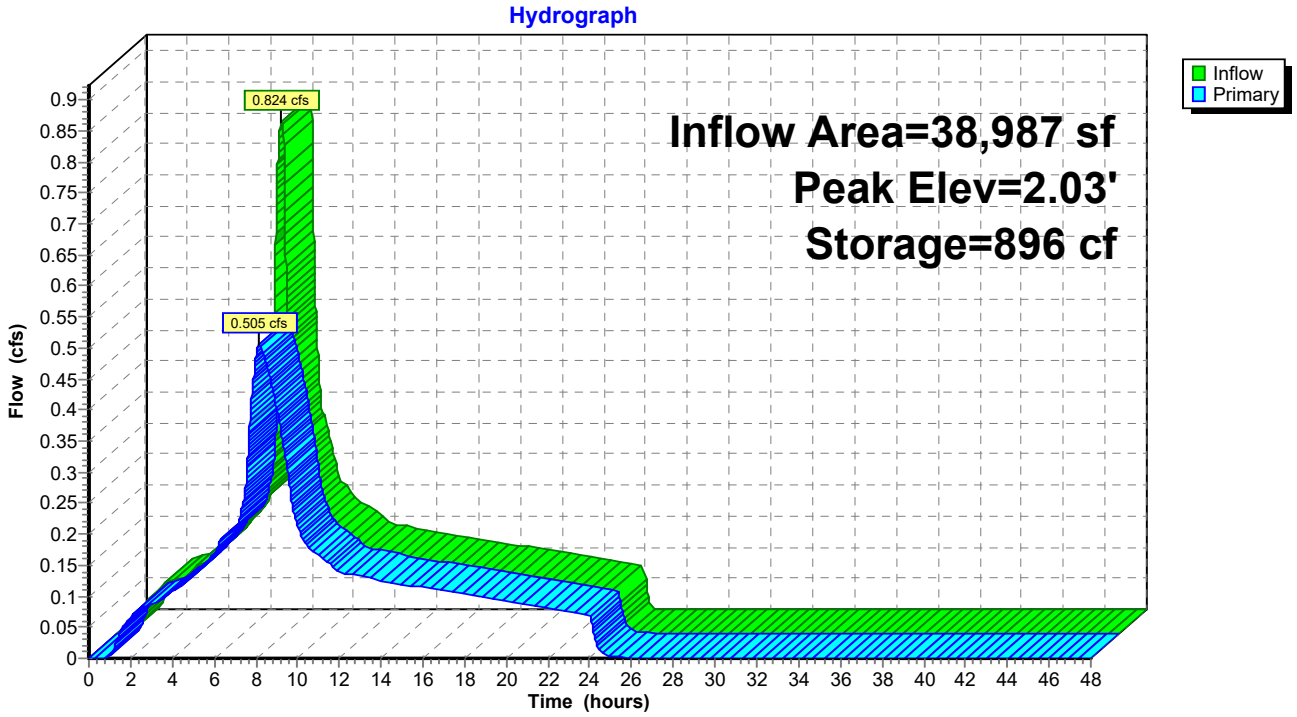
3,825.0 cf Field - 1,311.4 cf Chambers = 2,513.6 cf Stone x 40.0% Voids = 1,005.4 cf Stone Storage

Chamber Storage + Stone Storage = 2,056.2 cf = 0.047 af
Overall Storage Efficiency = 53.8%
Overall System Size = 50.00' x 17.00' x 4.50'

6 Chambers
141.7 cy Field
93.1 cy Stone



Pond 4P: Single Pond - Full



Summary for Subcatchment 5S: North 1

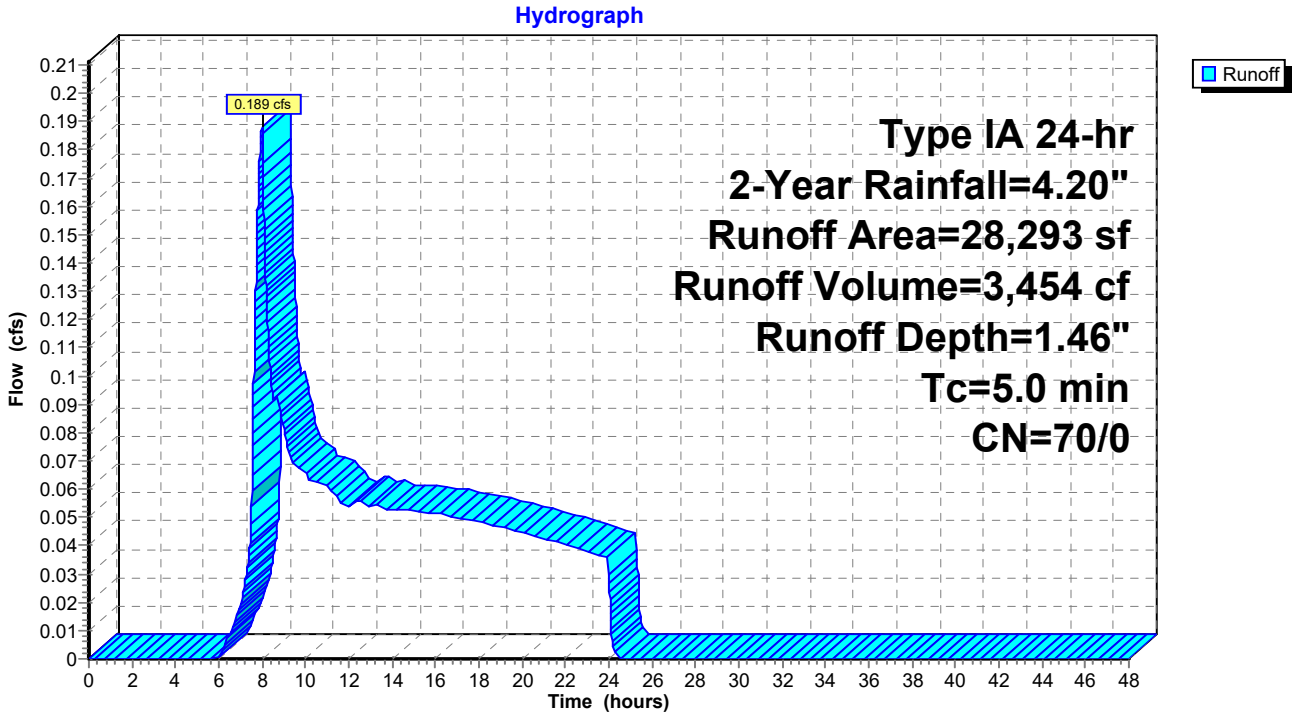
Runoff = 0.189 cfs @ 8.00 hrs, Volume= 3,454 cf, Depth= 1.46"
Routed to Pond 7P : Outfall

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=4.20"

	Area (sf)	CN	Description
*	28,293	70	
	28,293	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: North 1



Summary for Subcatchment 6S: North 3

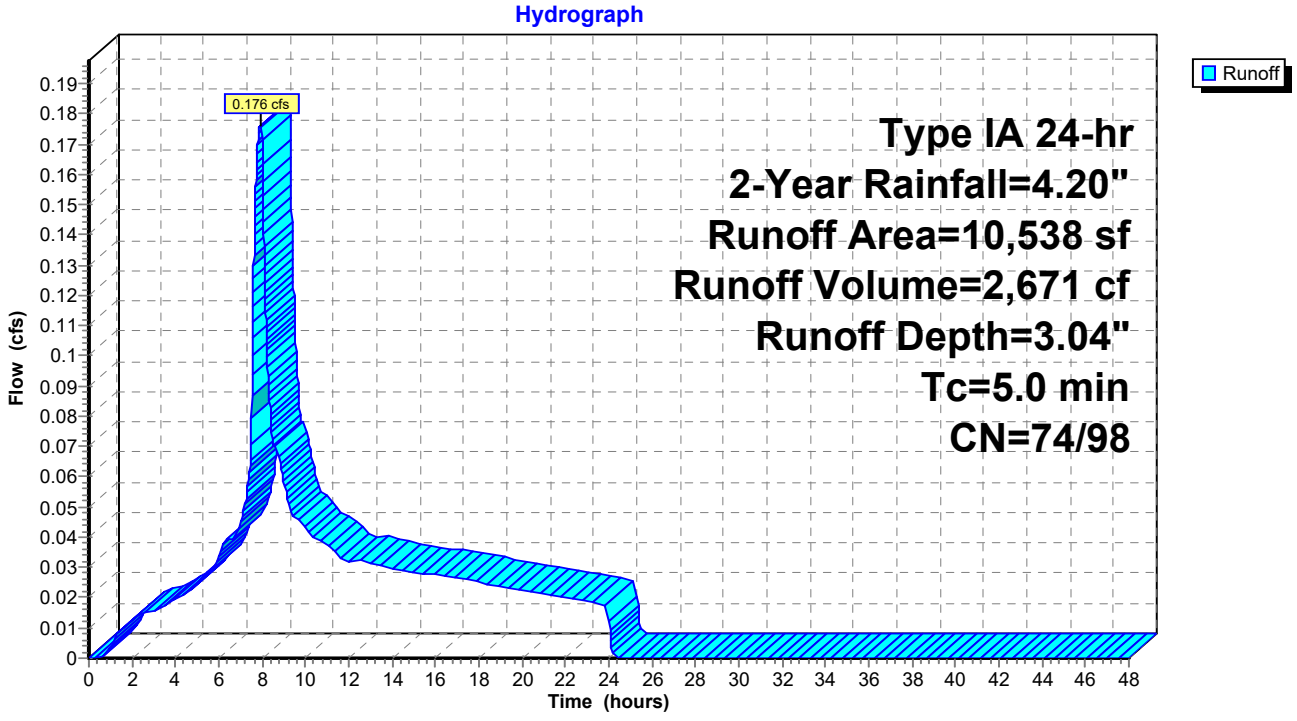
Runoff = 0.176 cfs @ 7.91 hrs, Volume= 2,671 cf, Depth= 3.04"
Routed to Pond 7P : Outfall

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=4.20"

	Area (sf)	CN	Description
*	4,379	74	
*	6,159	98	
	10,538	88	Weighted Average
	4,379	74	41.55% Pervious Area
	6,159	98	58.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: North 3

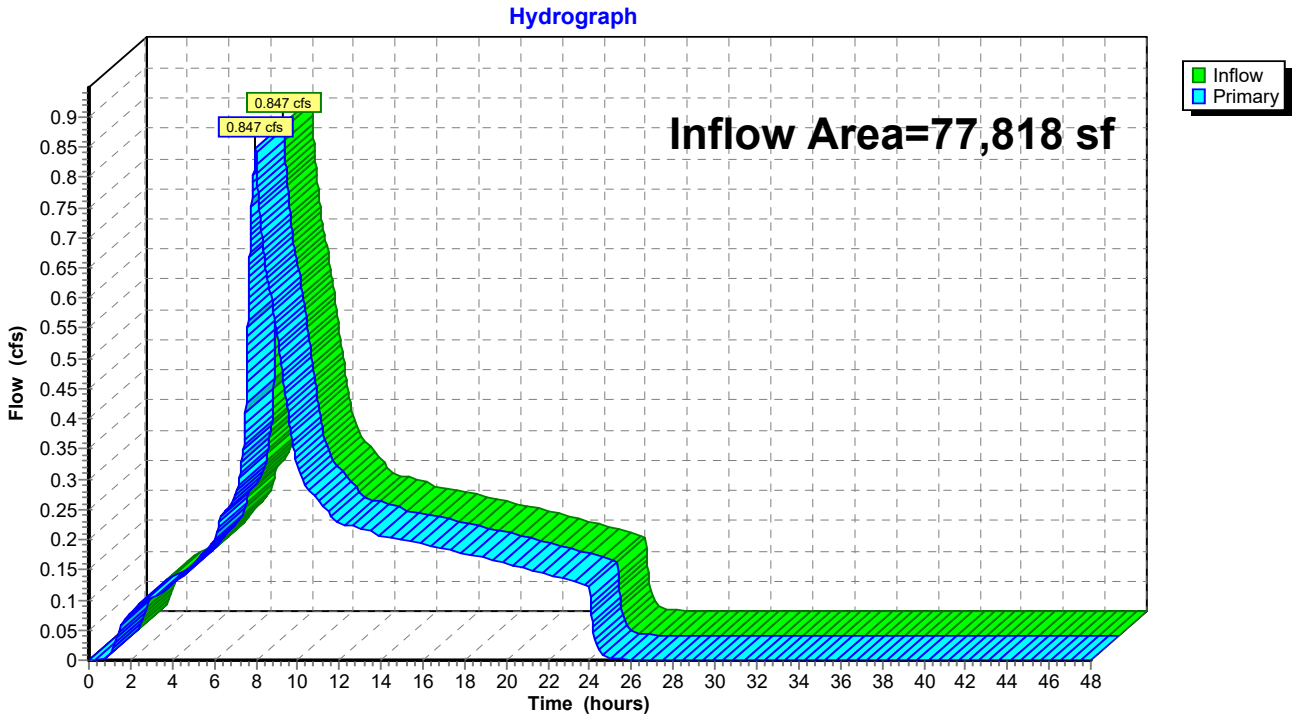


Summary for Pond 7P: Outfall

Inflow Area = 77,818 sf, 52.60% Impervious, Inflow Depth = 2.81" for 2-Year event
Inflow = 0.847 cfs @ 8.00 hrs, Volume= 18,225 cf
Primary = 0.847 cfs @ 8.00 hrs, Volume= 18,225 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Pond 7P: Outfall



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: Existing Basin North Runoff Area=127,624 sf 0.00% Impervious Runoff Depth=2.57"
Tc=5.0 min CN=70/0 Runoff=1.690 cfs 27,324 cf

Subcatchment2S: North 2 Runoff Area=24,871 sf 90.61% Impervious Runoff Depth=5.22"
Tc=5.0 min CN=74/98 Runoff=0.735 cfs 10,829 cf

Subcatchment3S: North 4 Runoff Area=14,116 sf 86.67% Impervious Runoff Depth=5.13"
Tc=5.0 min CN=74/98 Runoff=0.408 cfs 6,029 cf

Pond 4P: Single Pond - Full Peak Elev=2.86' Storage=1,387 cf Inflow=1.143 cfs 16,858 cf
Outflow=0.803 cfs 16,857 cf

Subcatchment5S: North 1 Runoff Area=28,293 sf 0.00% Impervious Runoff Depth=2.57"
Tc=5.0 min CN=70/0 Runoff=0.375 cfs 6,058 cf

Subcatchment6S: North 3 Runoff Area=10,538 sf 58.45% Impervious Runoff Depth=4.41"
Tc=5.0 min CN=74/98 Runoff=0.259 cfs 3,874 cf

Pond 7P: Outfall Inflow=1.287 cfs 26,789 cf
Primary=1.287 cfs 26,789 cf

Total Runoff Area = 205,442 sf Runoff Volume = 54,114 cf Average Runoff Depth = 3.16"
80.08% Pervious = 164,513 sf 19.92% Impervious = 40,929 sf

Summary for Subcatchment 1S: Existing Basin North

~27% west

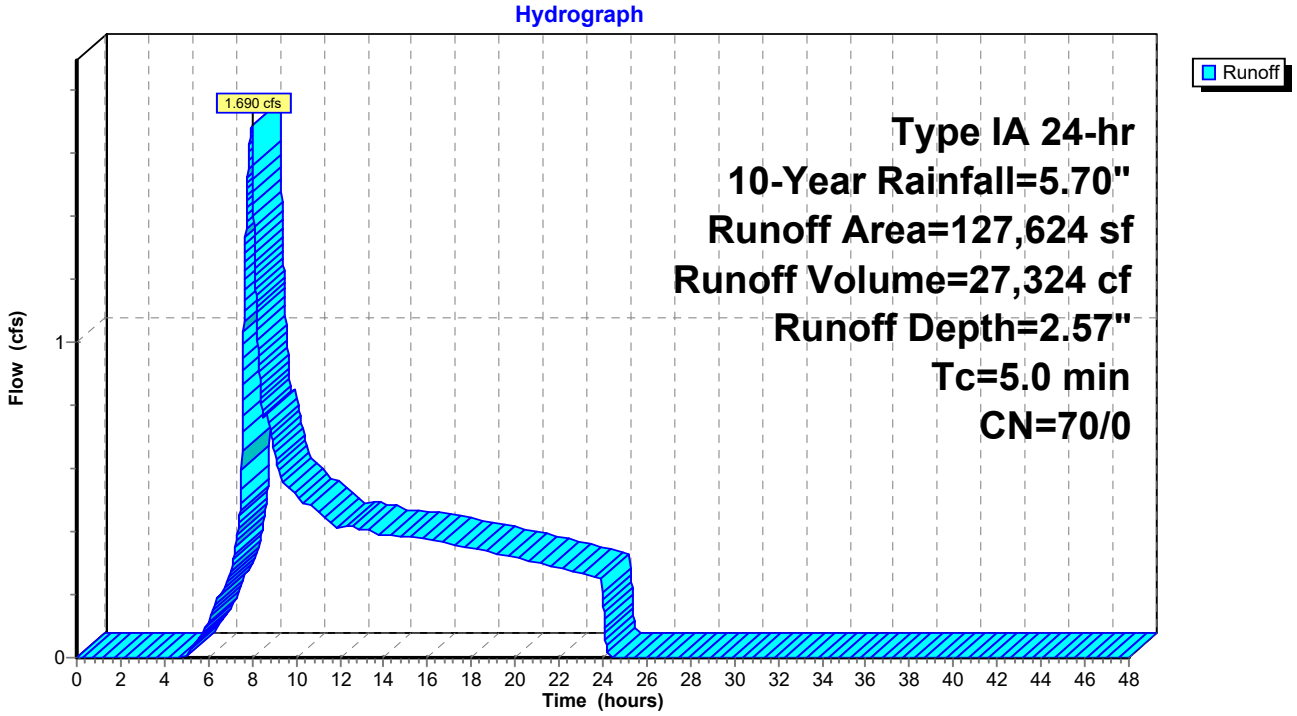
Runoff = 1.690 cfs @ 7.99 hrs, Volume= 27,324 cf, Depth= 2.57"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=5.70"

Area (sf)	CN	Description
127,624	70	Woods, Good, HSG C
127,624	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Existing Basin North



Summary for Subcatchment 2S: North 2

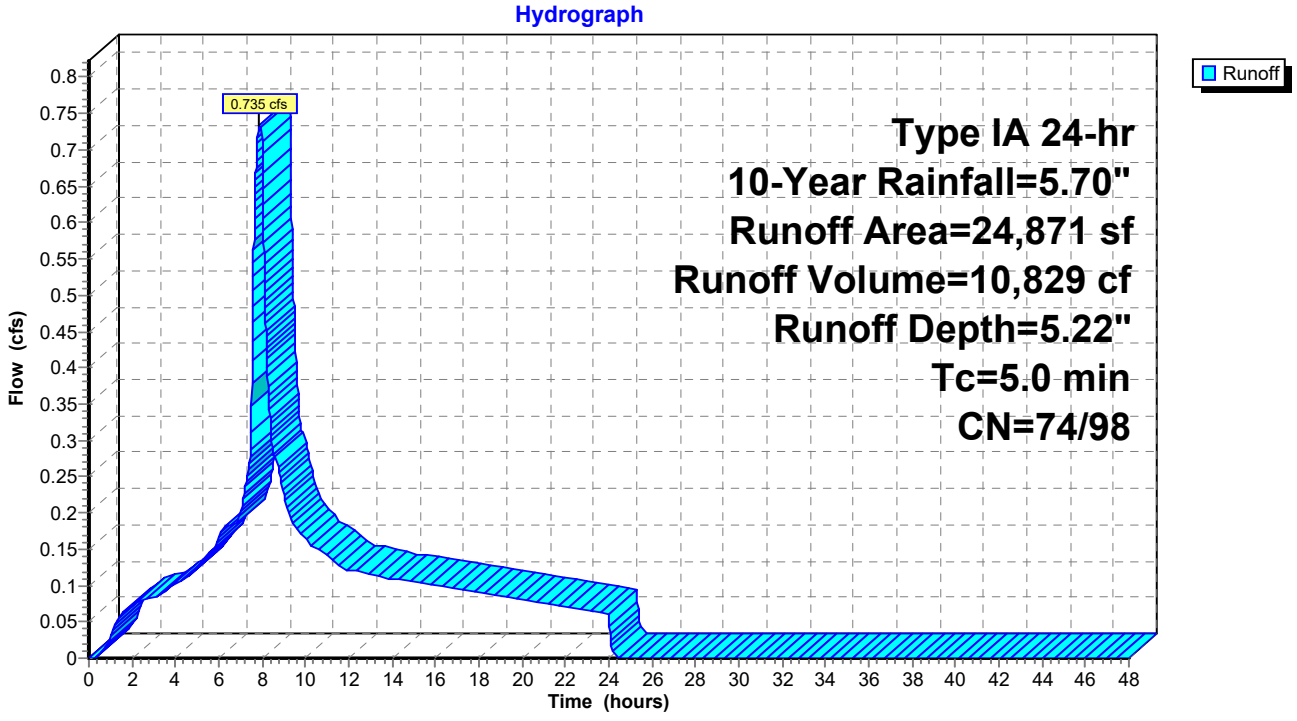
Runoff = 0.735 cfs @ 7.88 hrs, Volume= 10,829 cf, Depth= 5.22"
Routed to Pond 4P : Single Pond - Full

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=5.70"

	Area (sf)	CN	Description
*	2,336	74	
*	22,535	98	
	24,871	96	Weighted Average
	2,336	74	9.39% Pervious Area
	22,535	98	90.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: North 2



Summary for Subcatchment 3S: North 4

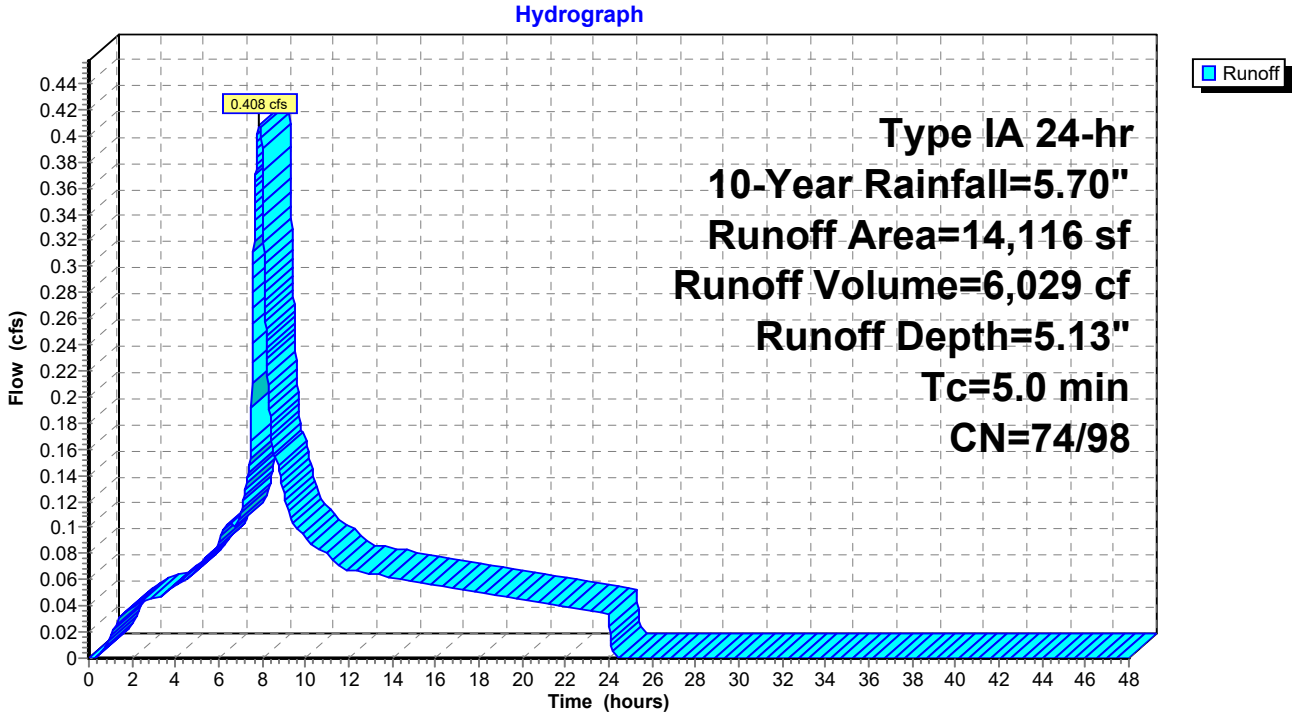
Runoff = 0.408 cfs @ 7.88 hrs, Volume= 6,029 cf, Depth= 5.13"
Routed to Pond 4P : Single Pond - Full

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=5.70"

	Area (sf)	CN	Description
	1,881	74	
*	12,235	98	
	14,116	95	Weighted Average
	1,881	74	13.33% Pervious Area
	12,235	98	86.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: North 4



Summary for Pond 4P: Single Pond - Full

Inflow Area = 38,987 sf, 89.18% Impervious, Inflow Depth = 5.19" for 10-Year event
Inflow = 1.143 cfs @ 7.88 hrs, Volume= 16,858 cf
Outflow = 0.803 cfs @ 8.11 hrs, Volume= 16,857 cf, Atten= 30%, Lag= 13.8 min
Primary = 0.803 cfs @ 8.11 hrs, Volume= 16,857 cf
Routed to Pond 7P : Outfall

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 2.86' @ 8.11 hrs Surf.Area= 850 sf Storage= 1,387 cf

Plug-Flow detention time= 17.7 min calculated for 16,854 cf (100% of inflow)
Center-of-Mass det. time= 17.7 min (678.8 - 661.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	1,005 cf	**17.00'W x 50.00'L x 4.50'H Field A** 3,825 cf Overall - 1,311 cf Embedded = 2,514 cf x 40.0% Voids
#2A	0.50'	1,051 cf	**ADS N-12 36"** x 6 Inside #1 Inside= 36.1"W x 36.1"H => 7.10 sf x 20.00'L = 142.0 cf Outside= 42.0"W x 42.0"H => 8.86 sf x 20.00'L = 177.2 cf 6 Chambers in 3 Rows 14.00' Header x 7.10 sf x 2 = 198.8 cf Inside
		2,056 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**3.75" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	2.75'	**6.00" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.803 cfs @ 8.11 hrs HW=2.86' TW=0.00' (Dynamic Tailwater)
1=Orifice/Grate (Orifice Controls 0.608 cfs @ 7.92 fps)
2=Orifice/Grate (Weir Controls 0.195 cfs @ 1.10 fps)

Pond 4P: Single Pond - Full - Chamber Wizard Field A

Chamber Model = ADS N-12 36" (ADS N-12® Pipe)
Inside= 36.1"W x 36.1"H => 7.10 sf x 20.00'L = 142.0 cf
Outside= 42.0"W x 42.0"H => 8.86 sf x 20.00'L = 177.2 cf

42.0" Wide + 21.0" Spacing = 63.0" C-C Row Spacing

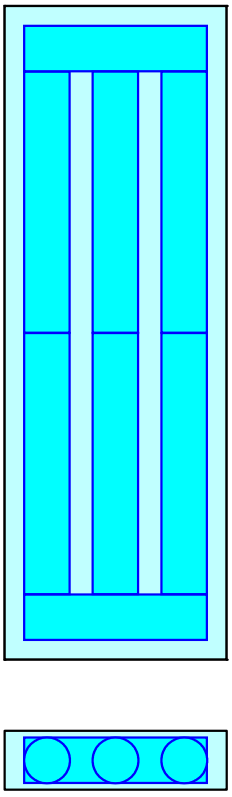
2 Chambers/Row x 20.00' Long +3.50' Header x 2 = 47.00' Row Length +18.0" End Stone x 2 = 50.00' Base Length
3 Rows x 42.0" Wide + 21.0" Spacing x 2 + 18.0" Side Stone x 2 = 17.00' Base Width
6.0" Stone Base + 42.0" Chamber Height + 6.0" Stone Cover = 4.50' Field Height

6 Chambers x 142.0 cf + 14.00' Header x 7.10 sf x 2 = 1,050.8 cf Chamber Storage
6 Chambers x 177.2 cf + 14.00' Header x 8.86 sf x 2 = 1,311.4 cf Displacement

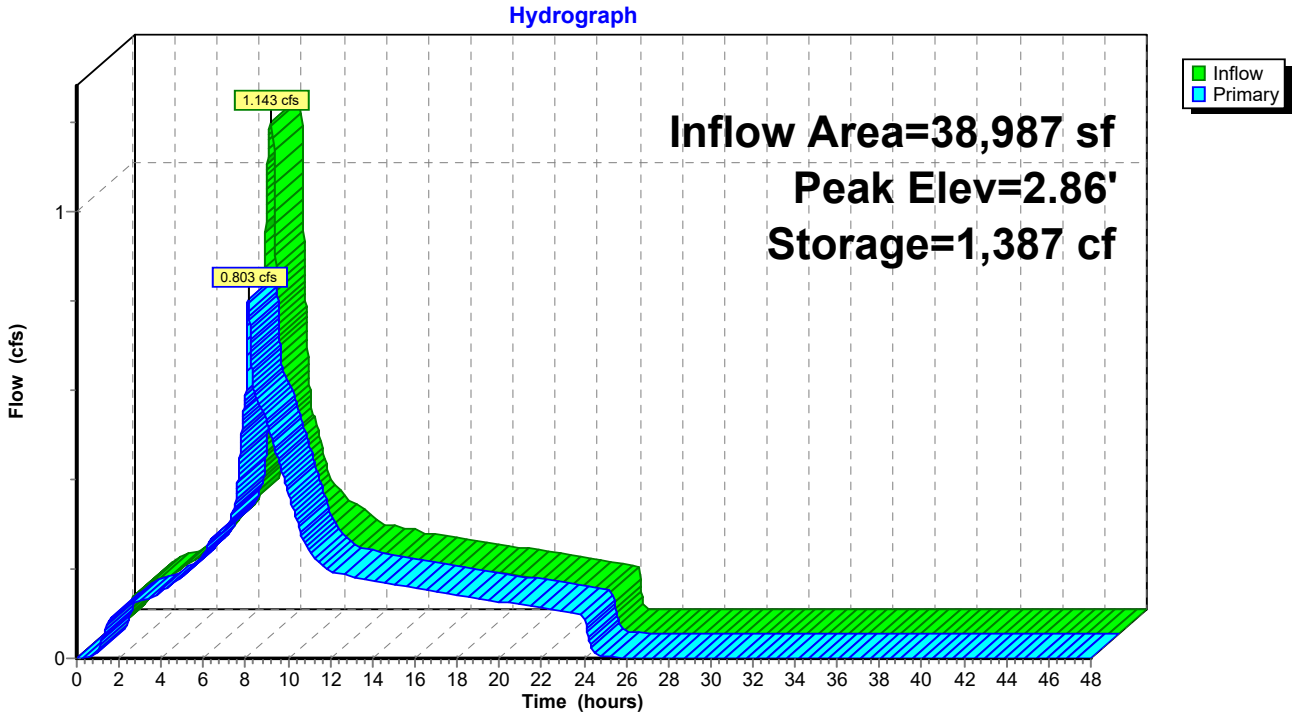
3,825.0 cf Field - 1,311.4 cf Chambers = 2,513.6 cf Stone x 40.0% Voids = 1,005.4 cf Stone Storage

Chamber Storage + Stone Storage = 2,056.2 cf = 0.047 af
Overall Storage Efficiency = 53.8%
Overall System Size = 50.00' x 17.00' x 4.50'

6 Chambers
141.7 cy Field
93.1 cy Stone



Pond 4P: Single Pond - Full



Summary for Subcatchment 5S: North 1

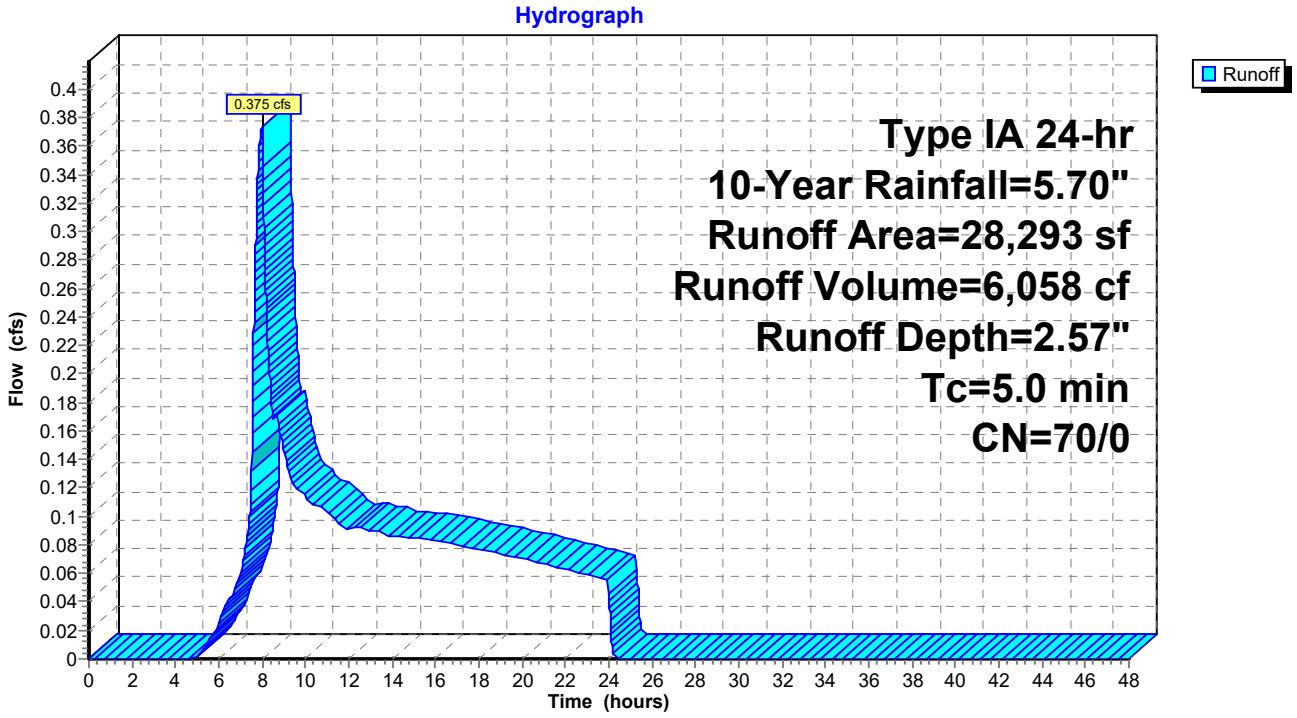
Runoff = 0.375 cfs @ 7.99 hrs, Volume= 6,058 cf, Depth= 2.57"
Routed to Pond 7P : Outfall

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=5.70"

	Area (sf)	CN	Description
*	28,293	70	
	28,293	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: North 1



Summary for Subcatchment 6S: North 3

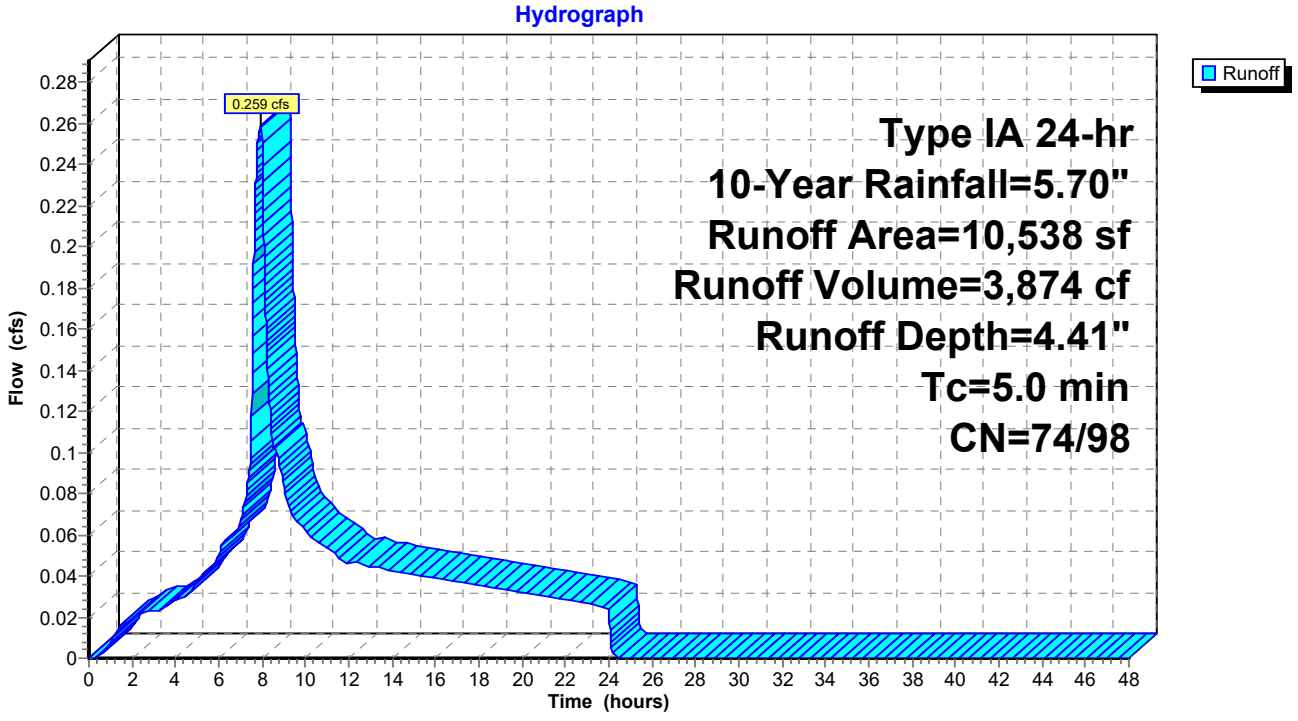
Runoff = 0.259 cfs @ 7.90 hrs, Volume= 3,874 cf, Depth= 4.41"
Routed to Pond 7P : Outfall

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=5.70"

	Area (sf)	CN	Description
*	4,379	74	
*	6,159	98	
	10,538	88	Weighted Average
	4,379	74	41.55% Pervious Area
	6,159	98	58.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: North 3

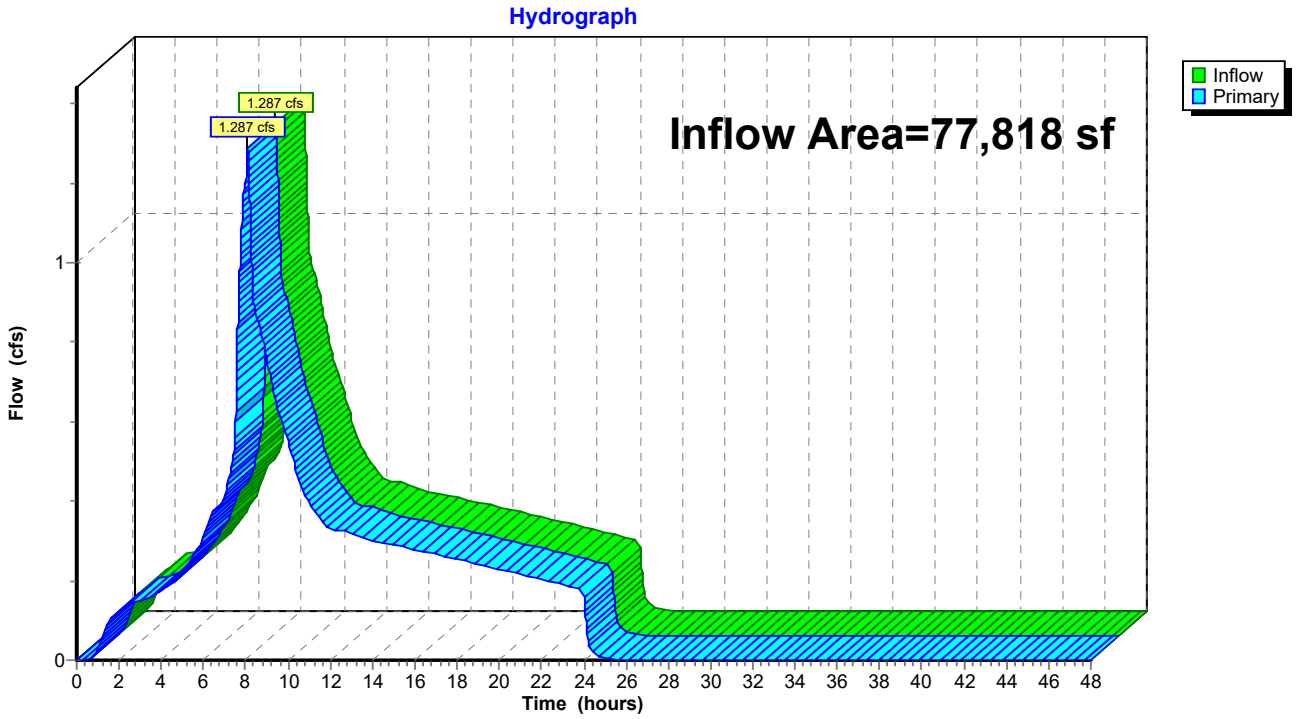


Summary for Pond 7P: Outfall

Inflow Area = 77,818 sf, 52.60% Impervious, Inflow Depth = 4.13" for 10-Year event
Inflow = 1.287 cfs @ 8.08 hrs, Volume= 26,789 cf
Primary = 1.287 cfs @ 8.08 hrs, Volume= 26,789 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Pond 7P: Outfall



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: Existing Basin North Runoff Area=127,624 sf 0.00% Impervious Runoff Depth=3.21"
Tc=5.0 min CN=70/0 Runoff=2.184 cfs 34,108 cf

Subcatchment2S: North 2 Runoff Area=24,871 sf 90.61% Impervious Runoff Depth=6.01"
Tc=5.0 min CN=74/98 Runoff=0.844 cfs 12,461 cf

Subcatchment3S: North 4 Runoff Area=14,116 sf 86.67% Impervious Runoff Depth=5.91"
Tc=5.0 min CN=74/98 Runoff=0.470 cfs 6,950 cf

Pond 4P: Single Pond - Full Peak Elev=3.03' Storage=1,478 cf Inflow=1.314 cfs 19,411 cf
Outflow=1.123 cfs 19,410 cf

Subcatchment5S: North 1 Runoff Area=28,293 sf 0.00% Impervious Runoff Depth=3.21"
Tc=5.0 min CN=70/0 Runoff=0.484 cfs 7,562 cf

Subcatchment6S: North 3 Runoff Area=10,538 sf 58.45% Impervious Runoff Depth=5.16"
Tc=5.0 min CN=74/98 Runoff=0.305 cfs 4,531 cf

Pond 7P: Outfall Inflow=1.881 cfs 31,503 cf
Primary=1.881 cfs 31,503 cf

Total Runoff Area = 205,442 sf Runoff Volume = 65,612 cf Average Runoff Depth = 3.83"
80.08% Pervious = 164,513 sf 19.92% Impervious = 40,929 sf

Summary for Subcatchment 1S: Existing Basin North

~27% west

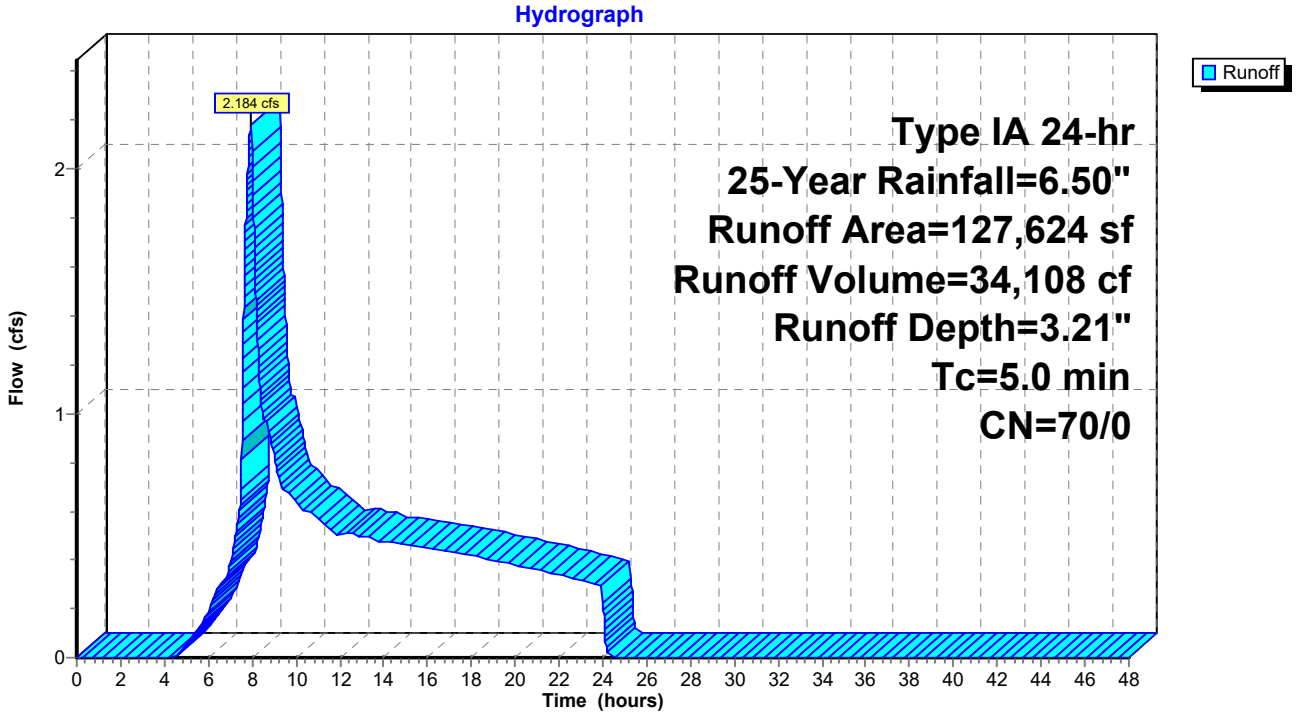
Runoff = 2.184 cfs @ 7.97 hrs, Volume= 34,108 cf, Depth= 3.21"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

Area (sf)	CN	Description
127,624	70	Woods, Good, HSG C
127,624	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Existing Basin North



Summary for Subcatchment 2S: North 2

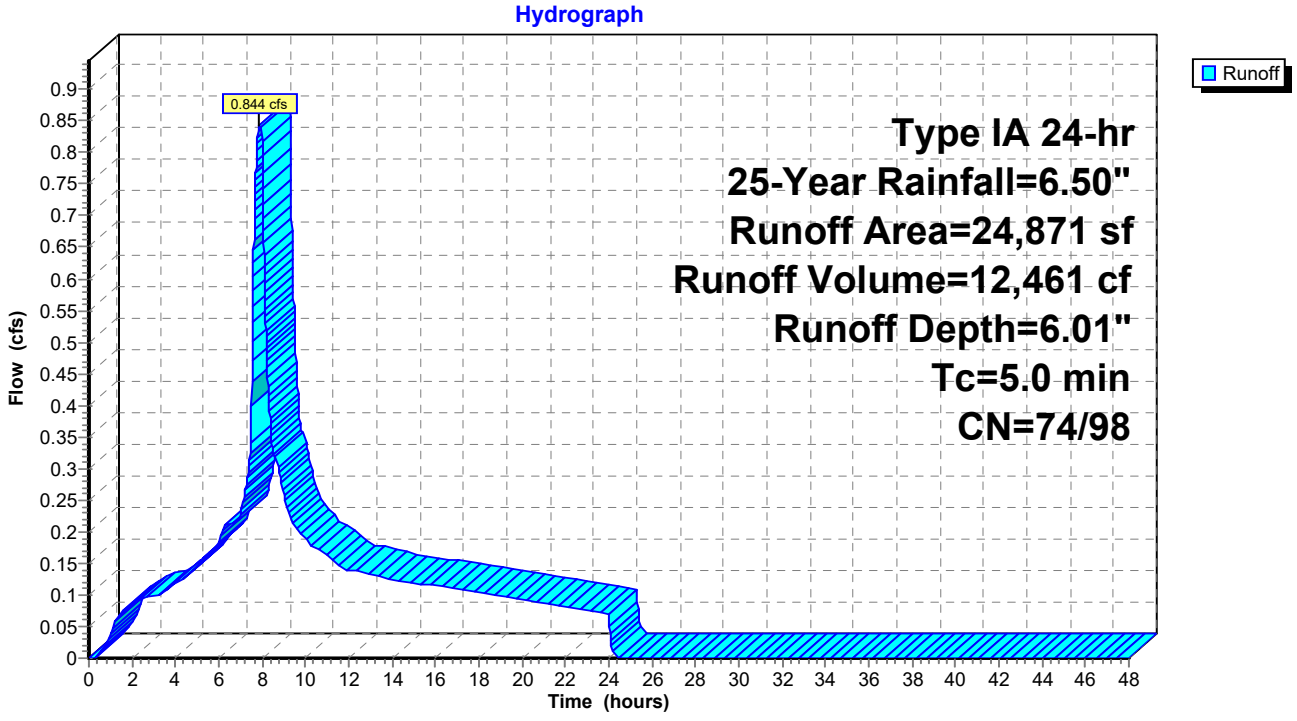
Runoff = 0.844 cfs @ 7.88 hrs, Volume= 12,461 cf, Depth= 6.01"
Routed to Pond 4P : Single Pond - Full

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	2,336	74	
*	22,535	98	
	24,871	96	Weighted Average
	2,336	74	9.39% Pervious Area
	22,535	98	90.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: North 2



Summary for Subcatchment 3S: North 4

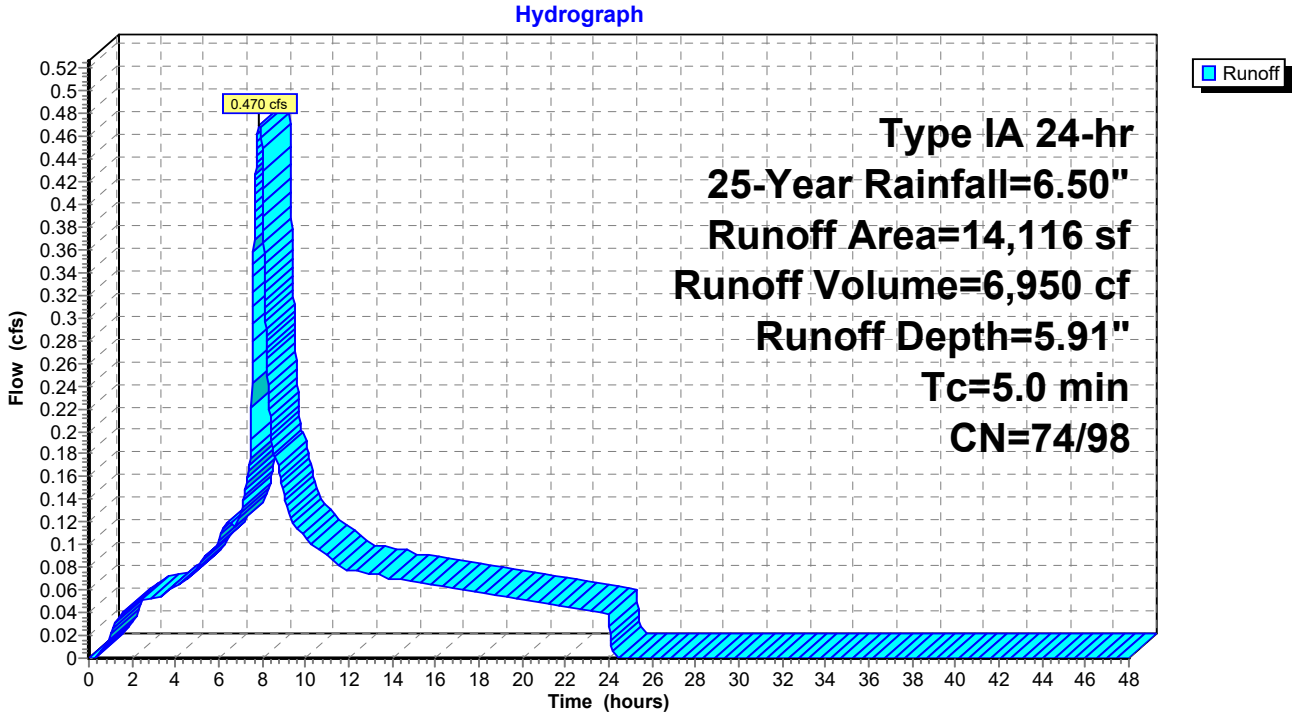
Runoff = 0.470 cfs @ 7.88 hrs, Volume= 6,950 cf, Depth= 5.91"
Routed to Pond 4P : Single Pond - Full

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
	1,881	74	
*	12,235	98	
	14,116	95	Weighted Average
	1,881	74	13.33% Pervious Area
	12,235	98	86.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: North 4



Summary for Pond 4P: Single Pond - Full

Inflow Area = 38,987 sf, 89.18% Impervious, Inflow Depth = 5.97" for 25-Year event
Inflow = 1.314 cfs @ 7.88 hrs, Volume= 19,411 cf
Outflow = 1.123 cfs @ 8.04 hrs, Volume= 19,410 cf, Atten= 15%, Lag= 9.6 min
Primary = 1.123 cfs @ 8.04 hrs, Volume= 19,410 cf
Routed to Pond 7P : Outfall

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 3.03' @ 8.04 hrs Surf.Area= 850 sf Storage= 1,478 cf

Plug-Flow detention time= 18.1 min calculated for 19,410 cf (100% of inflow)
Center-of-Mass det. time= 18.0 min (676.7 - 658.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	1,005 cf	**17.00'W x 50.00'L x 4.50'H Field A** 3,825 cf Overall - 1,311 cf Embedded = 2,514 cf x 40.0% Voids
#2A	0.50'	1,051 cf	**ADS N-12 36"** x 6 Inside #1 Inside= 36.1"W x 36.1"H => 7.10 sf x 20.00'L = 142.0 cf Outside= 42.0"W x 42.0"H => 8.86 sf x 20.00'L = 177.2 cf 6 Chambers in 3 Rows 14.00' Header x 7.10 sf x 2 = 198.8 cf Inside
		2,056 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**3.75" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	2.75'	**6.00" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.123 cfs @ 8.04 hrs HW=3.03' TW=0.00' (Dynamic Tailwater)
1=Orifice/Grate (Orifice Controls 0.626 cfs @ 8.16 fps)
2=Orifice/Grate (Orifice Controls 0.497 cfs @ 2.53 fps)

Pond 4P: Single Pond - Full - Chamber Wizard Field A

Chamber Model = ADS N-12 36" (ADS N-12® Pipe)
Inside= 36.1"W x 36.1"H => 7.10 sf x 20.00'L = 142.0 cf
Outside= 42.0"W x 42.0"H => 8.86 sf x 20.00'L = 177.2 cf

42.0" Wide + 21.0" Spacing = 63.0" C-C Row Spacing

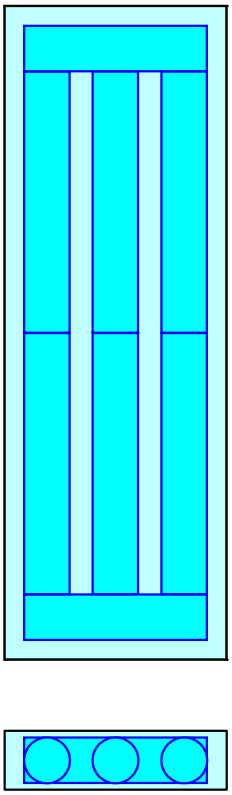
2 Chambers/Row x 20.00' Long +3.50' Header x 2 = 47.00' Row Length +18.0" End Stone x 2 = 50.00' Base Length
3 Rows x 42.0" Wide + 21.0" Spacing x 2 + 18.0" Side Stone x 2 = 17.00' Base Width
6.0" Stone Base + 42.0" Chamber Height + 6.0" Stone Cover = 4.50' Field Height

6 Chambers x 142.0 cf + 14.00' Header x 7.10 sf x 2 = 1,050.8 cf Chamber Storage
6 Chambers x 177.2 cf + 14.00' Header x 8.86 sf x 2 = 1,311.4 cf Displacement

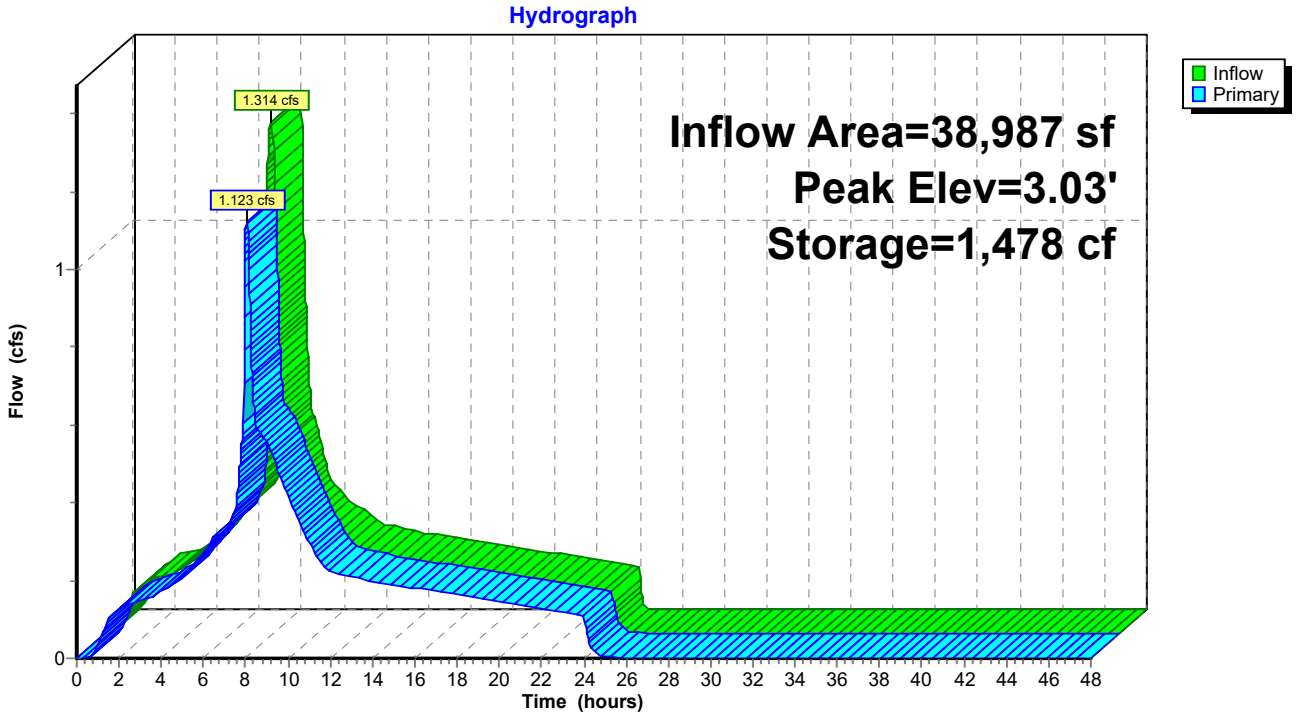
3,825.0 cf Field - 1,311.4 cf Chambers = 2,513.6 cf Stone x 40.0% Voids = 1,005.4 cf Stone Storage

Chamber Storage + Stone Storage = 2,056.2 cf = 0.047 af
Overall Storage Efficiency = 53.8%
Overall System Size = 50.00' x 17.00' x 4.50'

6 Chambers
141.7 cy Field
93.1 cy Stone



Pond 4P: Single Pond - Full



Summary for Subcatchment 5S: North 1

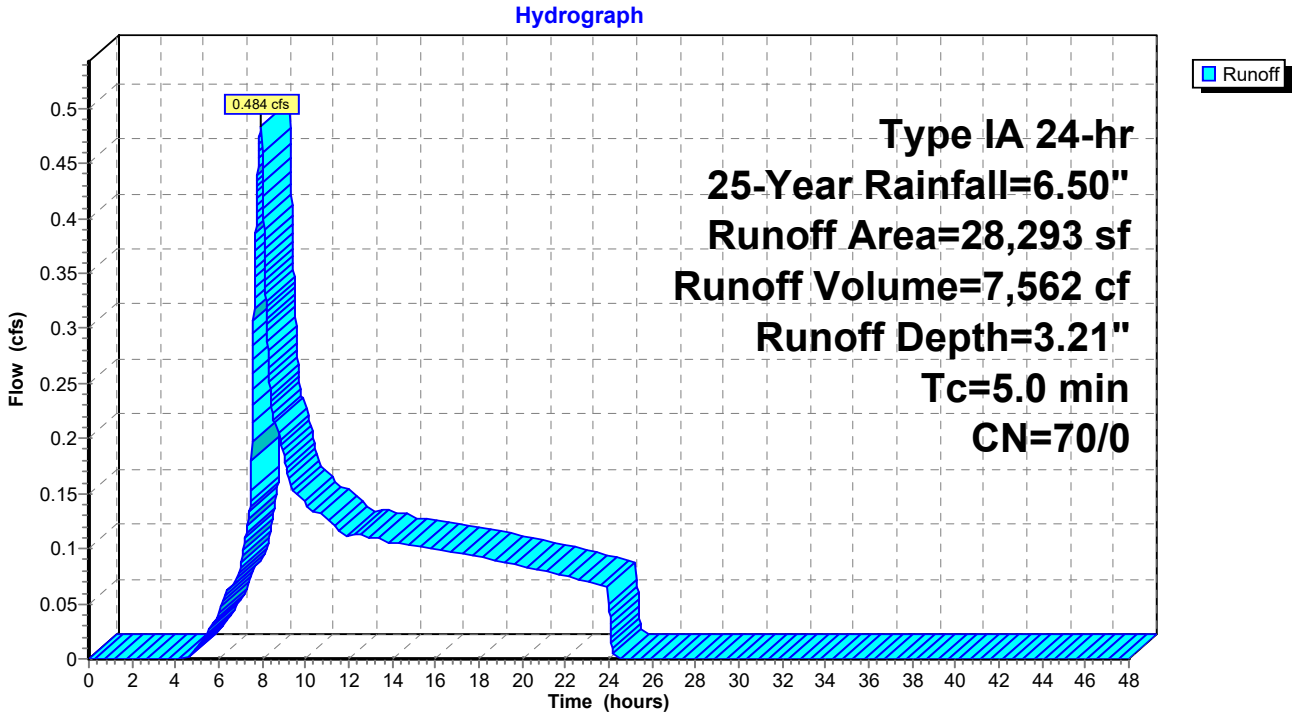
Runoff = 0.484 cfs @ 7.97 hrs, Volume= 7,562 cf, Depth= 3.21"
Routed to Pond 7P : Outfall

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	28,293	70	
	28,293	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: North 1



Summary for Subcatchment 6S: North 3

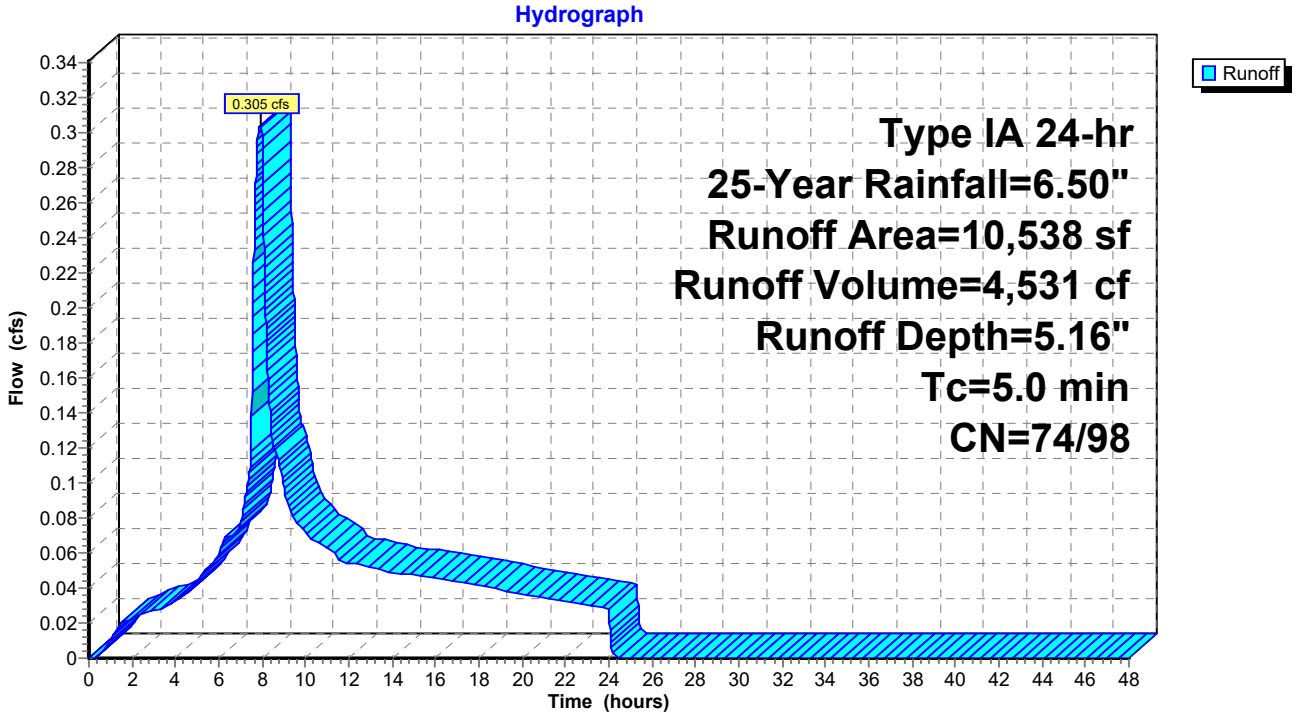
Runoff = 0.305 cfs @ 7.90 hrs, Volume= 4,531 cf, Depth= 5.16"
Routed to Pond 7P : Outfall

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	4,379	74	
*	6,159	98	
	10,538	88	Weighted Average
	4,379	74	41.55% Pervious Area
	6,159	98	58.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: North 3

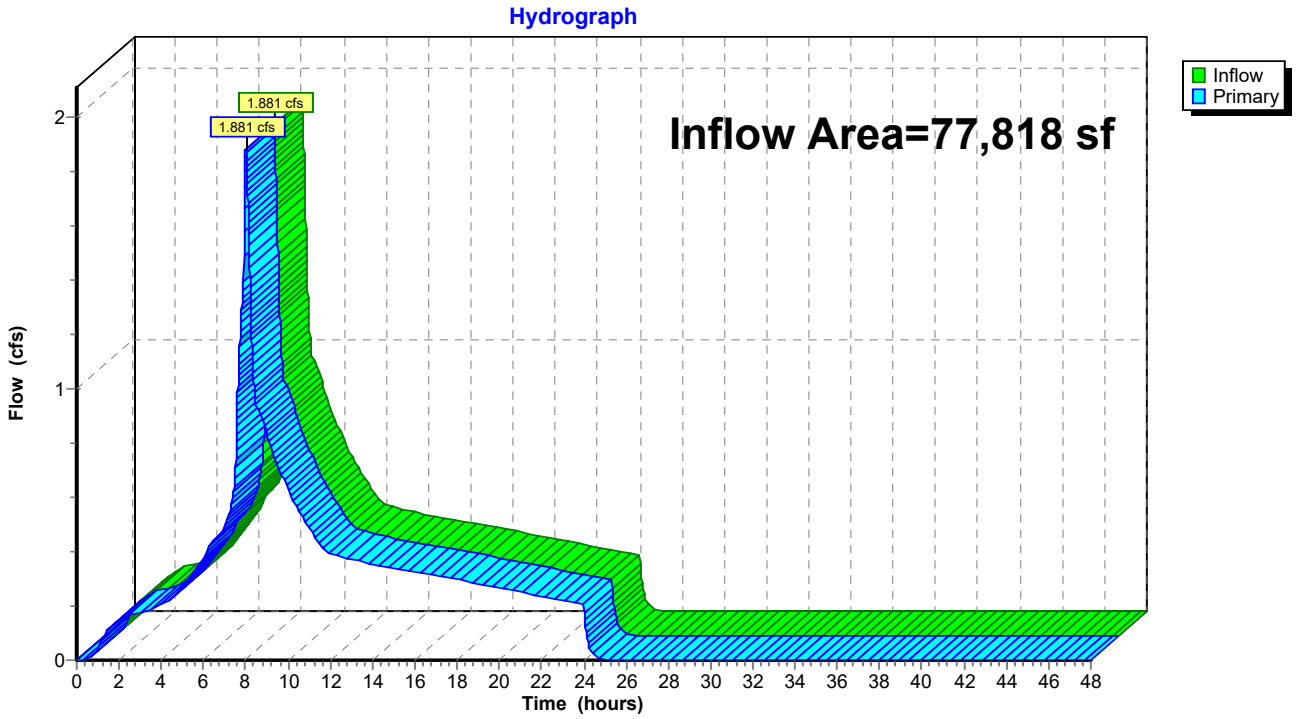


Summary for Pond 7P: Outfall

Inflow Area = 77,818 sf, 52.60% Impervious, Inflow Depth = 4.86" for 25-Year event
Inflow = 1.881 cfs @ 8.00 hrs, Volume= 31,503 cf
Primary = 1.881 cfs @ 8.00 hrs, Volume= 31,503 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Pond 7P: Outfall



Events for Subcatchment 1S: Existing Basin North

Event	Rainfall (inches)	Runoff (cfs)	Volume (cubic-feet)	Depth (inches)
2-Year	4.20	0.851	15,579	1.46
10-Year	5.70	1.690	27,324	2.57
25-Year	**6.50**	**2.184**	**34,108**	**3.21**

Events for Subcatchment 2S: North 2

Event	Rainfall (inches)	Runoff (cfs)	Volume (cubic-feet)	Depth (inches)
2-Year	4.20	0.531	7,785	3.76
10-Year	5.70	0.735	10,829	5.22
25-Year	**6.50**	**0.844**	**12,461**	**6.01**

Events for Subcatchment 3S: North 4

Event	Rainfall (inches)	Runoff (cfs)	Volume (cubic-feet)	Depth (inches)
2-Year	4.20	0.293	4,316	3.67
10-Year	5.70	0.408	6,029	5.13
25-Year	**6.50**	**0.470**	**6,950**	**5.91**

Events for Pond 4P: Single Pond - Full

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (cubic-feet)
2-Year	0.824	0.505	2.03	896
10-Year	1.143	0.803	2.86	1,387
25-Year	**1.314**	**1.123**	**3.03**	**1,478**

Events for Subcatchment 5S: North 1

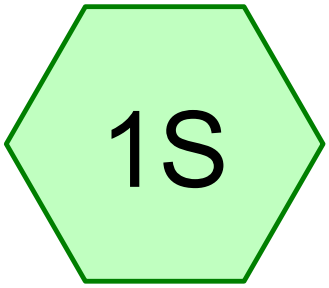
Event	Rainfall (inches)	Runoff (cfs)	Volume (cubic-feet)	Depth (inches)
2-Year	4.20	0.189	3,454	1.46
10-Year	5.70	0.375	6,058	2.57
25-Year	**6.50**	**0.484**	**7,562**	**3.21**

Events for Subcatchment 6S: North 3

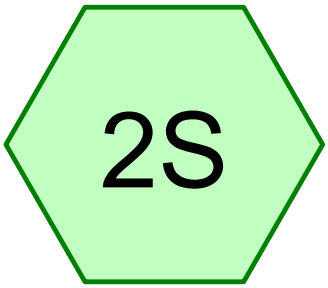
Event	Rainfall (inches)	Runoff (cfs)	Volume (cubic-feet)	Depth (inches)
2-Year	4.20	0.176	2,671	3.04
10-Year	5.70	0.259	3,874	4.41
25-Year	**6.50**	**0.305**	**4,531**	**5.16**

Events for Pond 7P: Outfall

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (cubic-feet)
2-Year	0.847	0.847	**0.00**	**0**
10-Year	1.287	1.287	0.00	0
25-Year	**1.881**	**1.881**	0.00	0



Existing Basin East



EAST

Subcat Reach Pond Link

Routing Diagram for 21-C018 (IHI - Lincoln City) - Discharge East
Prepared by Froelich Engineers, Printed 2/21/2022

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type IA 24-hr		Default	24.00	1	4.20	2
2	10-Year	Type IA 24-hr		Default	24.00	1	5.70	2
3	25-Year	Type IA 24-hr		Default	24.00	1	6.50	2

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: Existing Basin East Runoff Area=50,482 sf 0.00% Impervious Runoff Depth=1.46"
Tc=5.0 min CN=70/0 Runoff=0.336 cfs 6,162 cf

Subcatchment2S: EAST Runoff Area=109,343 sf 68.61% Impervious Runoff Depth=3.22"
Tc=5.0 min CN=72/98 Runoff=1.952 cfs 29,366 cf

Total Runoff Area = 159,825 sf Runoff Volume = 35,529 cf Average Runoff Depth = 2.67"
53.06% Pervious = 84,810 sf 46.94% Impervious = 75,015 sf

Summary for Subcatchment 1S: Existing Basin East

~27% west

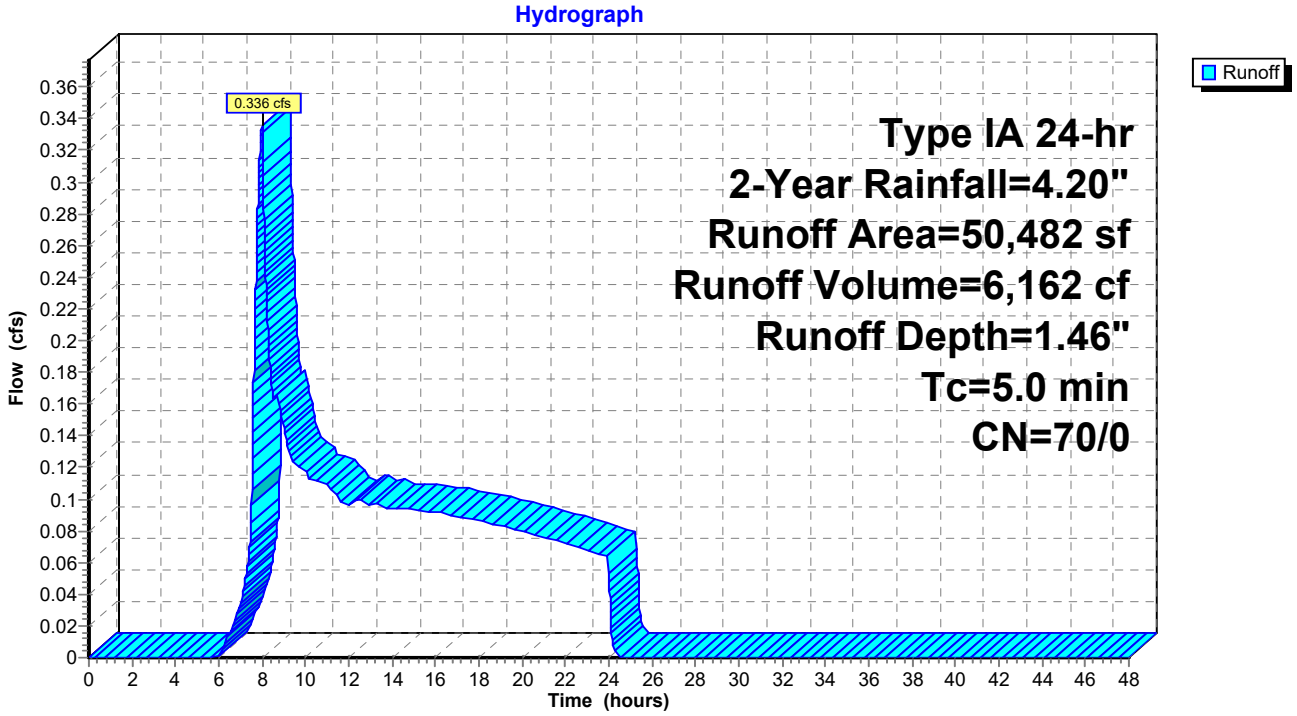
Runoff = 0.336 cfs @ 8.00 hrs, Volume= 6,162 cf, Depth= 1.46"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=4.20"

Area (sf)	CN	Description
50,482	70	Woods, Good, HSG C
50,482	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Existing Basin East



Summary for Subcatchment 2S: EAST

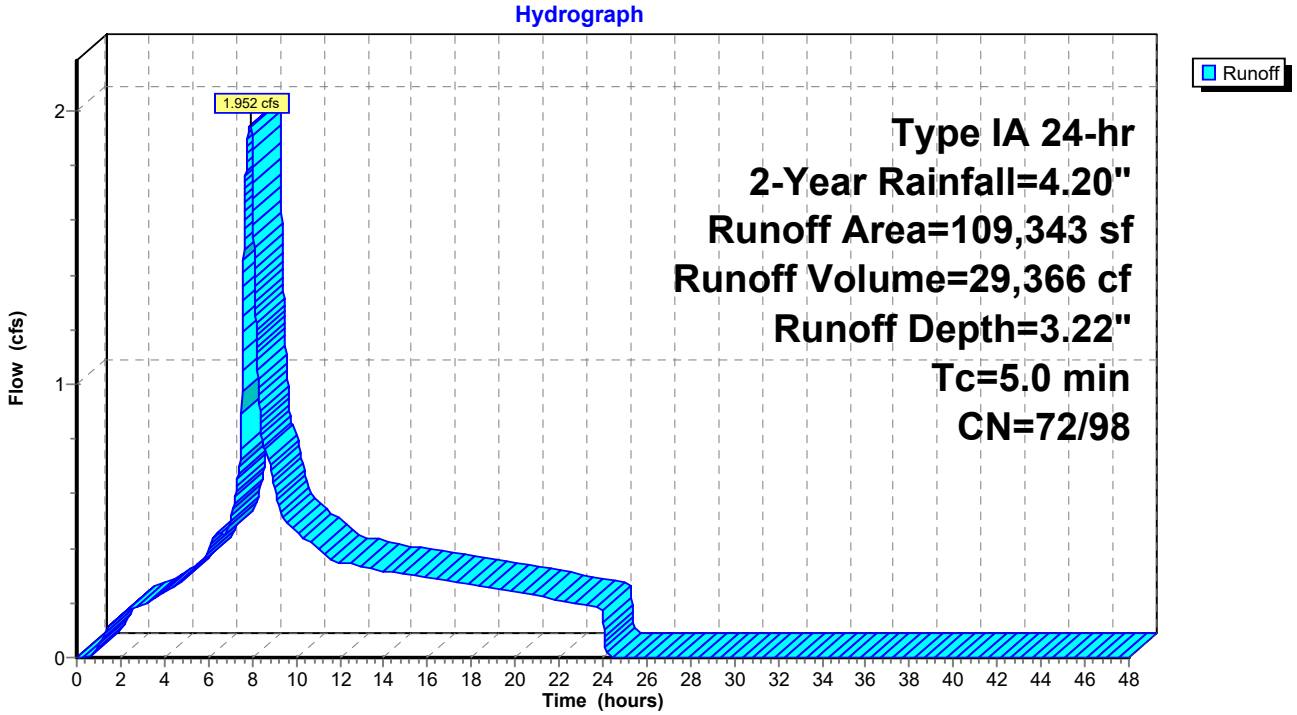
Runoff = 1.952 cfs @ 7.90 hrs, Volume= 29,366 cf, Depth= 3.22"
Routed to nonexistent node 4p

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-Year Rainfall=4.20"

	Area (sf)	CN	Description
*	21,341	74	
*	12,987	70	
*	75,015	98	
	109,343	90	Weighted Average
	34,328	72	31.39% Pervious Area
	75,015	98	68.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: EAST



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: Existing Basin East Runoff Area=50,482 sf 0.00% Impervious Runoff Depth=2.57"
Tc=5.0 min CN=70/0 Runoff=0.668 cfs 10,808 cf

Subcatchment2S: EAST Runoff Area=109,343 sf 68.61% Impervious Runoff Depth=4.61"
Tc=5.0 min CN=72/98 Runoff=2.813 cfs 42,012 cf

Total Runoff Area = 159,825 sf Runoff Volume = 52,820 cf Average Runoff Depth = 3.97"
53.06% Pervious = 84,810 sf 46.94% Impervious = 75,015 sf

Summary for Subcatchment 1S: Existing Basin East

~27% west

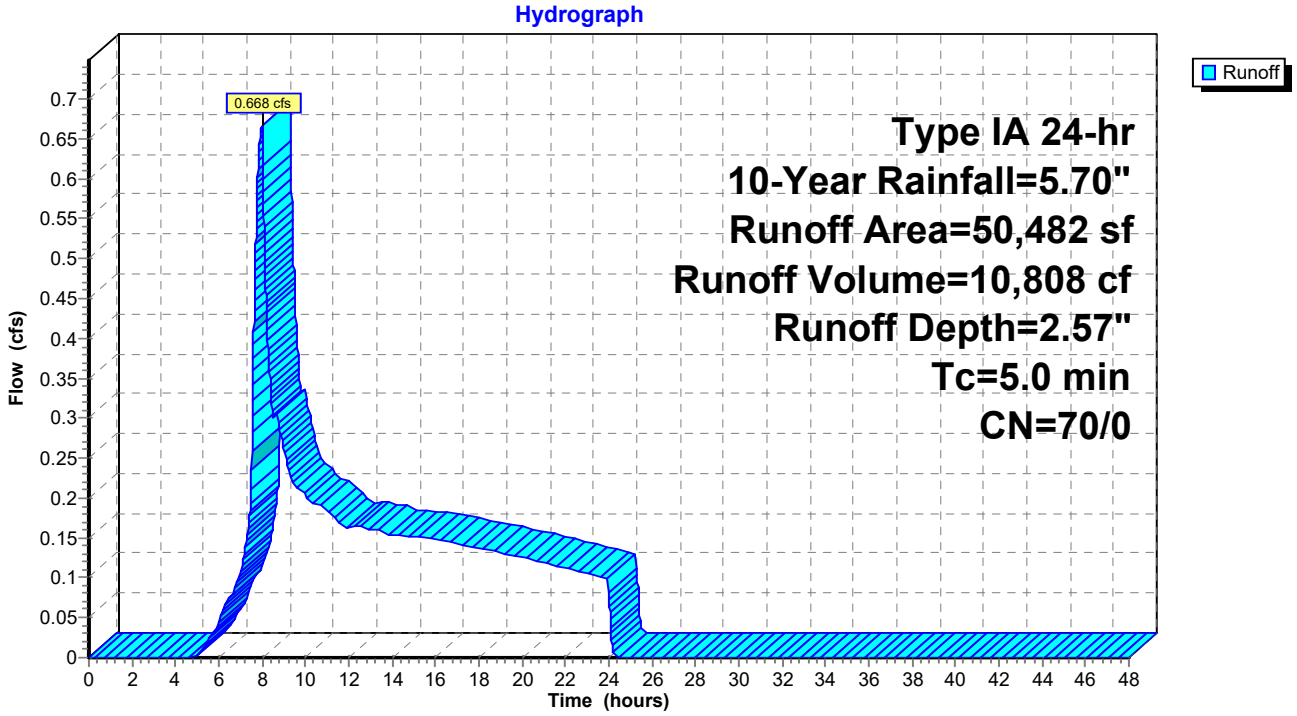
Runoff = 0.668 cfs @ 7.99 hrs, Volume= 10,808 cf, Depth= 2.57"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=5.70"

Area (sf)	CN	Description
50,482	70	Woods, Good, HSG C
50,482	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Existing Basin East



Summary for Subcatchment 2S: EAST

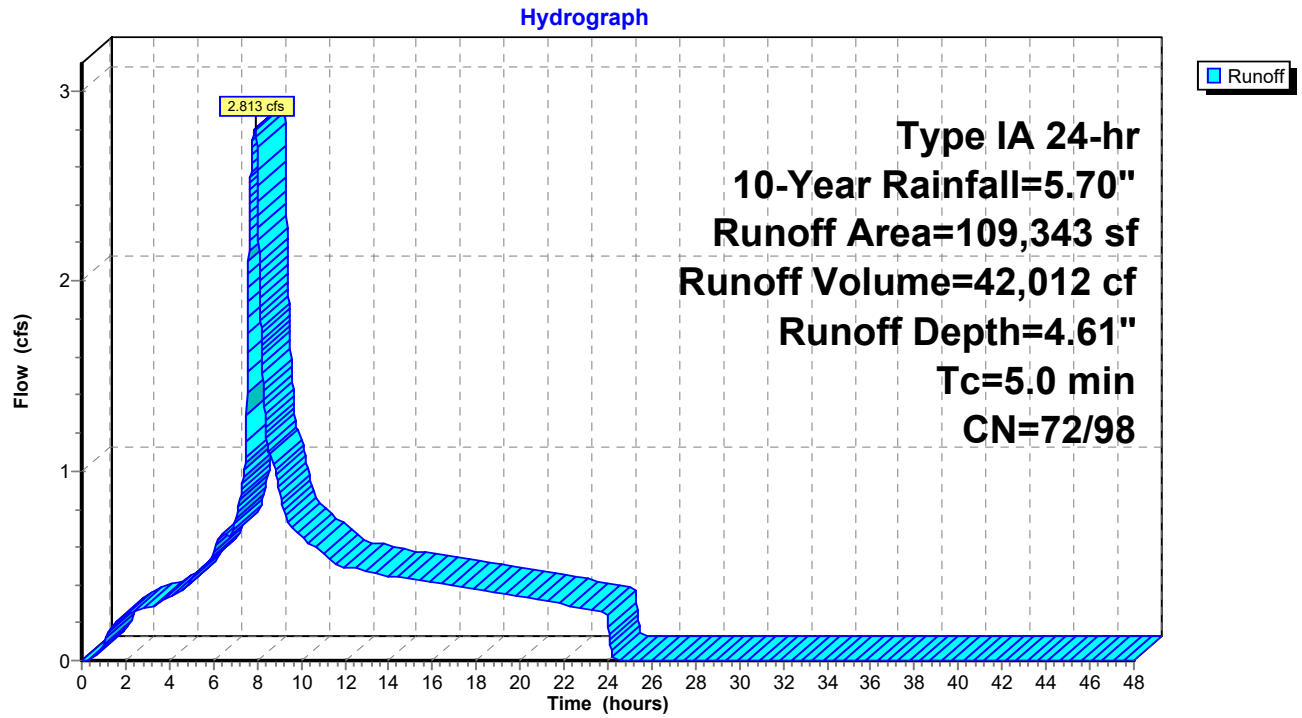
Runoff = 2.813 cfs @ 7.89 hrs, Volume= 42,012 cf, Depth= 4.61"
Routed to nonexistent node 4p

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Year Rainfall=5.70"

	Area (sf)	CN	Description
*	21,341	74	
*	12,987	70	
*	75,015	98	
	109,343	90	Weighted Average
	34,328	72	31.39% Pervious Area
	75,015	98	68.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: EAST



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: Existing Basin East Runoff Area=50,482 sf 0.00% Impervious Runoff Depth=3.21"
Tc=5.0 min CN=70/0 Runoff=0.864 cfs 13,492 cf

Subcatchment2S: EAST Runoff Area=109,343 sf 68.61% Impervious Runoff Depth=5.37"
Tc=5.0 min CN=72/98 Runoff=3.282 cfs 48,887 cf

Total Runoff Area = 159,825 sf Runoff Volume = 62,379 cf Average Runoff Depth = 4.68"
53.06% Pervious = 84,810 sf 46.94% Impervious = 75,015 sf

Summary for Subcatchment 1S: Existing Basin East

~27% west

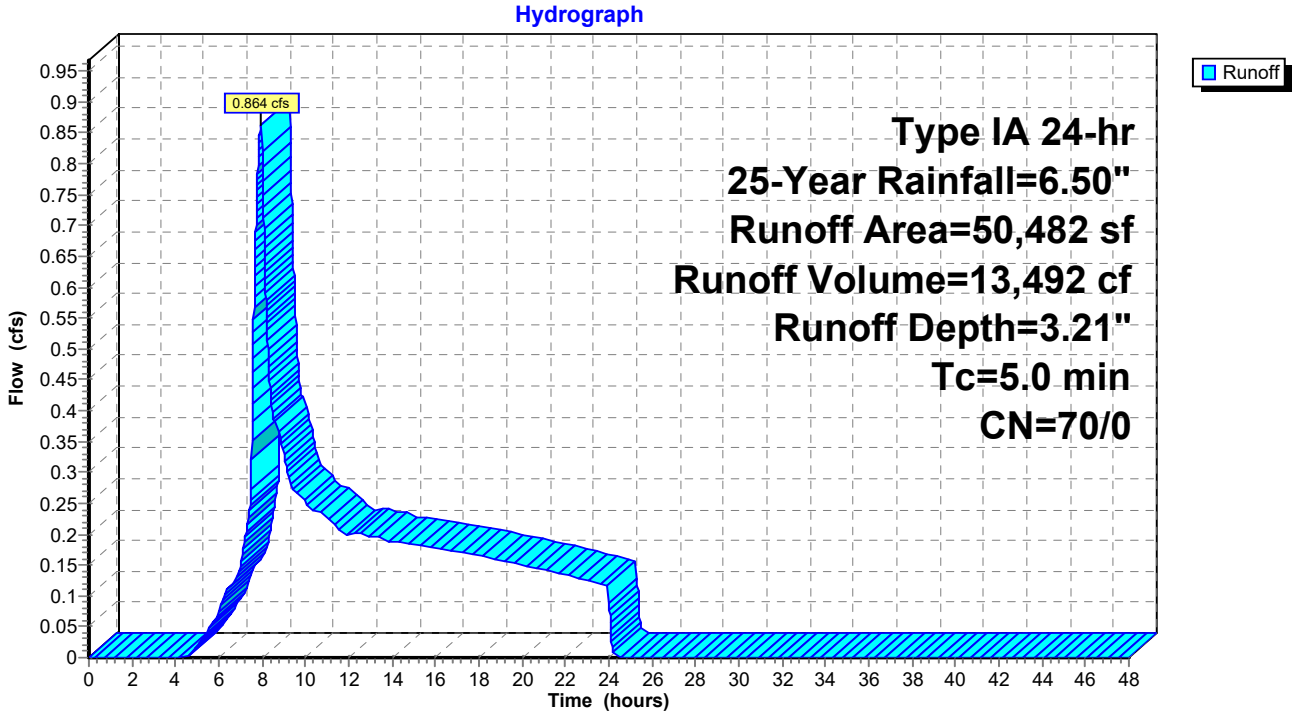
Runoff = 0.864 cfs @ 7.97 hrs, Volume= 13,492 cf, Depth= 3.21"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

Area (sf)	CN	Description
50,482	70	Woods, Good, HSG C
50,482	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: Existing Basin East



Summary for Subcatchment 2S: EAST

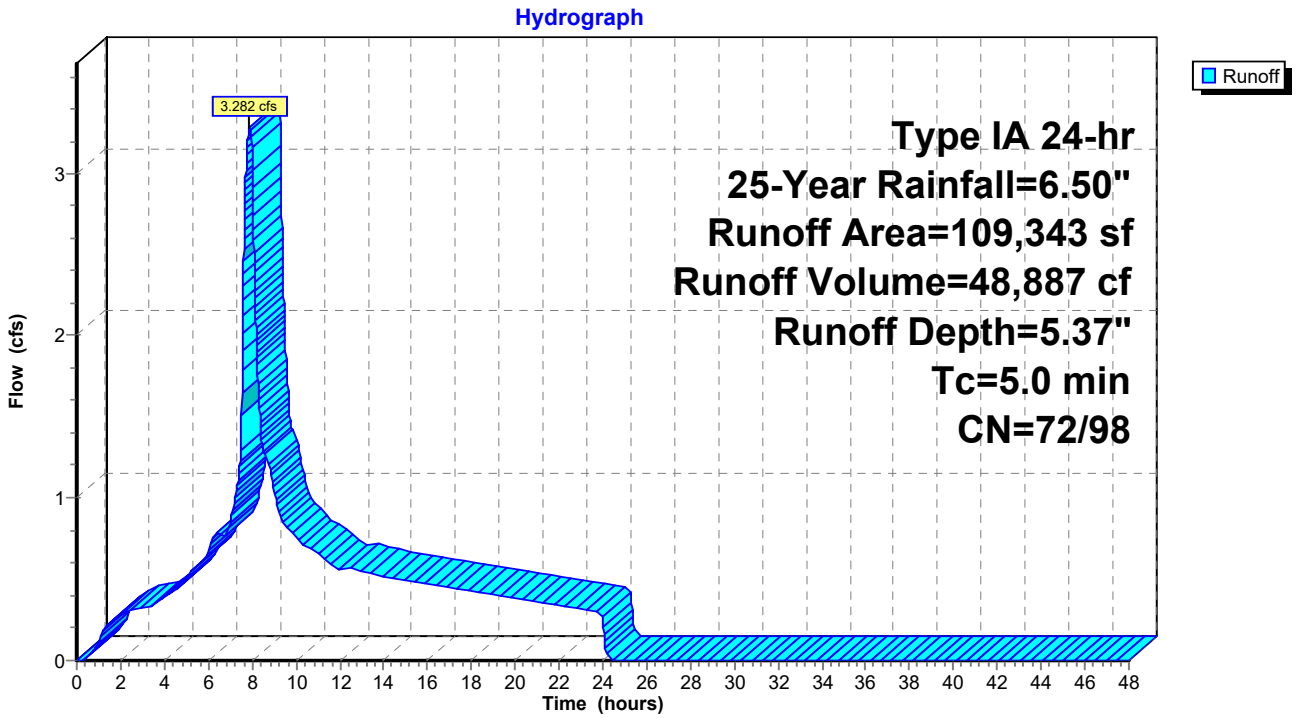
Runoff = 3.282 cfs @ 7.89 hrs, Volume= 48,887 cf, Depth= 5.37"
Routed to nonexistent node 4p

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	21,341	74	
*	12,987	70	
*	75,015	98	
	109,343	90	Weighted Average
	34,328	72	31.39% Pervious Area
	75,015	98	68.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: EAST



Events for Subcatchment 1S: Existing Basin East

Event	Rainfall (inches)	Runoff (cfs)	Volume (cubic-feet)	Depth (inches)
2-Year	4.20	0.336	6,162	1.46
10-Year	5.70	0.668	10,808	2.57
25-Year	**6.50**	**0.864**	**13,492**	**3.21**

Events for Subcatchment 2S: EAST

Event	Rainfall (inches)	Runoff (cfs)	Volume (cubic-feet)	Depth (inches)
2-Year	4.20	1.952	29,366	3.22
10-Year	5.70	2.813	42,012	4.61
25-Year	**6.50**	**3.282**	**48,887**	**5.37**

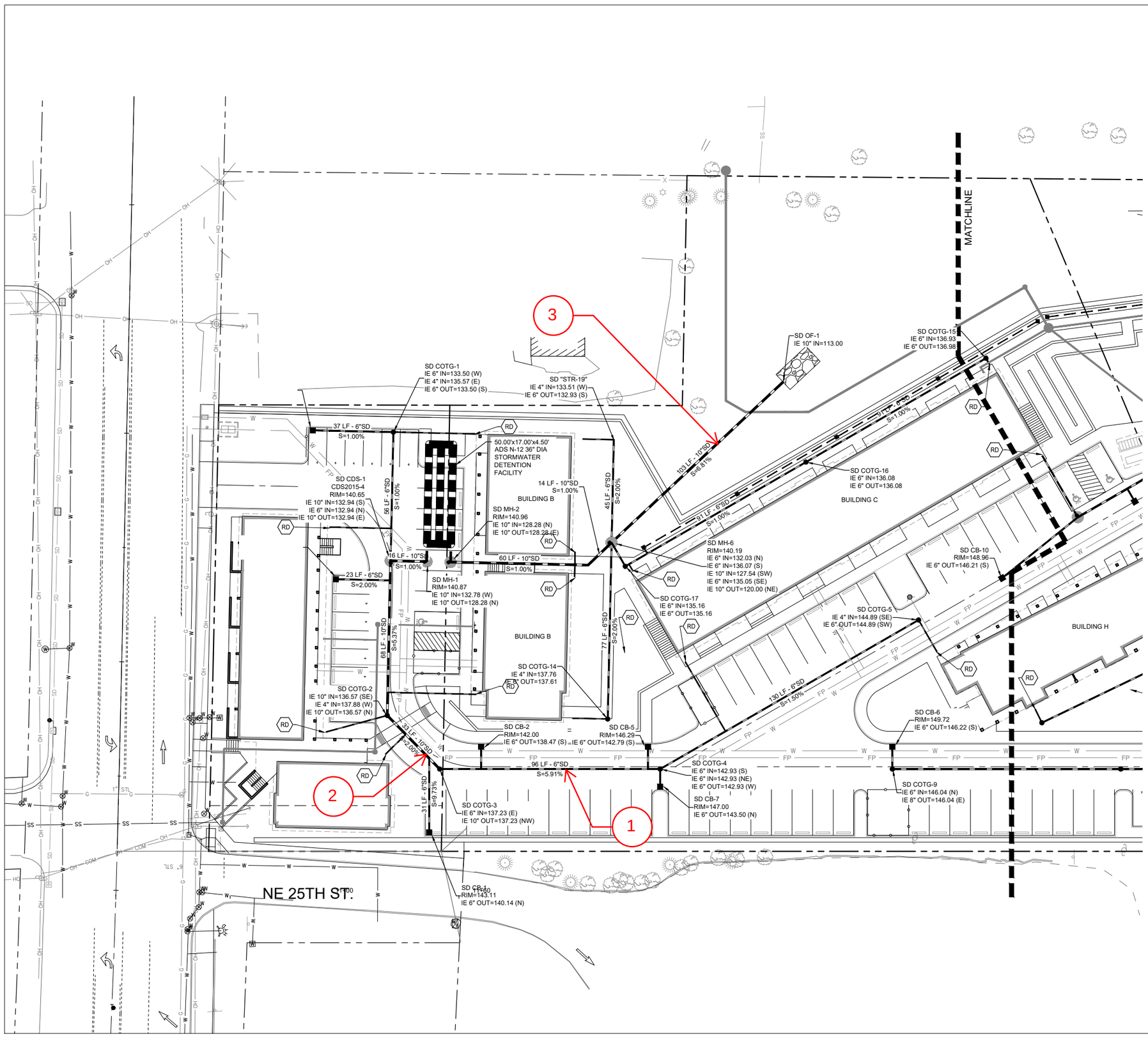
Appendix G: Stormwater Conveyance Calculations

FROELICH ENGINEERS

Conveyance Calculations

IHI - Lincoln City
Project #21-C018

DESIGN SECTION		DESIGN CALCULATIONS		DETAIL						
		RUNOFF	TOTAL	SLOPE	DIA	CAPACITY	VEL.	RUNOFF	VEL.	CAPACITY
PIPE	CONTRIBUTING BASIN/PIPE	Q CFS	Q FT/S	%	IN.	Qf CFS	Vf FT/S	RATIO Q/Qf	AT Q/QF	CHECK YES or NO
1	N4	0.47	0.47	1	6	0.56	2.86	0.84	0.62	YES
2	N2, PIPE 1	0.84	1.31	1	10	2.19	4.02	0.60	2.41	YES
3	N3, PIPE 2	0.31	1.62	1	10	2.19	4.02	0.74	2.41	YES
4	E10, E11, E12	0.88	0.88	1	8	1.21	3.46	0.73	1.33	YES
5	E3, E4, E5, E6	0.70	0.70	1	8	1.21	3.46	0.58	1.33	YES
6	E7, E8, PIPE 5	0.64	1.34	1	10	2.19	4.02	0.61	2.41	YES
7	E9, PIPE 4, PIPE 6	0.44	2.66	1	12	3.56	4.54	0.75	3.92	YES
8	E2	0.41	0.41	1	6	0.56	2.86	0.74	0.62	YES



SHEET NOTES

1. ALL MANHOLES ARE 48" DIAMETER U.N.O.
2. CATCH BASINS SHALL BE ODOT TYPE G2 W/ ACF ENVIRONMENTAL TRASH GUARD PLUS.
3. STORMWATER OUTFALLS WILL INCLUDE CONCRETE WING WALLS AND BASE SLAB AS WELL AS RIP RAP ENERGY DISSIPATER.
4. PIPE SIZE SHOWN ARE BASED ON PRELIMINARY SIZING ANALYSIS.
5. PIPE BEDDING AND BACKFILL FOR ALL UTILITIES SHALL BE DONE PER DETAIL X/CX.X.
6. STRUCTURES LOCATIONS ARE BASED ON CENTER OF STRUCTURE.

UTILITY LABEL LEGEND

STRUCTURE LABEL

XX XX-XX
X+XX.X RT X.X' — LOCATION (WHERE APPLICABLE)
RIM= — STRUCTURE INFO (WHERE APPLICABLE)
IE IN = XX.X
IE OUT = XX.X

UTILITY TYPE (SD=STORM DRAINAGE, S=SANITARY SEWER, W=WATER, FP=FIRE PROTECTION)
STRUCTURE TYPE CALLOUT
ID NUMBER (WHERE APPLICABLE)

PIPE LABEL

XXLF - XX" XX
S=X.XX% — SLOPE (WHERE APPLICABLE)

UTILITY LENGTH
UTILITY SIZE
UTILITY TYPE

STRUCTURE TYPE

CALLOUT	DESCRIPTION
AD	AREA DRAIN
BEND	BEND, USE FITTING IF APPLICABLE
CB	TRAPPED CATCH BASIN (ODOT TYPE G2)
CB2	INLINE CATCH BASIN
CDS	CONTECH CONTINUOUS DEFLECTIVE SEPARATOR
COTG	CLEANOUT TO GRADE
FCMH	FLOW CONTROL MANHOLE
FD	FOUNDATION DRAINAGE
GV	GATE VALVE
OF	OUTFALL
MH	48" DIA. MH
RD	ROOF DRAIN
TEE	TEE CONNECTION
WYE	WYE CONNECTION

SHEET LEGEND

RD — ROOF DRAIN. COORDINATE CONNECTION, SIZE, AND LOCATION WITH ARCHITECTURAL PLANS

SCALE 1 INCH = 20 FEET
20 0 20 40

LRS ARCHITECTS

PRELIMINARY NOT FOR CONSTRUCTION

CONSULTANT:

FROELICH ENGINEERS
CIVIL · STRUCTURAL
Portland, OR. | Bend, OR. | Denver, CO.
(503) 624-7005

PROJECT NUMBER: *XXXXXX*

LINCOLN CITY AFFORDABLE HOUSING

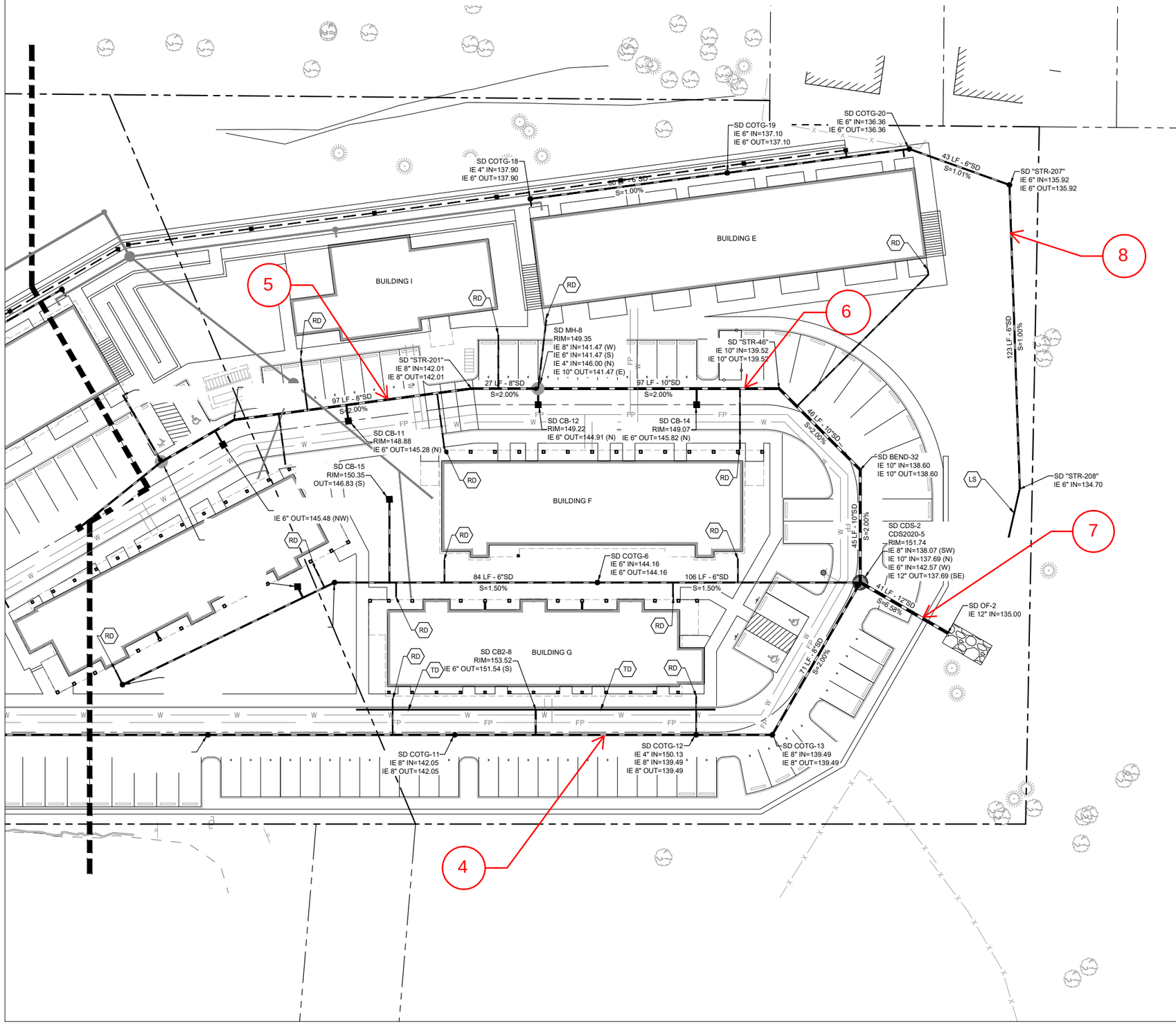
2510 NE HWY 101
LINCOLN CITY, OR
97367

SHEET TITLE:

UTILITY PLAN - WEST - STORM

DRAWN BY: *Author*

SHEET:
C402
DEVELOPMENT REVIEW
01/31/2022



SHEET NOTES

1. ALL MANHOLES ARE 48" DIAMETER U.N.O.
2. CATCH BASINS SHALL BE ODOT TYPE G2 W/ ACF ENVIRONMENTAL TRASH GUARD PLUS.
3. STORMWATER OUTFALLS WILL INCLUDE CONCRETE WING WALLS AND BASE SLAB AND RIP RAP ENERGY DISSIPATER.
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6. STRUCTURES LOCATIONS ARE BASED ON CENTER OF STRUCTURE.

UTILITY LABEL LEGEND

STRUCTURE LABEL

XX XX-XX
X+XX.X RT X.X' ← LOCATION (WHERE APPLICABLE)
RIM= ← STRUCTURE INFO (WHERE APPLICABLE)
IE IN = XX.X
IE OUT = XX.X

- UTILITY TYPE (SD=STORM DRAINAGE, S=SANITARY SEWER, W=WATER, FP=FIRE PROTECTION)
- STRUCTURE TYPE CALLOUT
- ID NUMBER (WHERE APPLICABLE)

PIPE LABEL

XXLF - XX" XX
S=X.XX% ← SLOPE (WHERE APPLICABLE)

- UTILITY LENGTH
- UTILITY SIZE
- UTILITY TYPE

STRUCTURE TYPE

CALLOUT	DESCRIPTION
AD	AREA DRAIN
BEND	BEND, USE FITTING IF APPLICABLE
CB	TRAPPED CATCH BASIN (ODOT TYPE G2)
CB2	INLINE CATCH BASIN
CDS	CONTECH CONTINUOUS DEFLECTIVE SEPARATOR
COTG	CLEANOUT TO GRADE
FCMH	FLOW CONTROL MANHOLE
FD	FOUNDATION DRAINAGE
GV	GATE VALVE
OF	OUTFALL
MH	48" DIA. MH
RD	ROOF DRAIN
TEE	TEE CONNECTION
WYE	WYE CONNECTION

SHEET LEGEND

- TD — TRENCH DRAIN
- LS — LEVEL SPREADER
- RD — ROOF DRAIN. COORDINATE CONNECTION, SIZE, AND LOCATION WITH ARCHITECTURAL PLANS

SCALE 1 INCH = 20 FEET
20 0 20 40

LRS ARCHITECTS

PRELIMINARY NOT FOR CONSTRUCTION

CONSULTANT:

FROELICH ENGINEERS
CIVIL · STRUCTURAL
Portland, OR. | Bend, OR. | Denver, CO.
(503) 624-7005

PROJECT NUMBER: *XXXXXX*

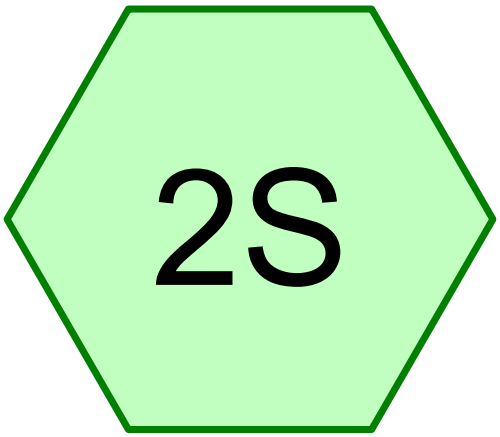
LINCOLN CITY AFFORDABLE HOUSING

2510 NE HWY 101
LINCOLN CITY, OR
97367

SHEET TITLE:
UTILITY PLAN - EAST - STORM

DRAWN BY: *Author*

SHEET:
C403
DEVELOPMENT REVIEW
01/31/2022



WEST 1

Subcat Reach Pond Link

Routing Diagram for 21-C018 (IHI - Lincoln City) - Discharge West
Prepared by Froelich Engineers, Printed 2/21/2022

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	25-Year	Type IA 24-hr		Default	24.00	1	6.50	2

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment2S: WEST 1 Runoff Area=5,532 sf 35.85% Impervious Runoff Depth=4.56"
Tc=5.0 min CN=74/98 Runoff=0.141 cfs 2,102 cf

Total Runoff Area = 5,532 sf Runoff Volume = 2,102 cf Average Runoff Depth = 4.56"
64.15% Pervious = 3,549 sf 35.85% Impervious = 1,983 sf

Summary for Subcatchment 2S: WEST 1

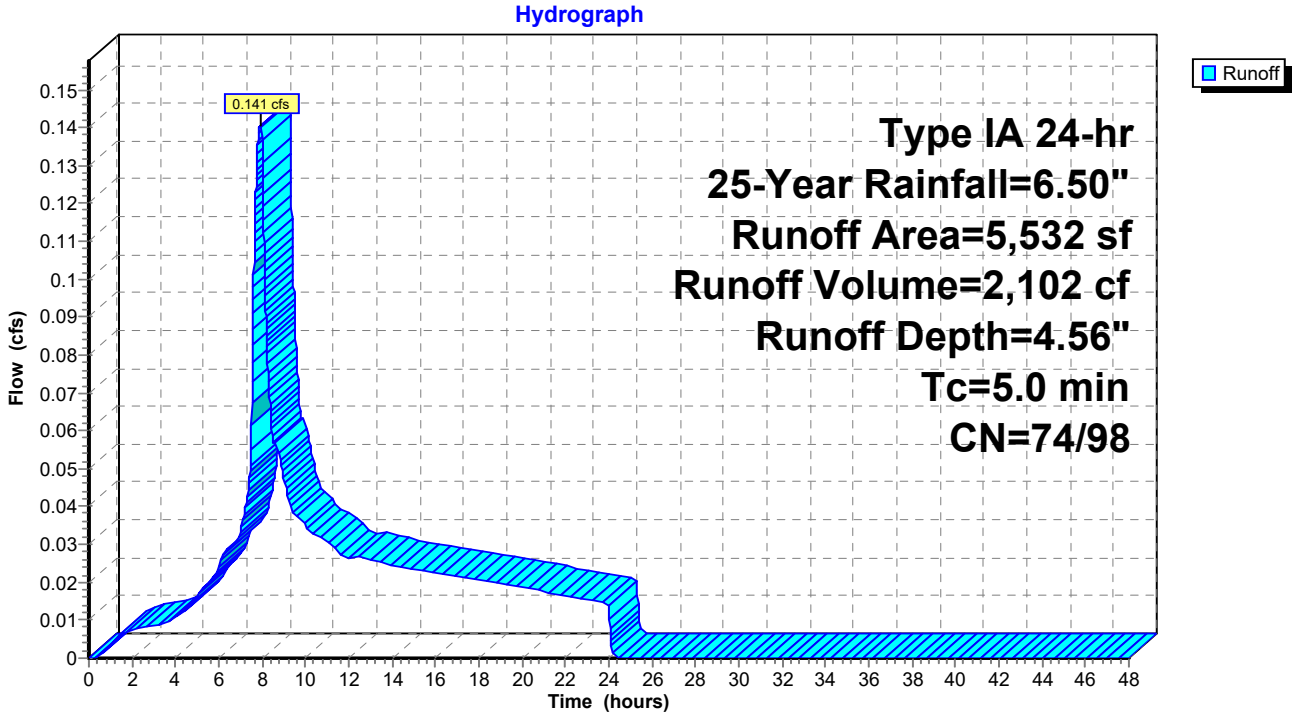
Runoff = 0.141 cfs @ 7.92 hrs, Volume= 2,102 cf, Depth= 4.56"
Routed to nonexistent node 4p

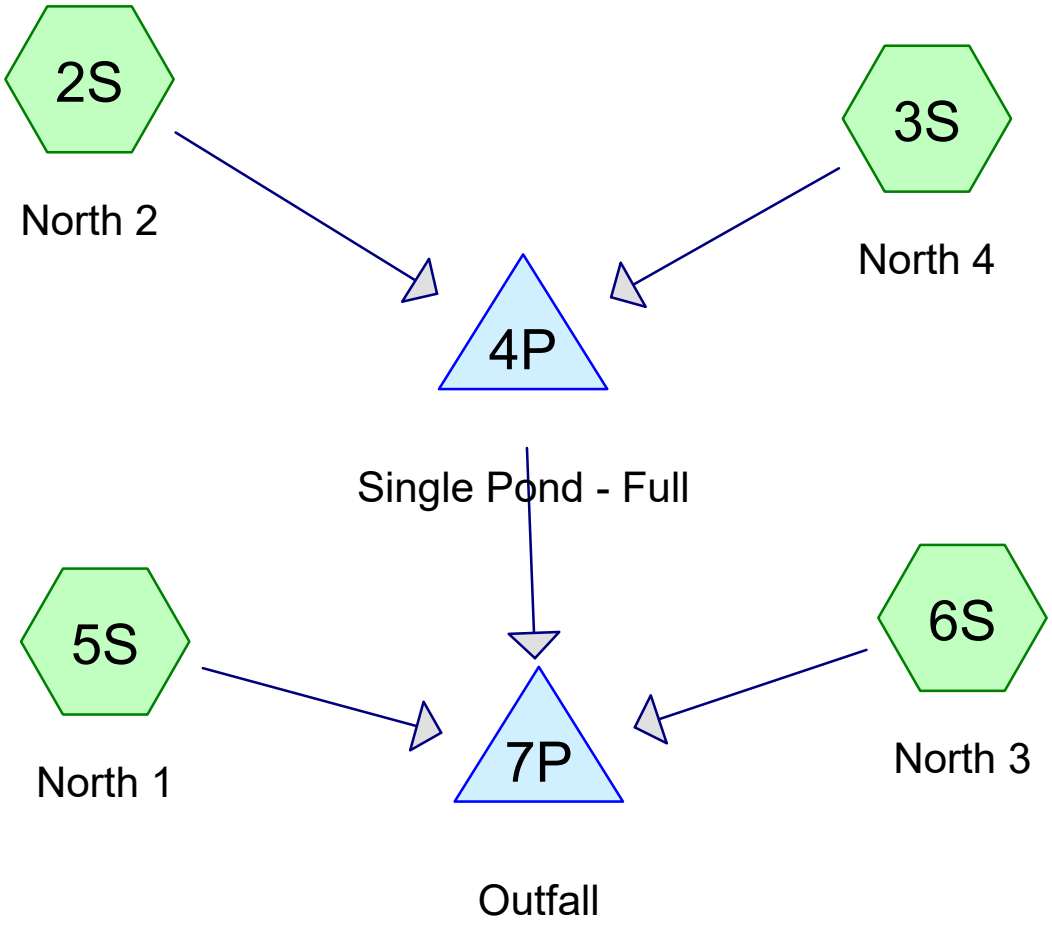
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

Area (sf)	CN	Description
1,983	98	Paved parking, HSG C
3,549	74	>75% Grass cover, Good, HSG C
5,532	83	Weighted Average
3,549	74	64.15% Pervious Area
1,983	98	35.85% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: WEST 1





Subcat Reach Pond Link

Routing Diagram for 21-C018 (IHI - Lincoln City) - Discharge North
Prepared by Froelich Engineers, Printed 2/21/2022

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	25-Year	Type IA 24-hr		Default	24.00	1	6.50	2

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment2S: North 2 Runoff Area=24,871 sf 90.61% Impervious Runoff Depth=6.01"
Tc=5.0 min CN=74/98 Runoff=0.844 cfs 12,461 cf

Subcatchment3S: North 4 Runoff Area=14,116 sf 86.67% Impervious Runoff Depth=5.91"
Tc=5.0 min CN=74/98 Runoff=0.470 cfs 6,950 cf

Subcatchment5S: North 1 Runoff Area=28,293 sf 0.00% Impervious Runoff Depth=3.21"
Tc=5.0 min CN=70/0 Runoff=0.484 cfs 7,562 cf

Subcatchment6S: North 3 Runoff Area=10,538 sf 58.45% Impervious Runoff Depth=5.16"
Tc=5.0 min CN=74/98 Runoff=0.305 cfs 4,531 cf

Total Runoff Area = 77,818 sf Runoff Volume = 31,503 cf Average Runoff Depth = 4.86"
47.40% Pervious = 36,889 sf 52.60% Impervious = 40,929 sf

Summary for Subcatchment 2S: North 2

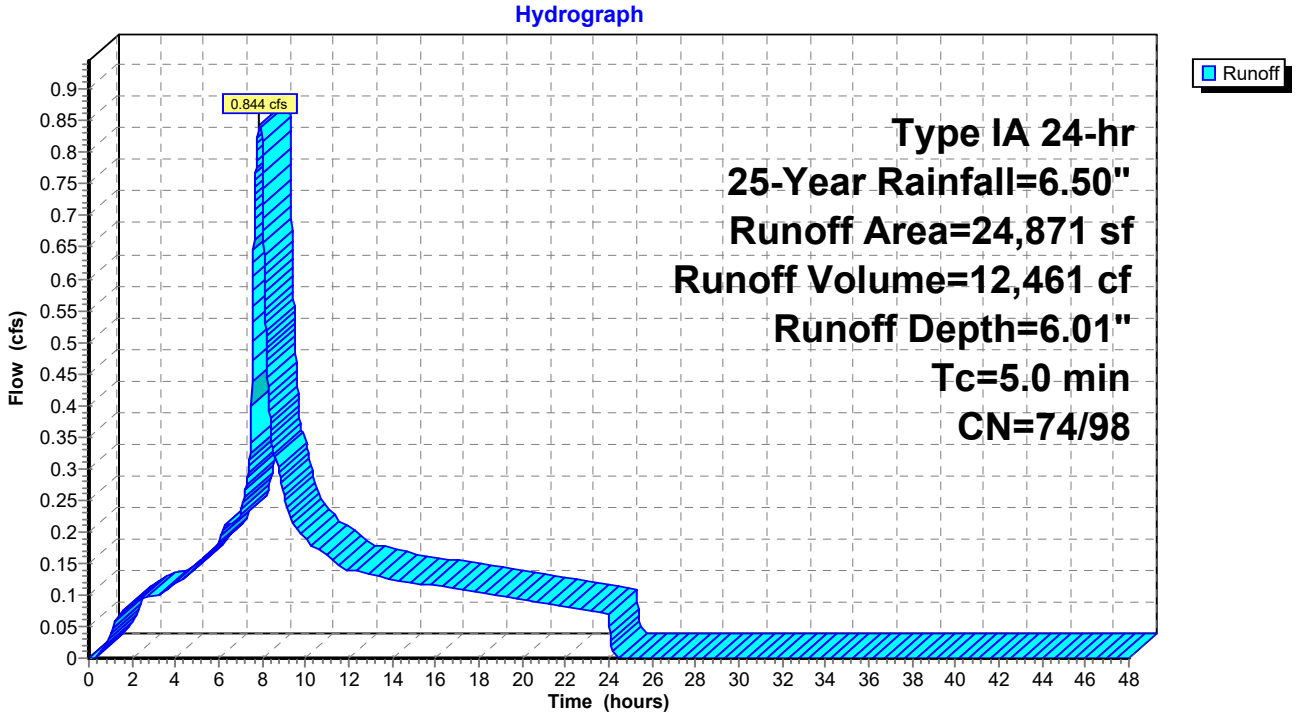
Runoff = 0.844 cfs @ 7.88 hrs, Volume= 12,461 cf, Depth= 6.01"
Routed to Pond 4P : Single Pond - Full

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	2,336	74	
*	22,535	98	
	24,871	96	Weighted Average
	2,336	74	9.39% Pervious Area
	22,535	98	90.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: North 2



Summary for Subcatchment 3S: North 4

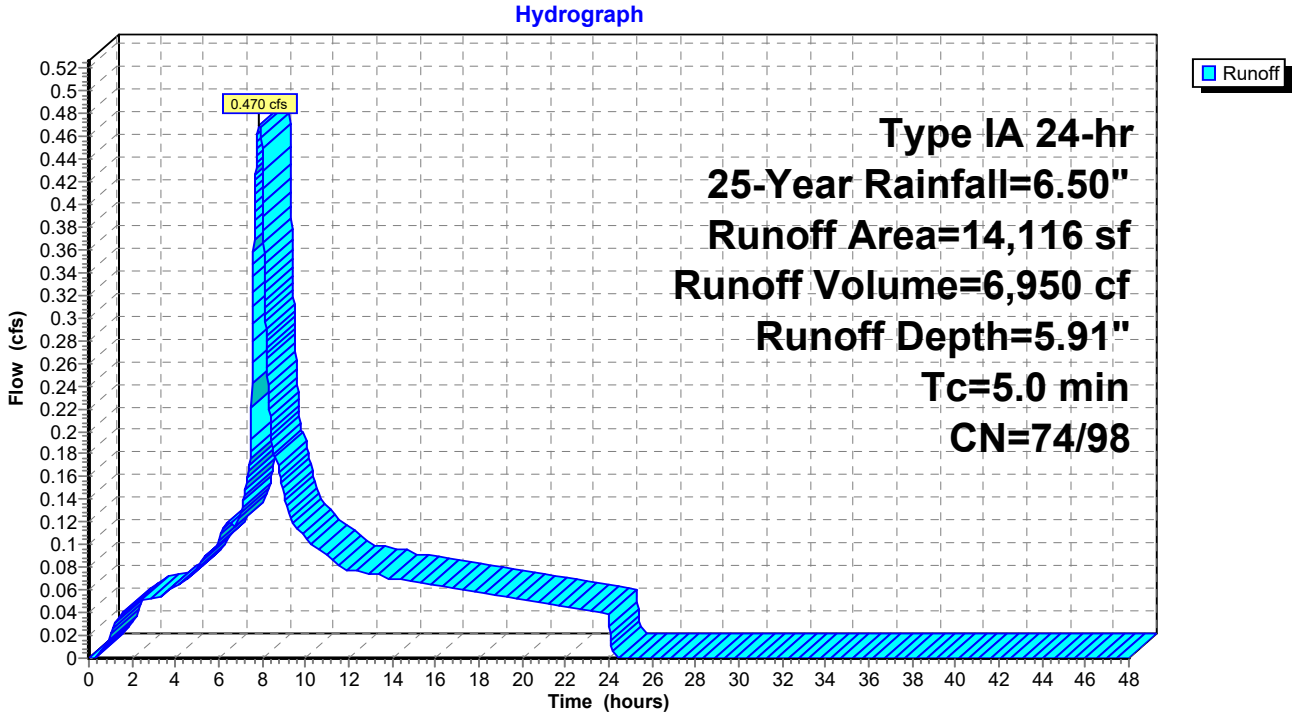
Runoff = 0.470 cfs @ 7.88 hrs, Volume= 6,950 cf, Depth= 5.91"
Routed to Pond 4P : Single Pond - Full

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
	1,881	74	
*	12,235	98	
	14,116	95	Weighted Average
	1,881	74	13.33% Pervious Area
	12,235	98	86.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: North 4



Summary for Subcatchment 5S: North 1

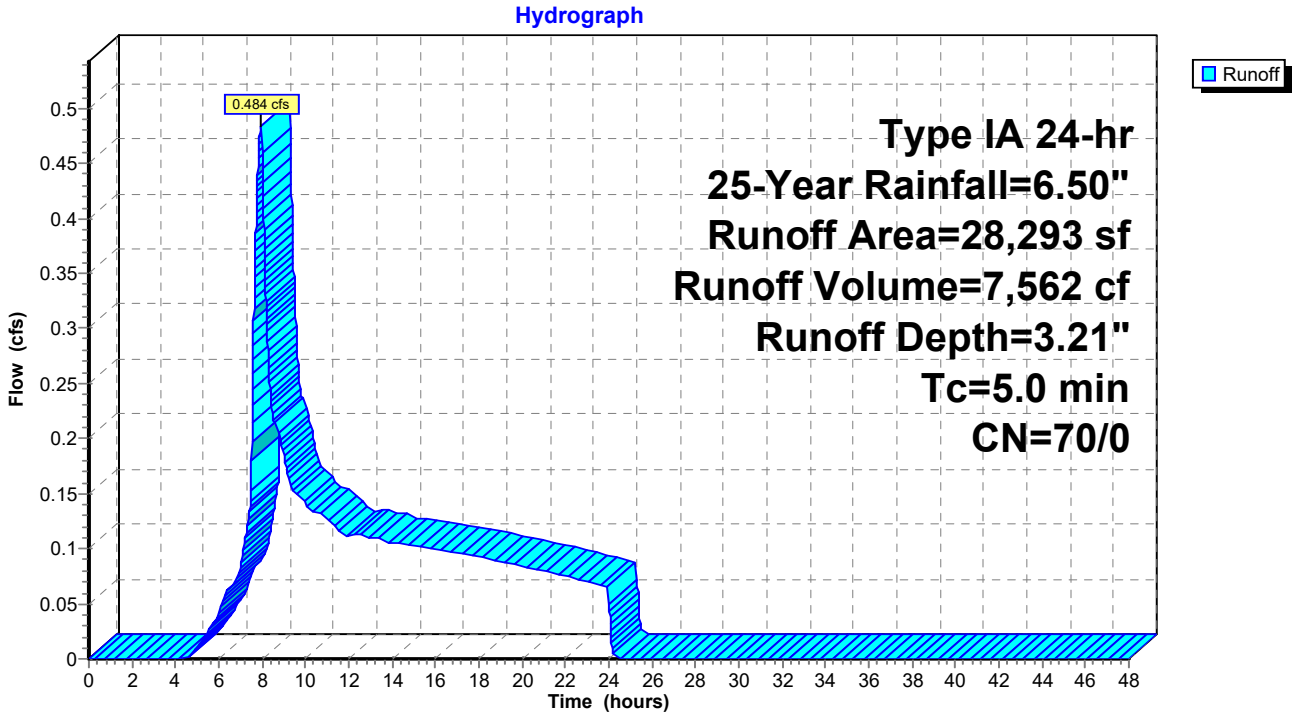
Runoff = 0.484 cfs @ 7.97 hrs, Volume= 7,562 cf, Depth= 3.21"
Routed to Pond 7P : Outfall

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	28,293	70	
	28,293	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: North 1



Summary for Subcatchment 6S: North 3

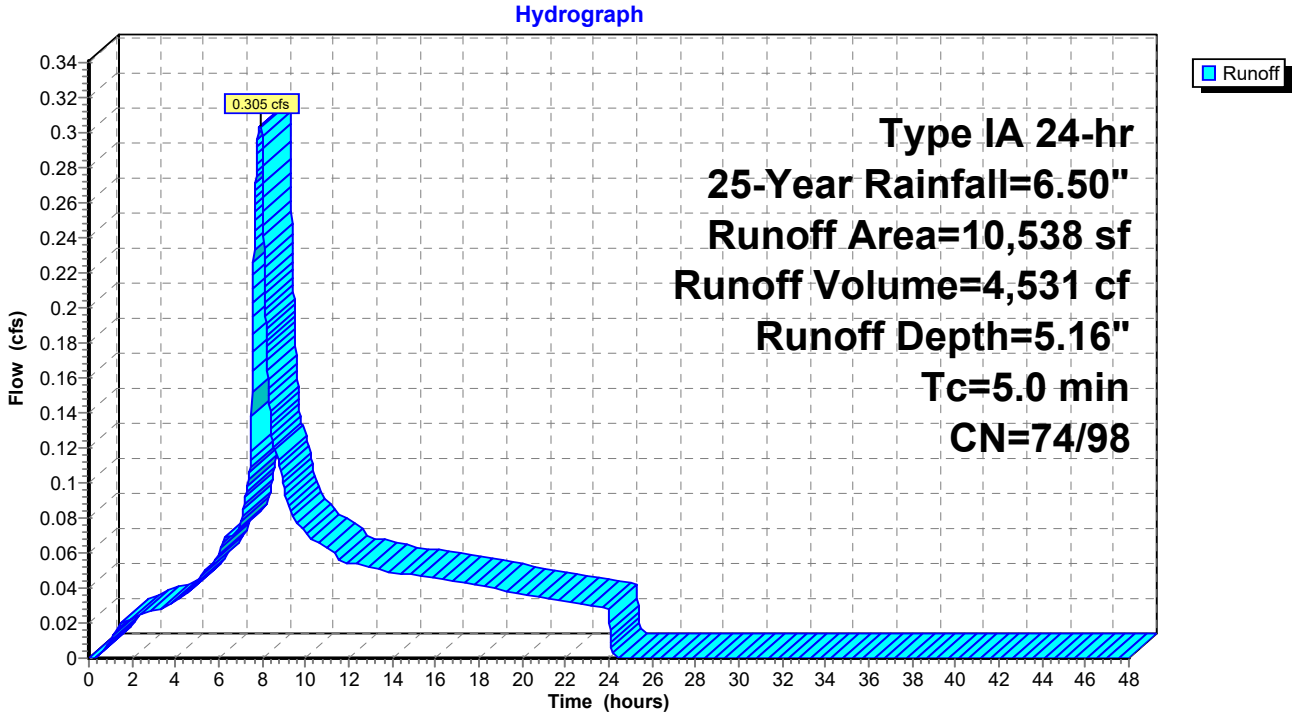
Runoff = 0.305 cfs @ 7.90 hrs, Volume= 4,531 cf, Depth= 5.16"
Routed to Pond 7P : Outfall

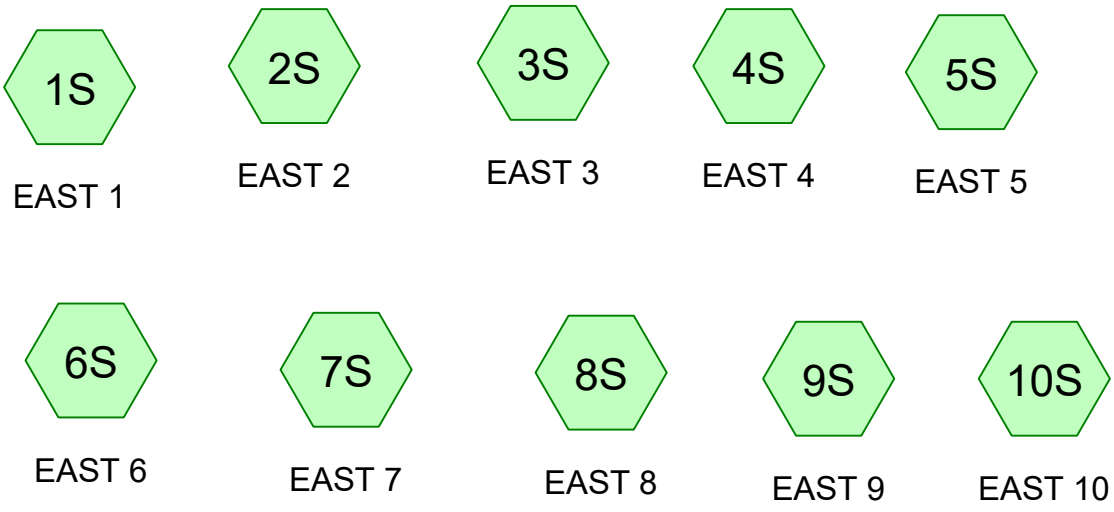
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	4,379	74	
*	6,159	98	
	10,538	88	Weighted Average
	4,379	74	41.55% Pervious Area
	6,159	98	58.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: North 3





Subcat Reach Pond Link

Routing Diagram for 21-C018 (IHI - Lincoln City) - Conveyance - EAST-1
Prepared by Froelich Engineers, Printed 2/24/2022

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	25-Year	Type IA 24-hr		Default	24.00	1	6.50	2

Time span=5.00-20.00 hrs, dt=0.01 hrs, 1501 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1S: EAST 1 Runoff Area=12,987 sf 0.00% Impervious Runoff Depth>2.74"
Tc=5.0 min CN=70/0 Runoff=0.222 cfs 2,962 cf

Subcatchment2S: EAST 2 Runoff Area=12,783 sf 80.22% Impervious Runoff Depth>4.54"
Tc=5.0 min CN=74/98 Runoff=0.413 cfs 4,841 cf

Subcatchment3S: EAST 3 Runoff Area=5,531 sf 54.17% Impervious Runoff Depth>4.07"
Tc=5.0 min CN=74/98 Runoff=0.156 cfs 1,878 cf

Subcatchment4S: EAST 4 Runoff Area=7,994 sf 93.21% Impervious Runoff Depth>4.78"
Tc=5.0 min CN=74/98 Runoff=0.274 cfs 3,184 cf

Subcatchment5S: EAST 5 Runoff Area=5,038 sf 89.44% Impervious Runoff Depth>4.71"
Tc=5.0 min CN=74/98 Runoff=0.170 cfs 1,978 cf

Subcatchment6S: EAST 6 Runoff Area=2,803 sf 96.58% Impervious Runoff Depth>4.84"
Tc=5.0 min CN=74/98 Runoff=0.098 cfs 1,131 cf

Subcatchment7S: EAST 7 Runoff Area=11,230 sf 92.26% Impervious Runoff Depth>4.76"
Tc=5.0 min CN=74/98 Runoff=0.384 cfs 4,456 cf

Subcatchment8S: EAST 8 Runoff Area=8,435 sf 70.80% Impervious Runoff Depth>4.37"
Tc=5.0 min CN=74/98 Runoff=0.260 cfs 3,075 cf

Subcatchment9S: EAST 9 Runoff Area=15,711 sf 52.34% Impervious Runoff Depth>4.04"
Tc=5.0 min CN=74/98 Runoff=0.439 cfs 5,290 cf

Subcatchment10S: EAST 10 Runoff Area=9,459 sf 68.99% Impervious Runoff Depth>4.34"
Tc=5.0 min CN=74/98 Runoff=0.289 cfs 3,422 cf

Total Runoff Area = 91,971 sf Runoff Volume = 32,216 cf Average Runoff Depth = 4.20"
35.85% Pervious = 32,975 sf 64.15% Impervious = 58,996 sf

Summary for Subcatchment 1S: EAST 1

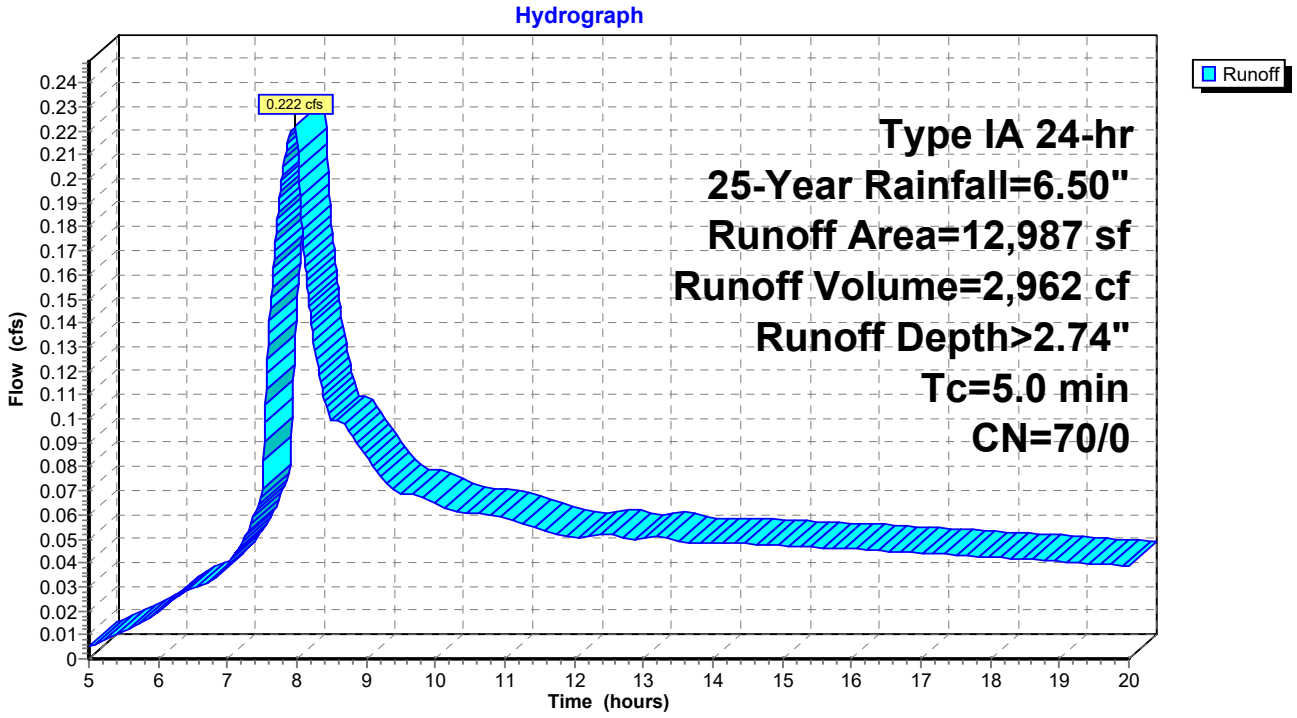
Runoff = 0.222 cfs @ 7.97 hrs, Volume= 2,962 cf, Depth> 2.74"
Routed to nonexistent node 11p

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	12,987	70	
	12,987	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 1S: EAST 1



Summary for Subcatchment 2S: EAST 2

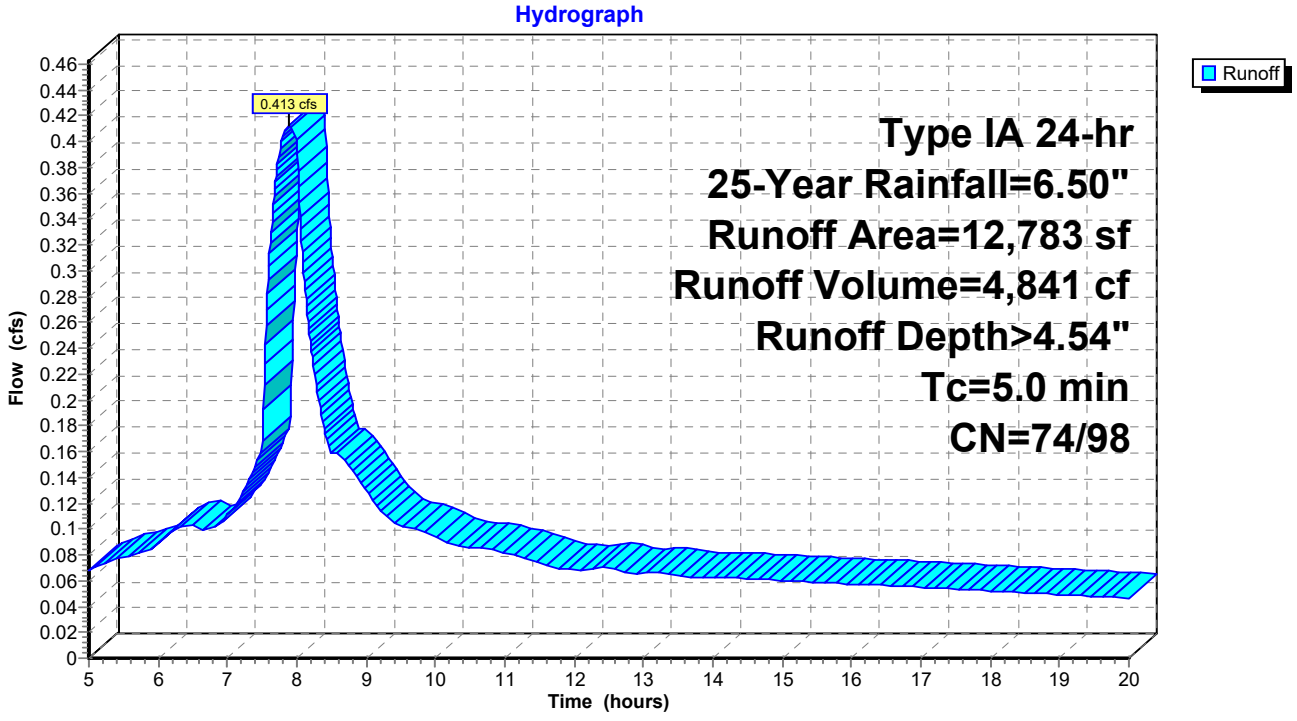
Runoff = 0.413 cfs @ 7.88 hrs, Volume= 4,841 cf, Depth> 4.54"
Routed to nonexistent node 10p

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	2,529	74	
	10,254	98	Paved roads w/curbs & sewers, HSG C
	12,783	93	Weighted Average
	2,529	74	19.78% Pervious Area
	10,254	98	80.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: EAST 2



Summary for Subcatchment 3S: EAST 3

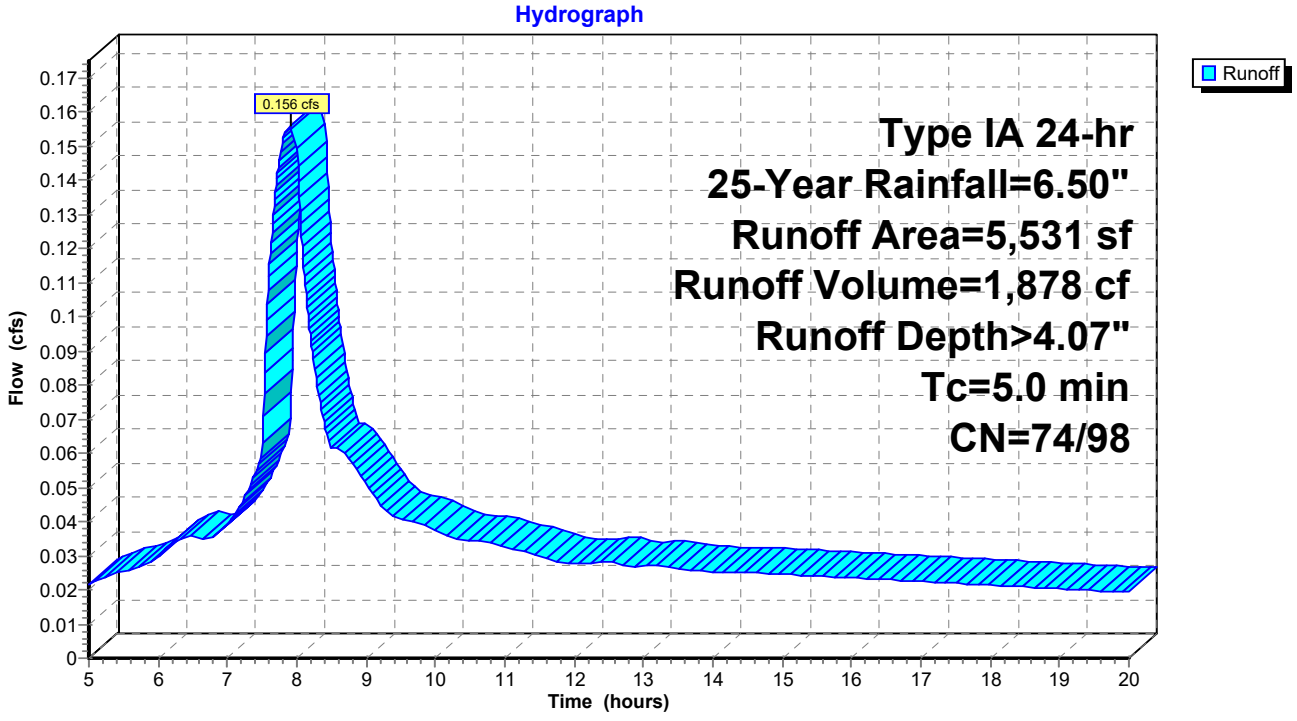
Runoff = 0.156 cfs @ 7.90 hrs, Volume= 1,878 cf, Depth> 4.07"
Routed to nonexistent node 10p

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	2,535	74	
*	2,996	98	
	5,531	87	Weighted Average
	2,535	74	45.83% Pervious Area
	2,996	98	54.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: EAST 3



Summary for Subcatchment 4S: EAST 4

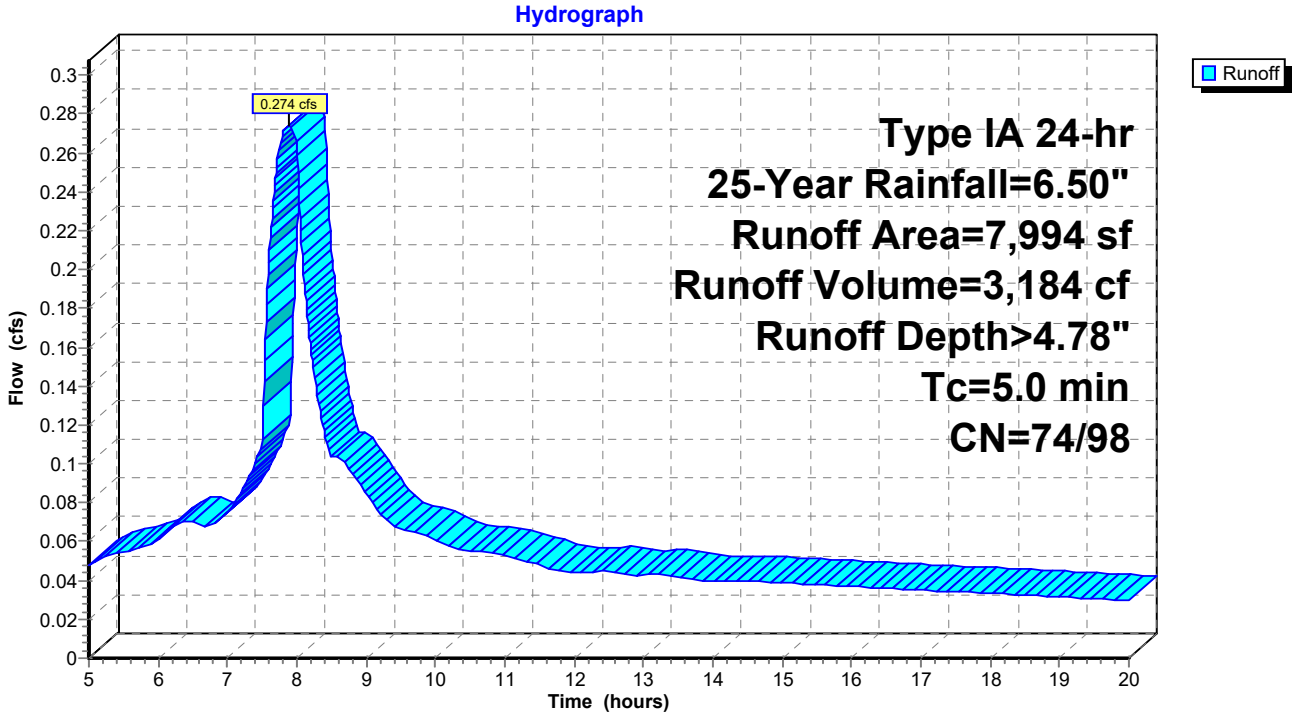
Runoff = 0.274 cfs @ 7.88 hrs, Volume= 3,184 cf, Depth> 4.78"
Routed to nonexistent node 12p

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	543	74	
*	7,451	98	
	7,994	96	Weighted Average
	543	74	6.79% Pervious Area
	7,451	98	93.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4S: EAST 4



Summary for Subcatchment 5S: EAST 5

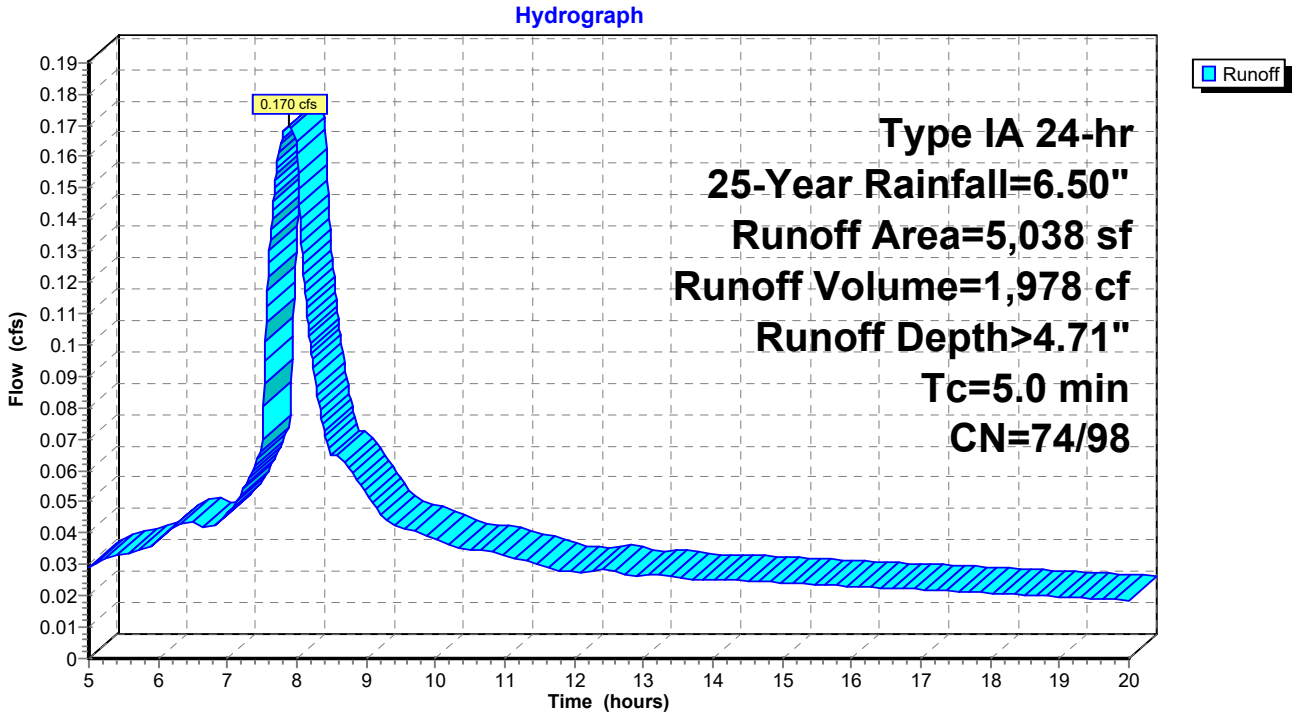
Runoff = 0.170 cfs @ 7.88 hrs, Volume= 1,978 cf, Depth> 4.71"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	532	74	
	4,506	98	Paved roads w/curbs & sewers, HSG C
	5,038	95	Weighted Average
	532	74	10.56% Pervious Area
	4,506	98	89.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: EAST 5



Summary for Subcatchment 6S: EAST 6

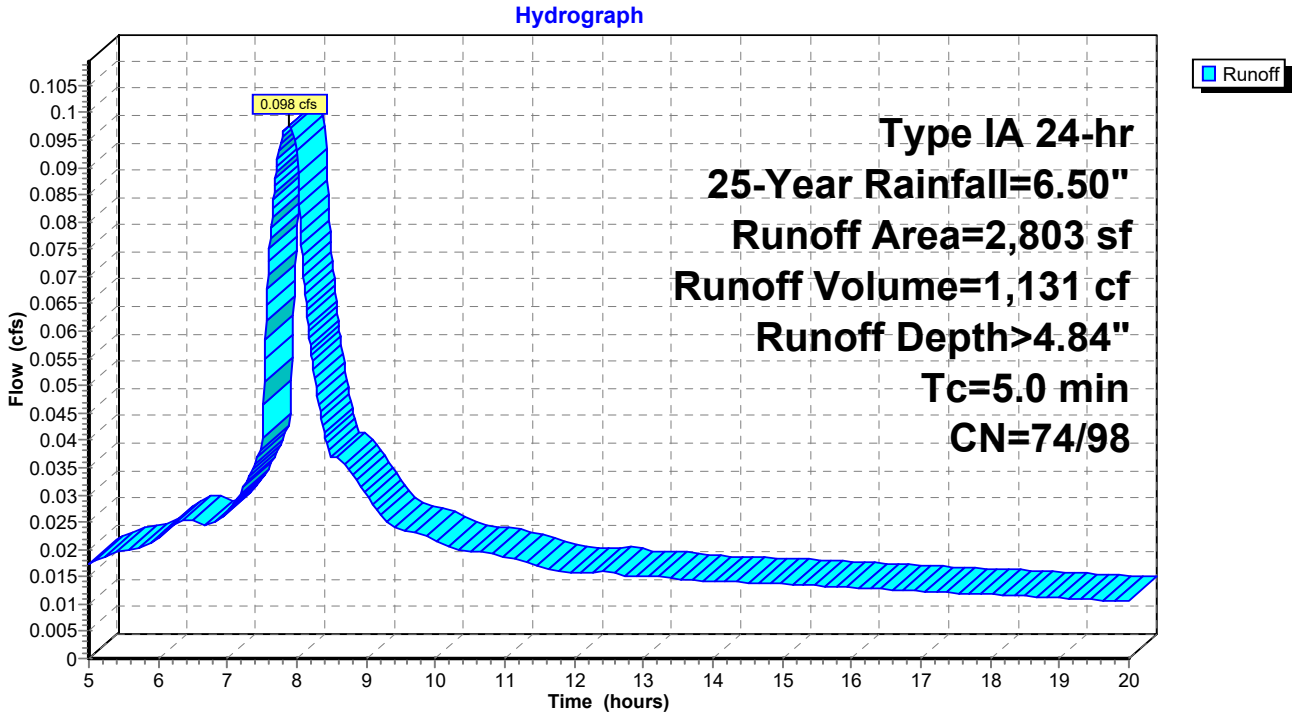
Runoff = 0.098 cfs @ 7.88 hrs, Volume= 1,131 cf, Depth> 4.84"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	96	74	
*	2,707	98	
	2,803	97	Weighted Average
	96	74	3.42% Pervious Area
	2,707	98	96.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: EAST 6



Summary for Subcatchment 7S: EAST 7

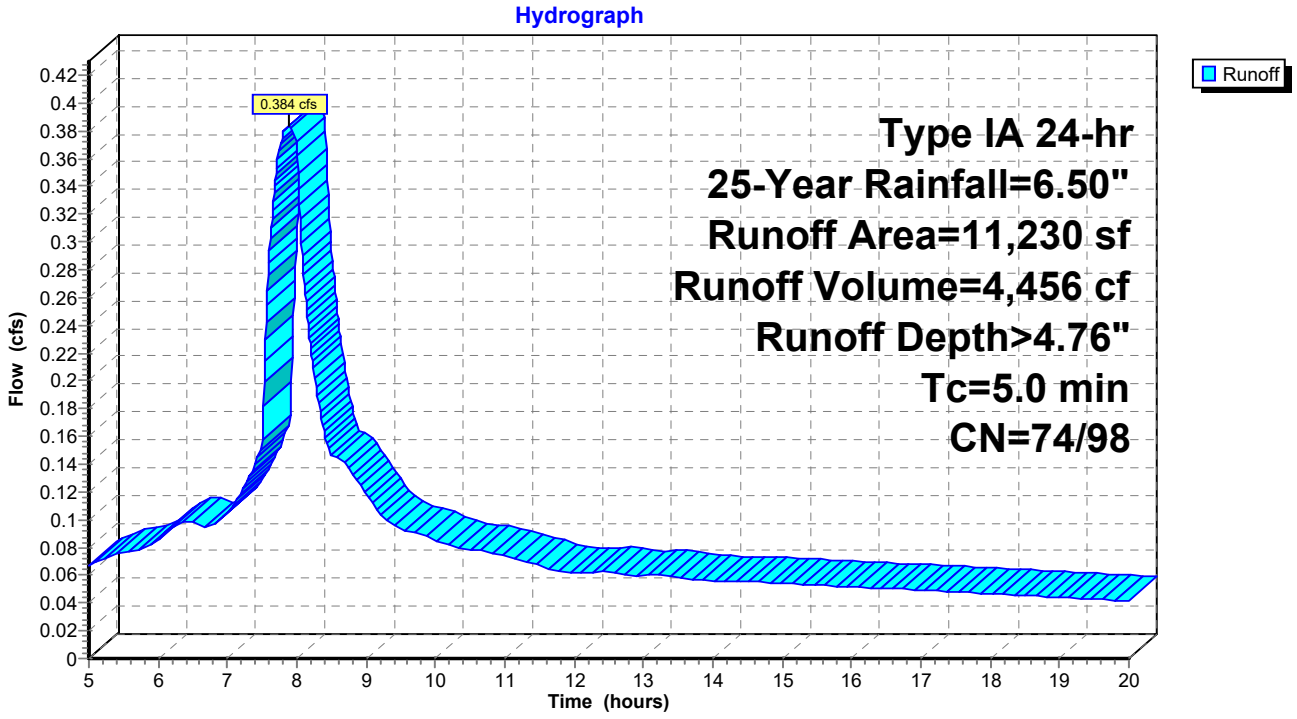
Runoff = 0.384 cfs @ 7.88 hrs, Volume= 4,456 cf, Depth> 4.76"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	869	74	
*	10,361	98	
	11,230	96	Weighted Average
	869	74	7.74% Pervious Area
	10,361	98	92.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7S: EAST 7



Summary for Subcatchment 8S: EAST 8

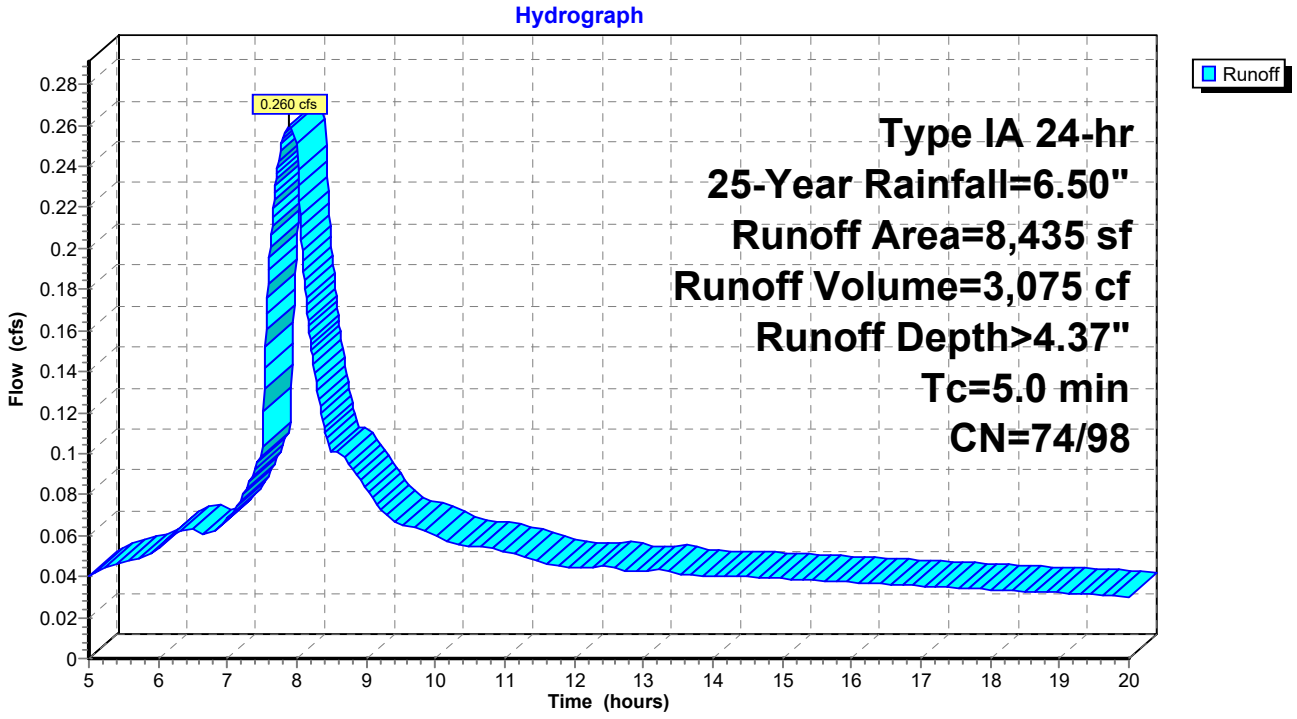
Runoff = 0.260 cfs @ 7.89 hrs, Volume= 3,075 cf, Depth> 4.37"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	2,463	74	
*	5,972	98	
	8,435	91	Weighted Average
	2,463	74	29.20% Pervious Area
	5,972	98	70.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 8S: EAST 8



Summary for Subcatchment 9S: EAST 9

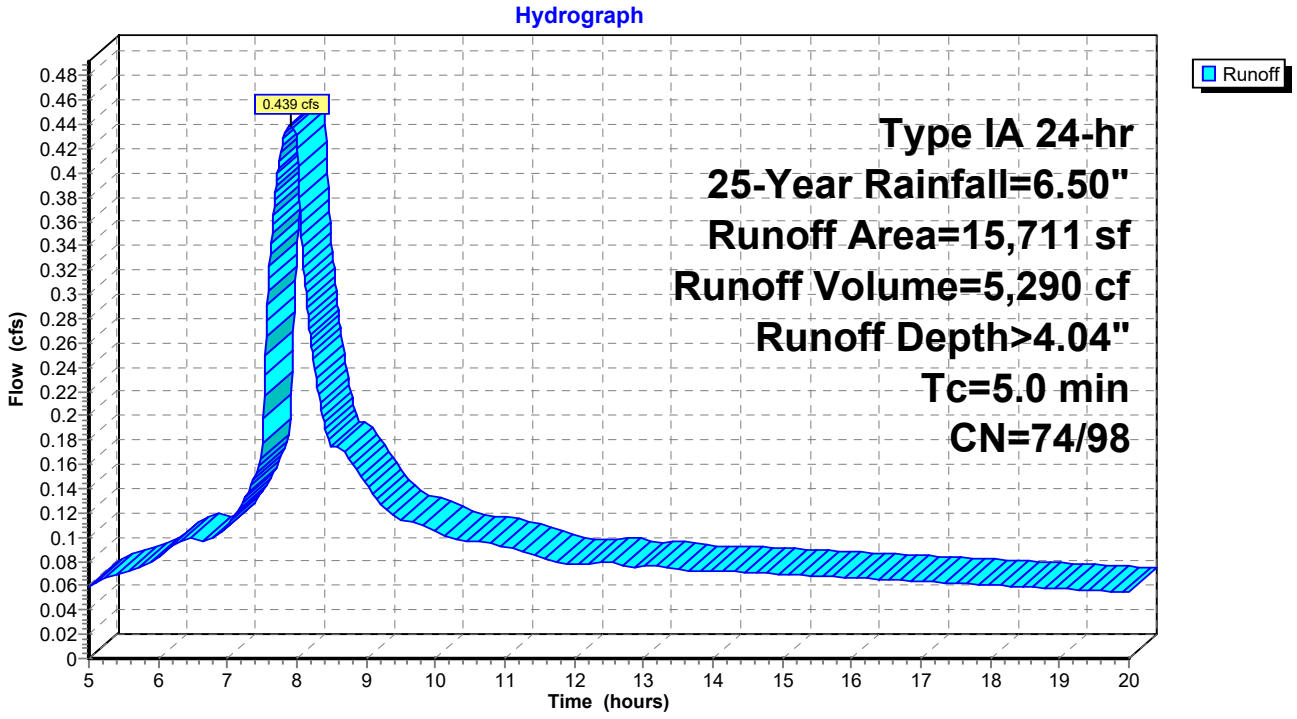
Runoff = 0.439 cfs @ 7.90 hrs, Volume= 5,290 cf, Depth> 4.04"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	7,488	74	
*	8,223	98	
	15,711	87	Weighted Average
	7,488	74	47.66% Pervious Area
	8,223	98	52.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9S: EAST 9



Summary for Subcatchment 10S: EAST 10

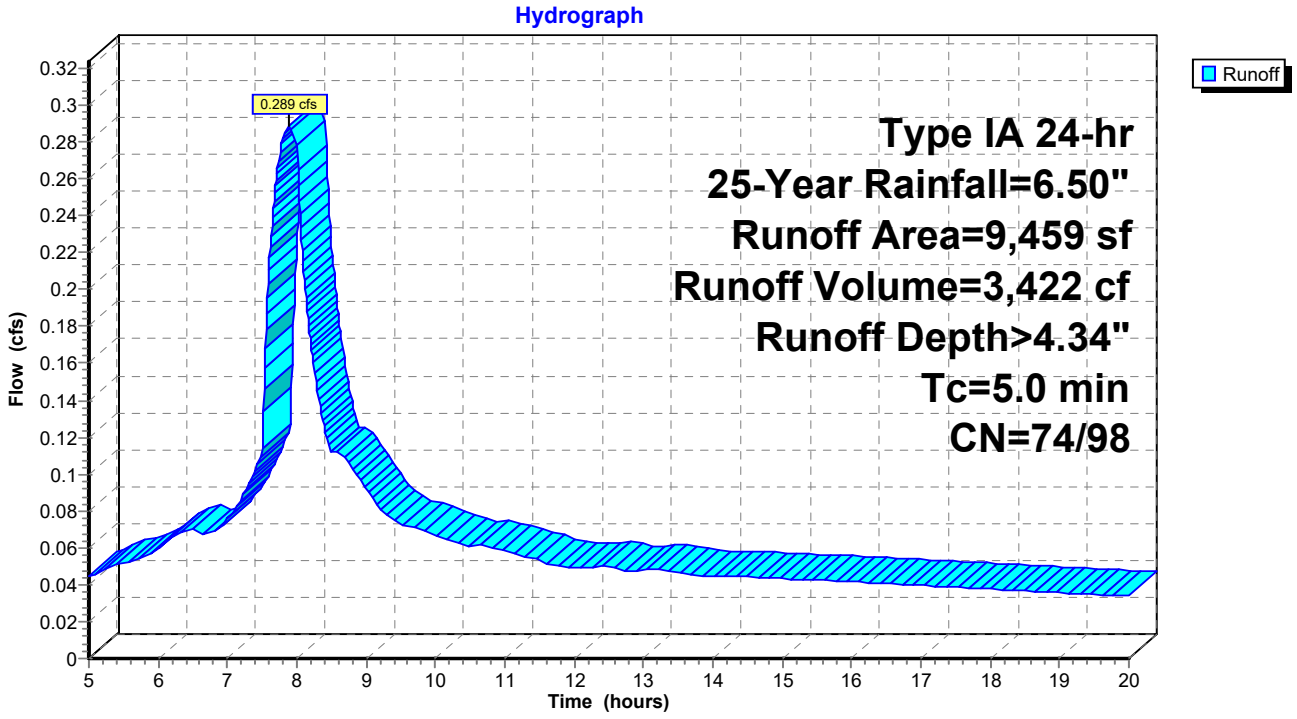
Runoff = 0.289 cfs @ 7.89 hrs, Volume= 3,422 cf, Depth> 4.34"

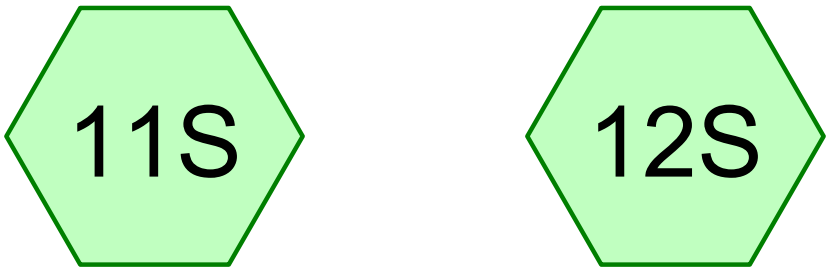
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	2,933	74	
	6,526	98	Paved roads w/curbs & sewers, HSG C
	9,459	91	Weighted Average
	2,933	74	31.01% Pervious Area
	6,526	98	68.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 10S: EAST 10





Subcat Reach Pond Link

Routing Diagram for 21-C018 (IHI - Lincoln City) - Conveyance - EAST-2
Prepared by Froelich Engineers, Printed 2/24/2022

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	25-Year	Type IA 24-hr		Default	24.00	1	6.50	2

Time span=5.00-20.00 hrs, dt=0.01 hrs, 1501 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment11S: EAST 11 Runoff Area=7,830 sf 94.39% Impervious Runoff Depth>4.80"
Tc=5.0 min CN=74/98 Runoff=0.270 cfs 3,132 cf

Subcatchment12S: EAST 12 Runoff Area=9,542 sf 90.43% Impervious Runoff Depth>4.73"
Tc=5.0 min CN=74/98 Runoff=0.323 cfs 3,760 cf

Total Runoff Area = 17,372 sf Runoff Volume = 6,893 cf Average Runoff Depth = 4.76"
7.78% Pervious = 1,352 sf 92.22% Impervious = 16,020 sf

Summary for Subcatchment 11S: EAST 11

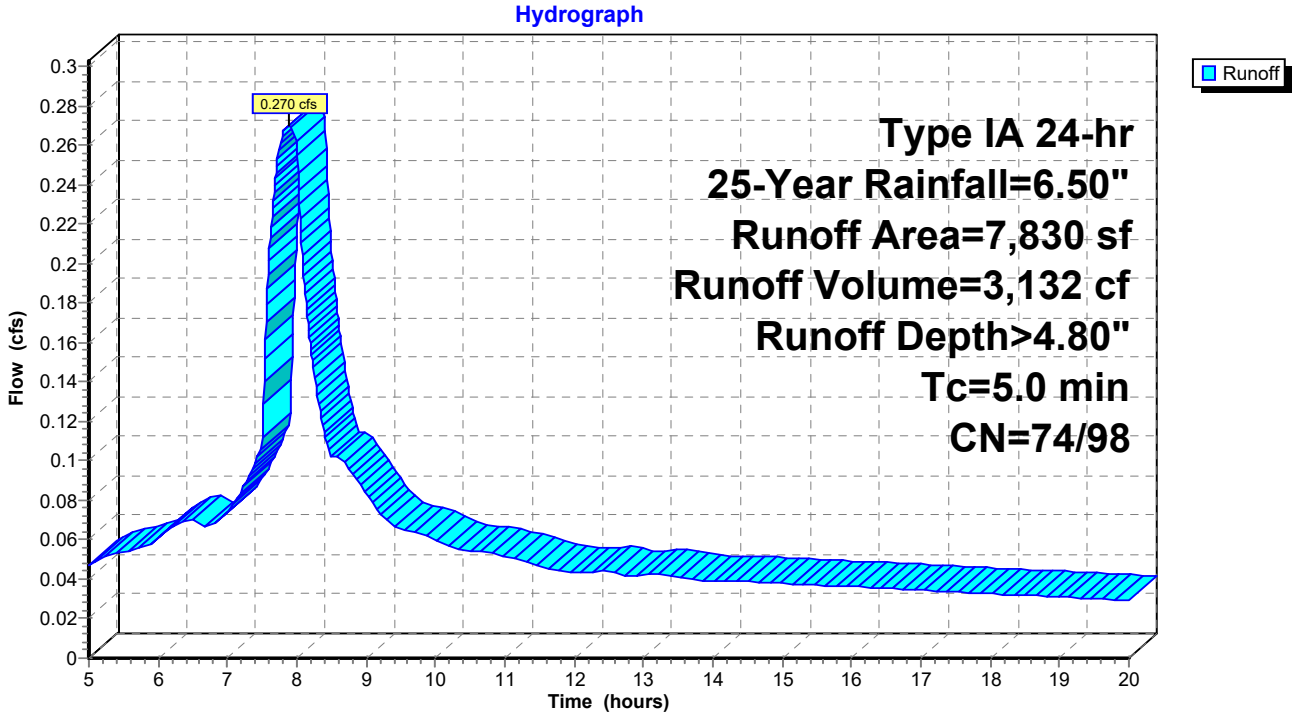
Runoff = 0.270 cfs @ 7.88 hrs, Volume= 3,132 cf, Depth> 4.80"
Routed to nonexistent node 11p

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	439	74	
*	7,391	98	
	7,830	97	Weighted Average
	439	74	5.61% Pervious Area
	7,391	98	94.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 11S: EAST 11



Summary for Subcatchment 12S: EAST 12

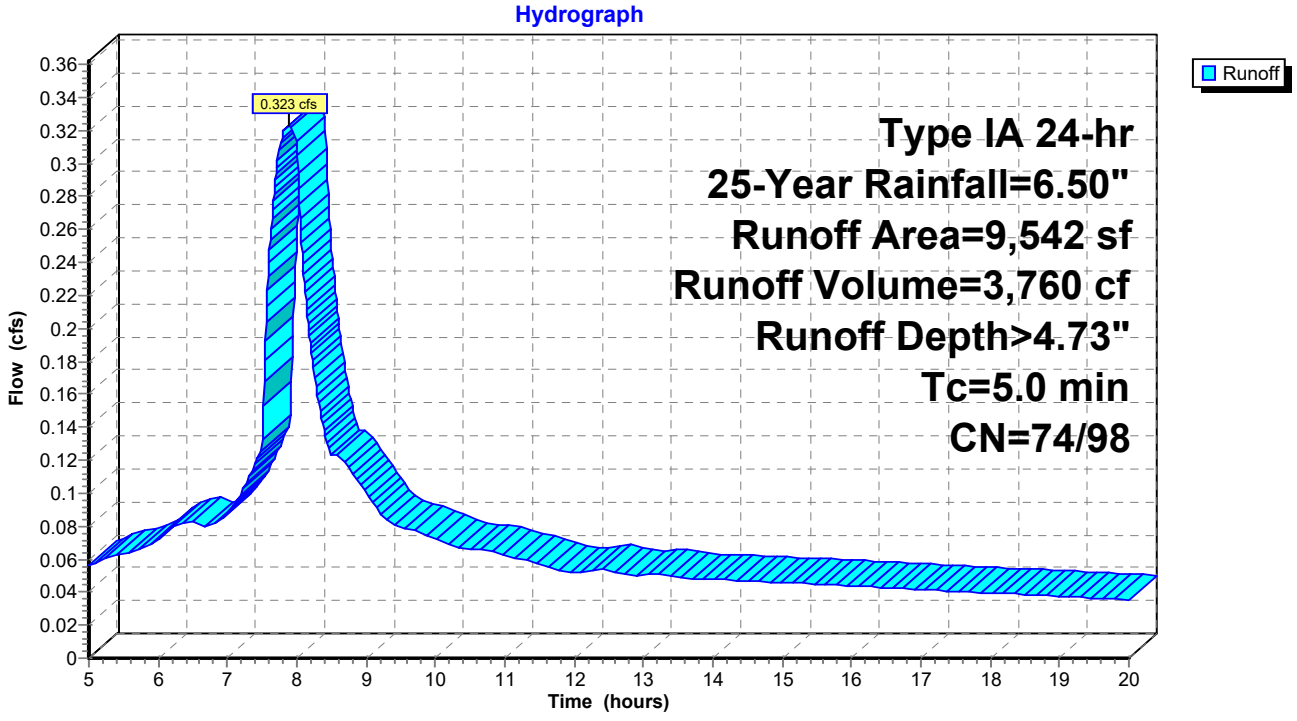
Runoff = 0.323 cfs @ 7.88 hrs, Volume= 3,760 cf, Depth> 4.73"
Routed to nonexistent node 10p

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=6.50"

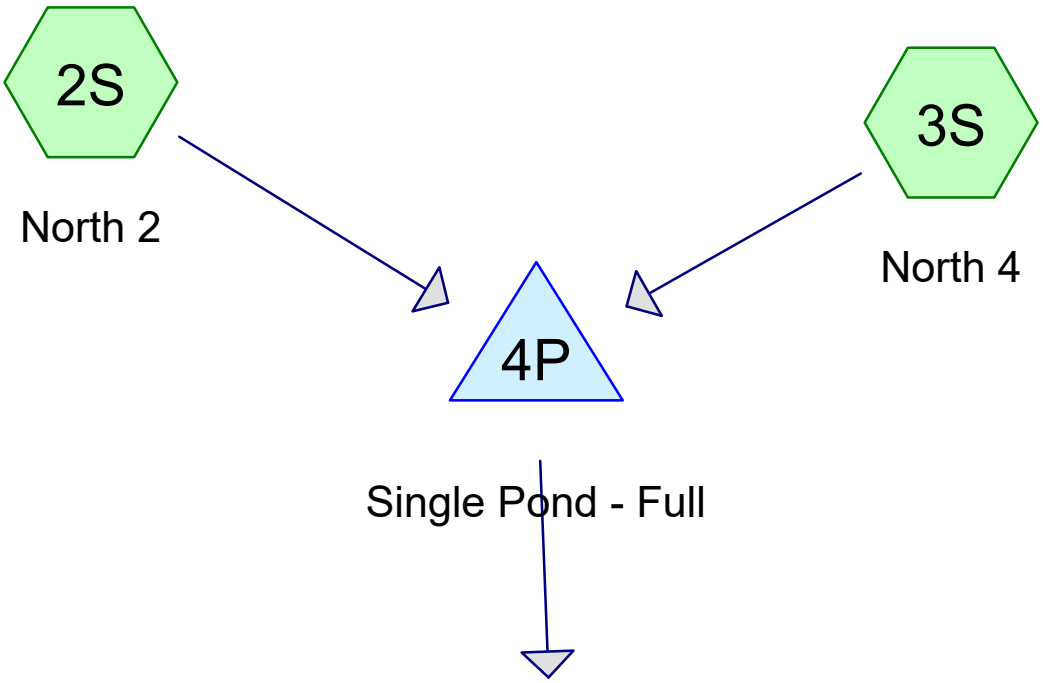
	Area (sf)	CN	Description
*	913	74	
*	8,629	98	
	9,542	96	Weighted Average
	913	74	9.57% Pervious Area
	8,629	98	90.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 12S: EAST 12



Appendix H: Water Quality Calculations



Subcat Reach Pond Link

Routing Diagram for 21-C018 (IHI - Lincoln City) - Discharge North
Prepared by Froelich Engineers, Printed 2/21/2022

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	WQ	Type IA 24-hr		Default	24.00	1	2.10	2

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment2S: North 2 Runoff Area=24,871 sf 90.61% Impervious Runoff Depth=1.73"
Tc=5.0 min CN=74/98 Runoff=0.249 cfs 3,596 cf

Subcatchment3S: North 4 Runoff Area=14,116 sf 86.67% Impervious Runoff Depth=1.68"
Tc=5.0 min CN=74/98 Runoff=0.135 cfs 1,973 cf

Pond 4P: Single Pond - Full Peak Elev=0.88' Storage=285 cf Inflow=0.384 cfs 5,568 cf
Outflow=0.314 cfs 5,568 cf

Total Runoff Area = 38,987 sf Runoff Volume = 5,568 cf Average Runoff Depth = 1.71"
10.82% Pervious = 4,217 sf 89.18% Impervious = 34,770 sf

Summary for Subcatchment 2S: North 2

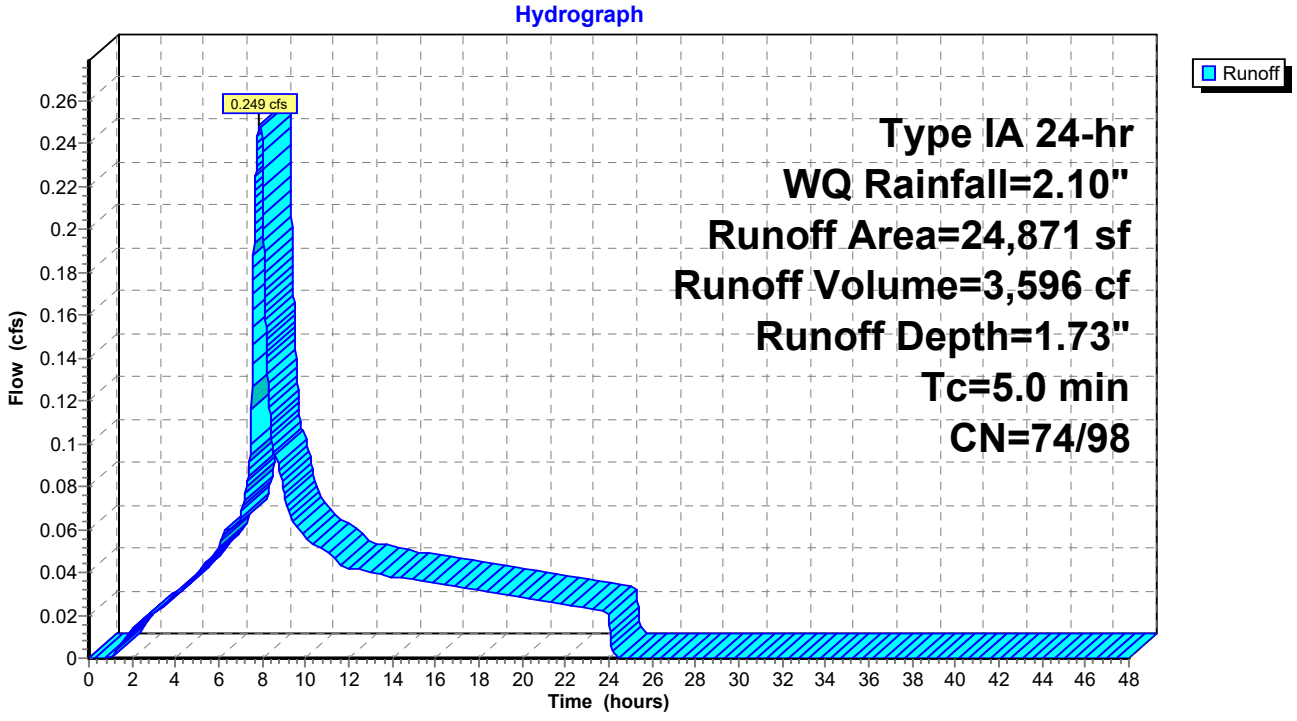
Runoff = 0.249 cfs @ 7.89 hrs, Volume= 3,596 cf, Depth= 1.73"
Routed to Pond 4P : Single Pond - Full

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=2.10"

	Area (sf)	CN	Description
*	2,336	74	
*	22,535	98	
	24,871	96	Weighted Average
	2,336	74	9.39% Pervious Area
	22,535	98	90.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: North 2



Summary for Subcatchment 3S: North 4

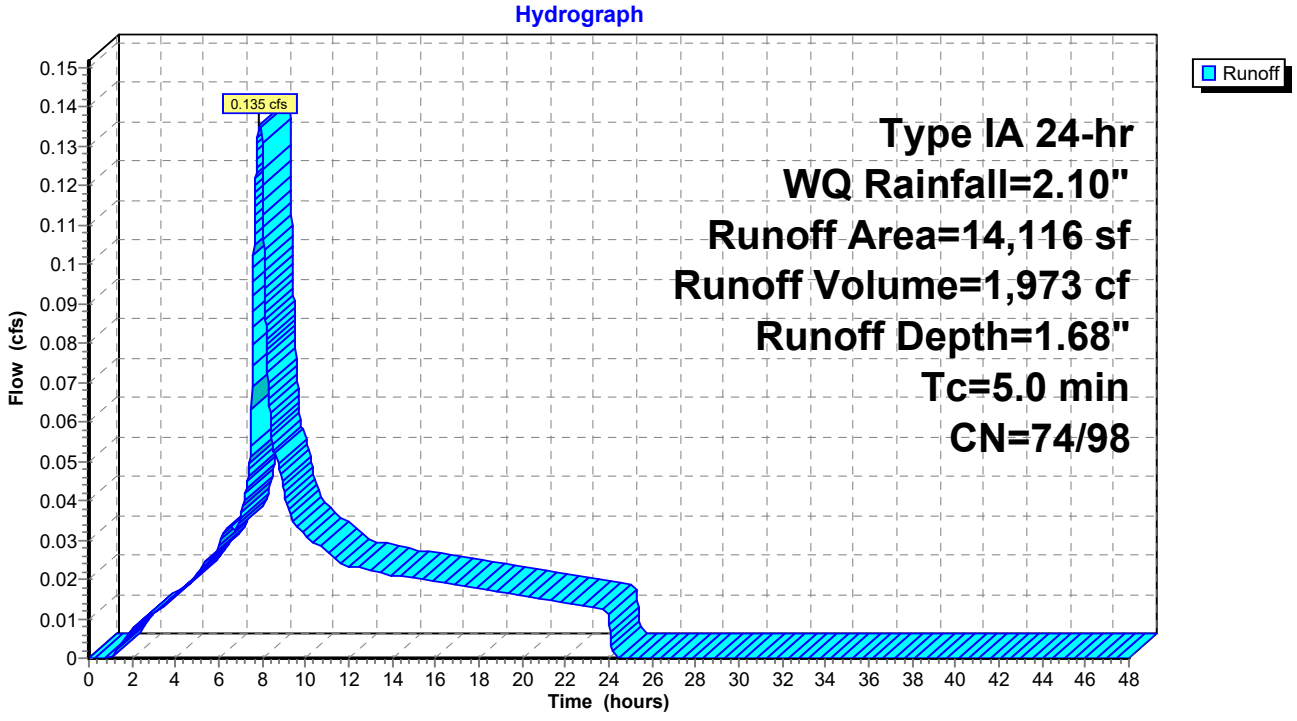
Runoff = 0.135 cfs @ 7.89 hrs, Volume= 1,973 cf, Depth= 1.68"
Routed to Pond 4P : Single Pond - Full

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=2.10"

	Area (sf)	CN	Description
	1,881	74	
*	12,235	98	
	14,116	95	Weighted Average
	1,881	74	13.33% Pervious Area
	12,235	98	86.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: North 4



Summary for Pond 4P: Single Pond - Full

Inflow Area = 38,987 sf, 89.18% Impervious, Inflow Depth = 1.71" for WQ event
Inflow = 0.384 cfs @ 7.89 hrs, Volume= 5,568 cf
Outflow = 0.314 cfs @ 8.06 hrs, Volume= 5,568 cf, Atten= 18%, Lag= 10.0 min
Primary = 0.314 cfs @ 8.06 hrs, Volume= 5,568 cf
Routed to Pond 7P : Outfall

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 0.88' @ 8.06 hrs Surf.Area= 850 sf Storage= 285 cf

Plug-Flow detention time= 15.9 min calculated for 5,567 cf (100% of inflow)
Center-of-Mass det. time= 16.0 min (701.0 - 685.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	1,005 cf	**17.00'W x 50.00'L x 4.50'H Field A** 3,825 cf Overall - 1,311 cf Embedded = 2,514 cf x 40.0% Voids
#2A	0.50'	1,051 cf	**ADS N-12 36"** x 6 Inside #1 Inside= 36.1"W x 36.1"H => 7.10 sf x 20.00'L = 142.0 cf Outside= 42.0"W x 42.0"H => 8.86 sf x 20.00'L = 177.2 cf 6 Chambers in 3 Rows 14.00' Header x 7.10 sf x 2 = 198.8 cf Inside
		2,056 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**3.75" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	2.75'	**6.00" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.314 cfs @ 8.06 hrs HW=0.88' TW=0.00' (Dynamic Tailwater)
1=Orifice/Grate (Orifice Controls 0.314 cfs @ 4.09 fps)
2=Orifice/Grate (Controls 0.000 cfs)

Pond 4P: Single Pond - Full - Chamber Wizard Field A

Chamber Model = ADS N-12 36" (ADS N-12® Pipe)
Inside= 36.1"W x 36.1"H => 7.10 sf x 20.00'L = 142.0 cf
Outside= 42.0"W x 42.0"H => 8.86 sf x 20.00'L = 177.2 cf

42.0" Wide + 21.0" Spacing = 63.0" C-C Row Spacing

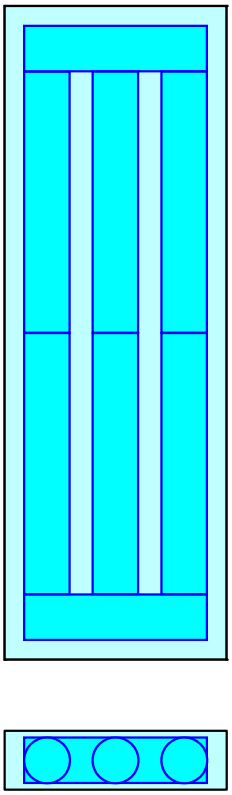
2 Chambers/Row x 20.00' Long +3.50' Header x 2 = 47.00' Row Length +18.0" End Stone x 2 = 50.00' Base Length
3 Rows x 42.0" Wide + 21.0" Spacing x 2 + 18.0" Side Stone x 2 = 17.00' Base Width
6.0" Stone Base + 42.0" Chamber Height + 6.0" Stone Cover = 4.50' Field Height

6 Chambers x 142.0 cf + 14.00' Header x 7.10 sf x 2 = 1,050.8 cf Chamber Storage
6 Chambers x 177.2 cf + 14.00' Header x 8.86 sf x 2 = 1,311.4 cf Displacement

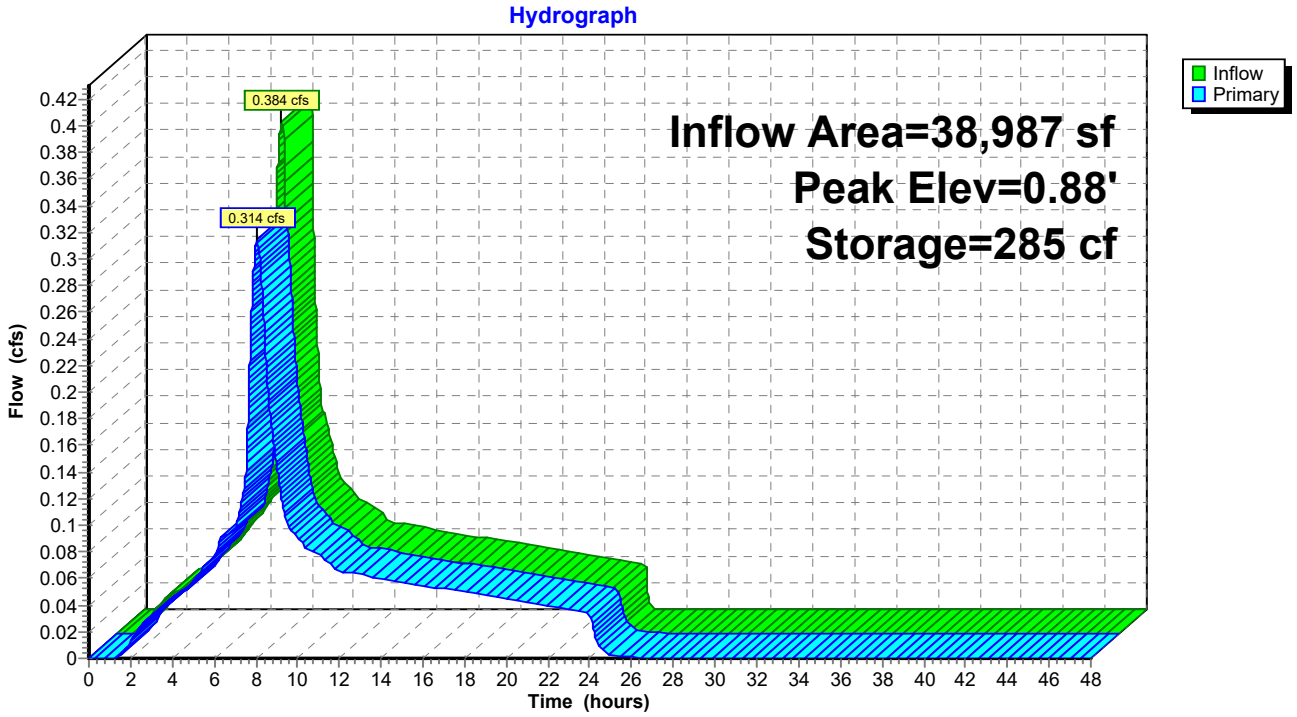
3,825.0 cf Field - 1,311.4 cf Chambers = 2,513.6 cf Stone x 40.0% Voids = 1,005.4 cf Stone Storage

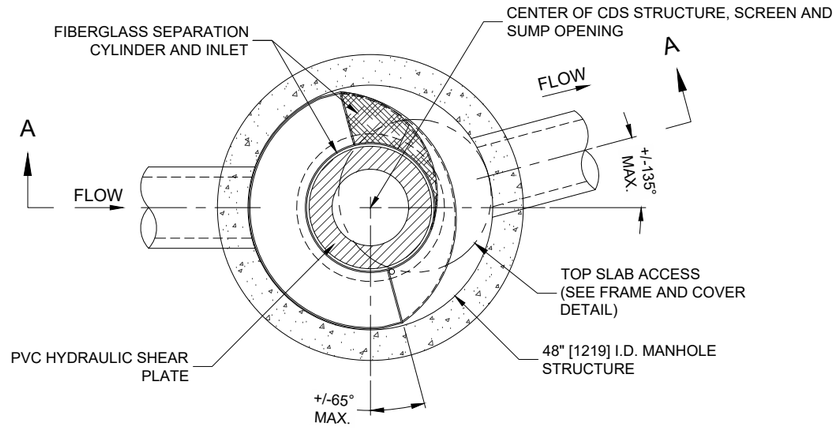
Chamber Storage + Stone Storage = 2,056.2 cf = 0.047 af
Overall Storage Efficiency = 53.8%
Overall System Size = 50.00' x 17.00' x 4.50'

6 Chambers
141.7 cy Field
93.1 cy Stone

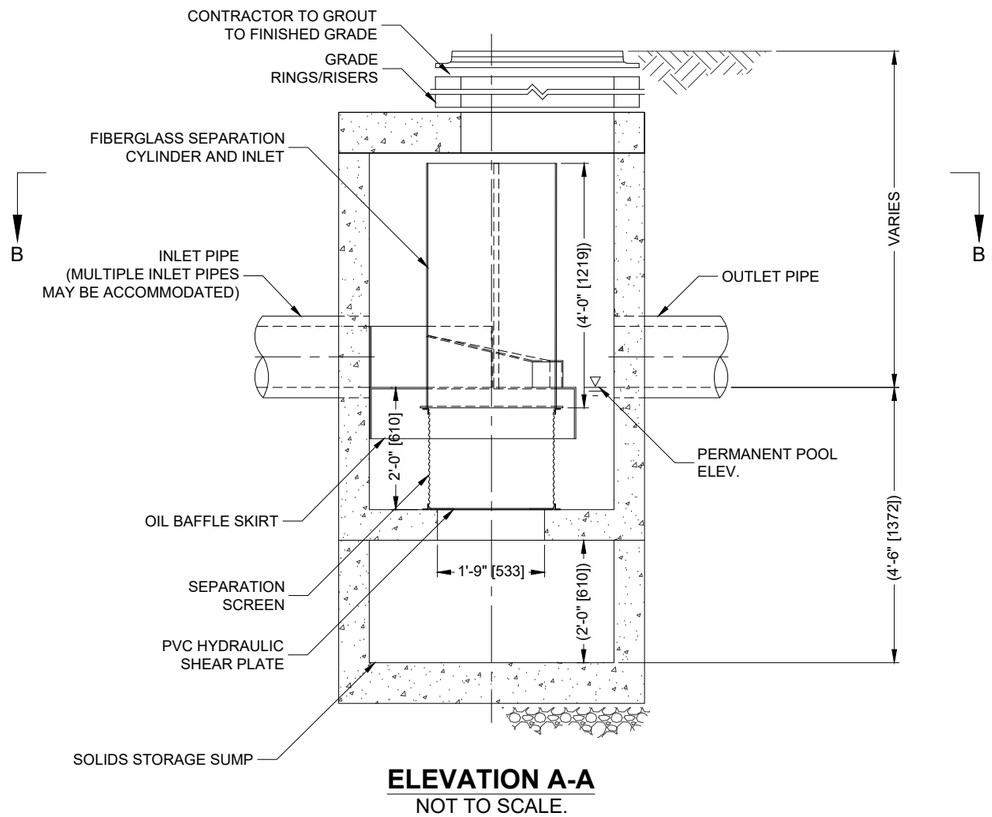


Pond 4P: Single Pond - Full





PLAN VIEW B-B
NOT TO SCALE.



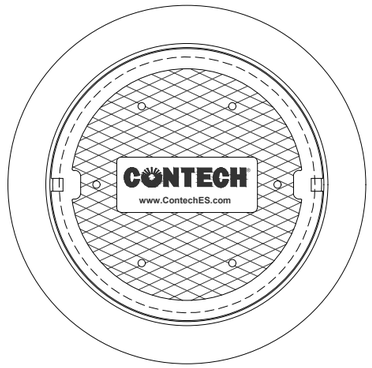
ELEVATION A-A
NOT TO SCALE.

CDS2015-4-C DESIGN NOTES

CDS2015-4-C RATED TREATMENT CAPACITY IS 0.7 CFS [19.8 L/s], OR PER LOCAL REGULATIONS. IF THE SITE CONDITIONS EXCEED MAXIMUM HYDRAULIC CAPACITY, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

CDS2015-4-C STANDARD CONFIGURATION IS SHOWN.

FOR NJDEP PROJECTS, PLEASE CONTACT YOUR LOCAL CONTECH REPRESENTATIVE FOR APPROVED CONFIGURATIONS.



FRAME AND COVER
(DIAMETER VARIES)
NOT TO SCALE

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS OR L/s)			*
PEAK FLOW RATE (CFS OR L/s)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST	WIDTH	HEIGHT	
	*	*	

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES

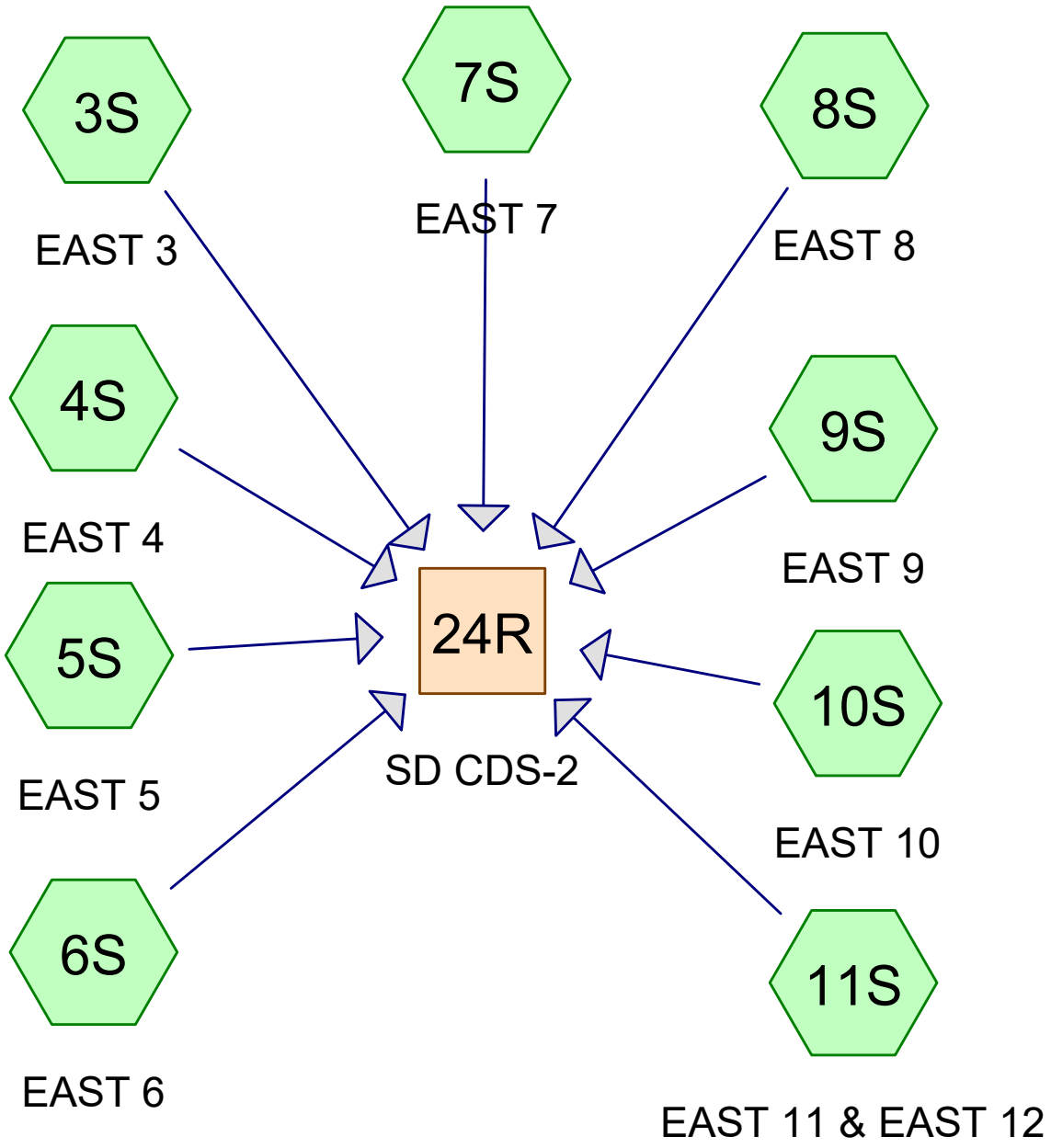
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO..
5. IF REQUIRED, PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.
6. CDS STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C-478 AND AASHTO LOAD FACTOR DESIGN METHOD.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE.
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET AND OUTLET PIPE(S). MATCH PIPE INVERTS WITH ELEVATIONS SHOWN. ALL PIPE CENTERLINES TO MATCH PIPE OPENING CENTERLINES.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS2015-4-C ONLINE CDS STANDARD DETAIL



Subcat Reach Pond Link

Routing Diagram for 21-C018 (IHI - Lincoln City) - WQ - EAST
Prepared by Froelich Engineers, Printed 2/24/2022

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	WQ	Type IA 24-hr		Default	24.00	1	2.10	2

Time span=5.00-20.00 hrs, dt=0.01 hrs, 1501 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment3S: EAST 3 Runoff Area=5,531 sf 54.17% Impervious Runoff Depth>0.97"
Tc=5.0 min CN=74/98 Runoff=0.035 cfs 447 cf

Subcatchment4S: EAST 4 Runoff Area=7,994 sf 93.21% Impervious Runoff Depth>1.44"
Tc=5.0 min CN=74/98 Runoff=0.082 cfs 962 cf

Subcatchment5S: EAST 5 Runoff Area=5,038 sf 89.44% Impervious Runoff Depth>1.40"
Tc=5.0 min CN=74/98 Runoff=0.050 cfs 587 cf

Subcatchment6S: EAST 6 Runoff Area=2,803 sf 96.58% Impervious Runoff Depth>1.49"
Tc=5.0 min CN=74/98 Runoff=0.030 cfs 347 cf

Subcatchment7S: EAST 7 Runoff Area=11,230 sf 92.26% Impervious Runoff Depth>1.43"
Tc=5.0 min CN=74/98 Runoff=0.114 cfs 1,341 cf

Subcatchment8S: EAST 8 Runoff Area=8,435 sf 70.80% Impervious Runoff Depth>1.17"
Tc=5.0 min CN=74/98 Runoff=0.067 cfs 823 cf

Subcatchment9S: EAST 9 Runoff Area=15,711 sf 52.34% Impervious Runoff Depth>0.95"
Tc=5.0 min CN=74/98 Runoff=0.095 cfs 1,240 cf

Subcatchment10S: EAST 10 Runoff Area=9,459 sf 68.99% Impervious Runoff Depth>1.15"
Tc=5.0 min CN=74/98 Runoff=0.073 cfs 906 cf

Subcatchment11S: EAST 11 & EAST 12 Runoff Area=17,372 sf 92.22% Impervious Runoff Depth>1.43"
Tc=5.0 min CN=74/98 Runoff=0.177 cfs 2,073 cf

Reach 24R: SD CDS-2 Inflow=0.722 cfs 8,726 cf
Outflow=0.722 cfs 8,726 cf

Total Runoff Area = 83,573 sf Runoff Volume = 8,726 cf Average Runoff Depth = 1.25"
22.51% Pervious = 18,811 sf 77.49% Impervious = 64,762 sf

Summary for Subcatchment 3S: EAST 3

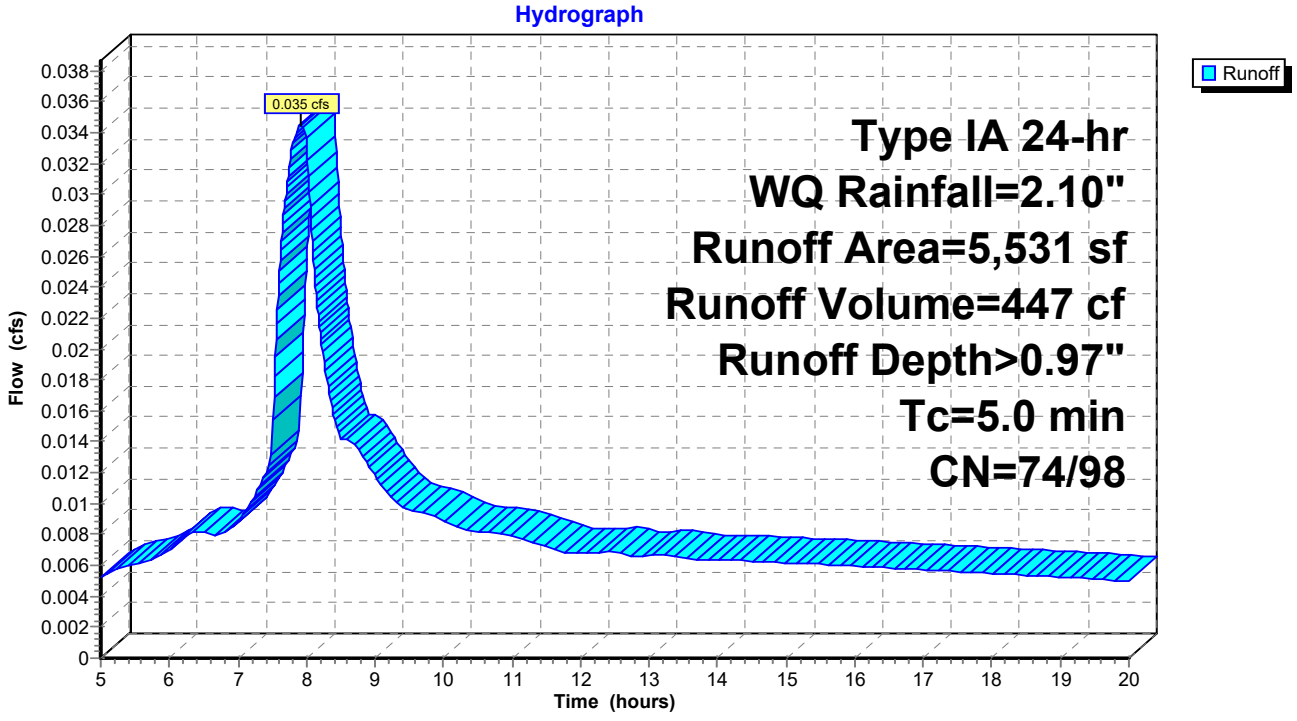
Runoff = 0.035 cfs @ 7.92 hrs, Volume= 447 cf, Depth> 0.97"
Routed to Reach 24R : SD CDS-2

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=2.10"

	Area (sf)	CN	Description
*	2,535	74	
*	2,996	98	
	5,531	87	Weighted Average
	2,535	74	45.83% Pervious Area
	2,996	98	54.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: EAST 3



Summary for Subcatchment 4S: EAST 4

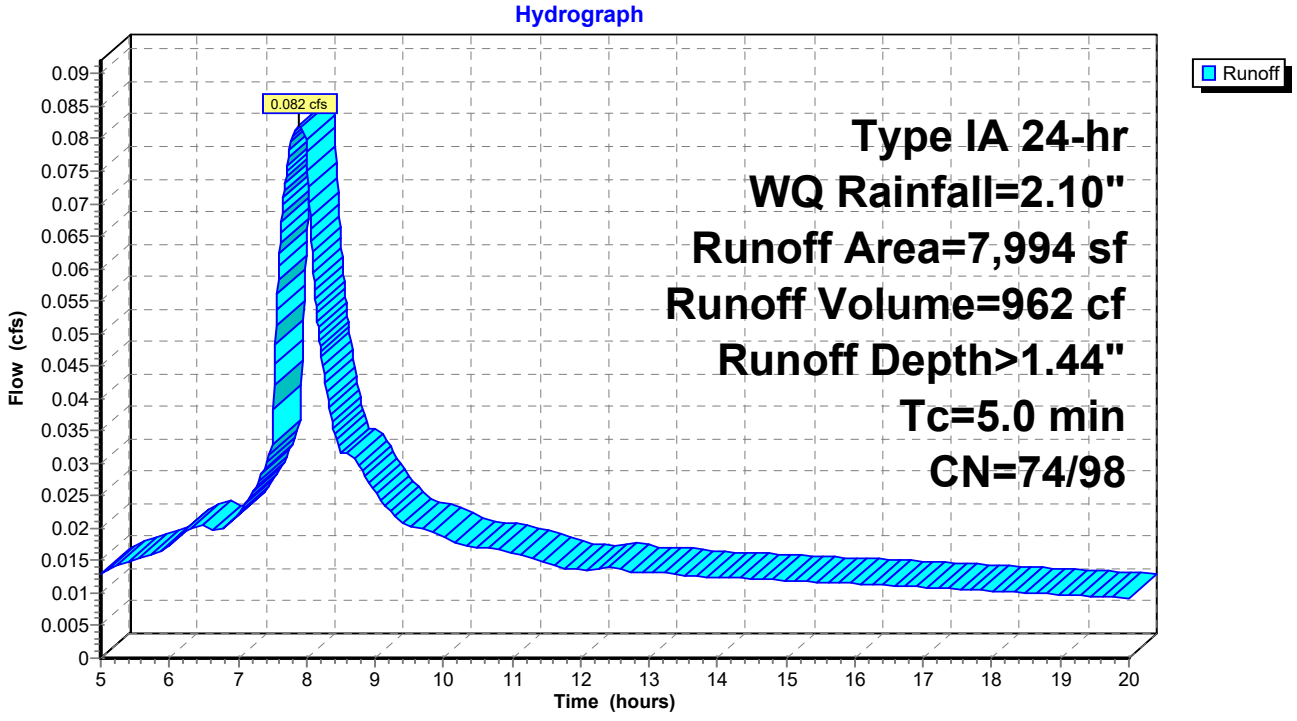
Runoff = 0.082 cfs @ 7.89 hrs, Volume= 962 cf, Depth> 1.44"
Routed to Reach 24R : SD CDS-2

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=2.10"

	Area (sf)	CN	Description
*	543	74	
*	7,451	98	
	7,994	96	Weighted Average
	543	74	6.79% Pervious Area
	7,451	98	93.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4S: EAST 4



Summary for Subcatchment 5S: EAST 5

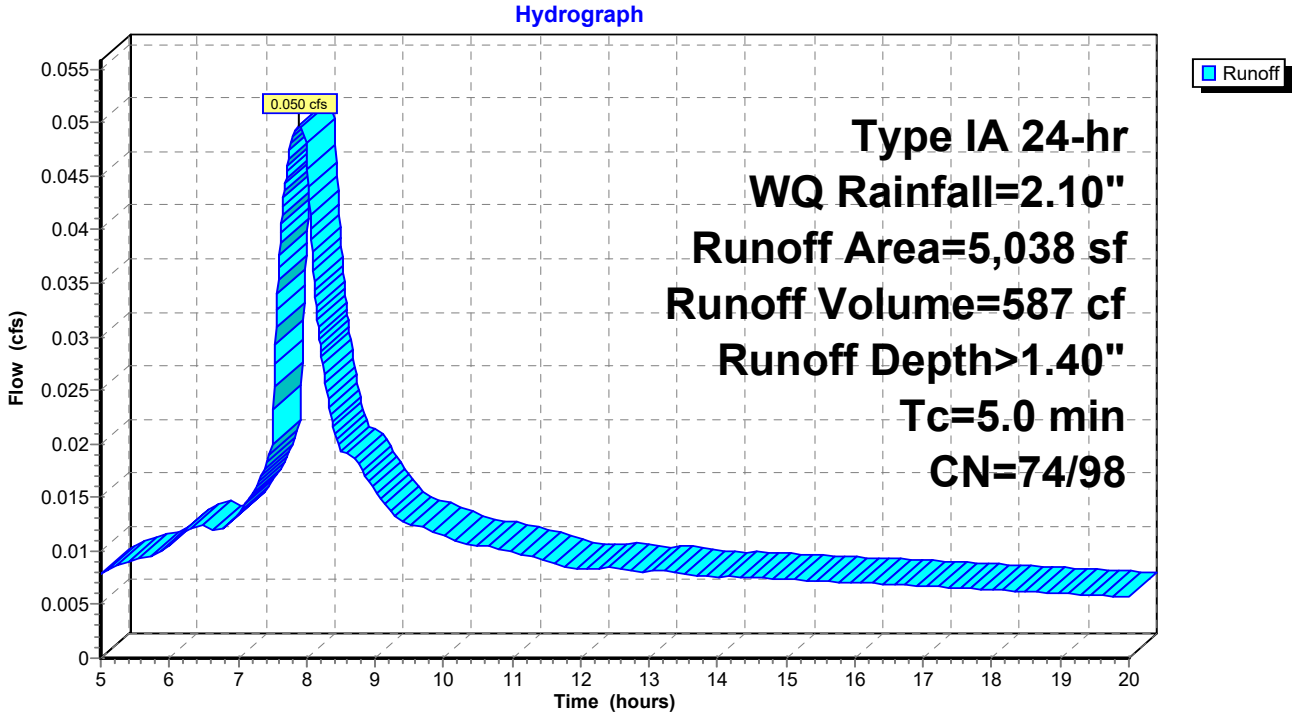
Runoff = 0.050 cfs @ 7.89 hrs, Volume= 587 cf, Depth> 1.40"
Routed to Reach 24R : SD CDS-2

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=2.10"

	Area (sf)	CN	Description
*	532	74	
	4,506	98	Paved roads w/curbs & sewers, HSG C
	5,038	95	Weighted Average
	532	74	10.56% Pervious Area
	4,506	98	89.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: EAST 5



Summary for Subcatchment 6S: EAST 6

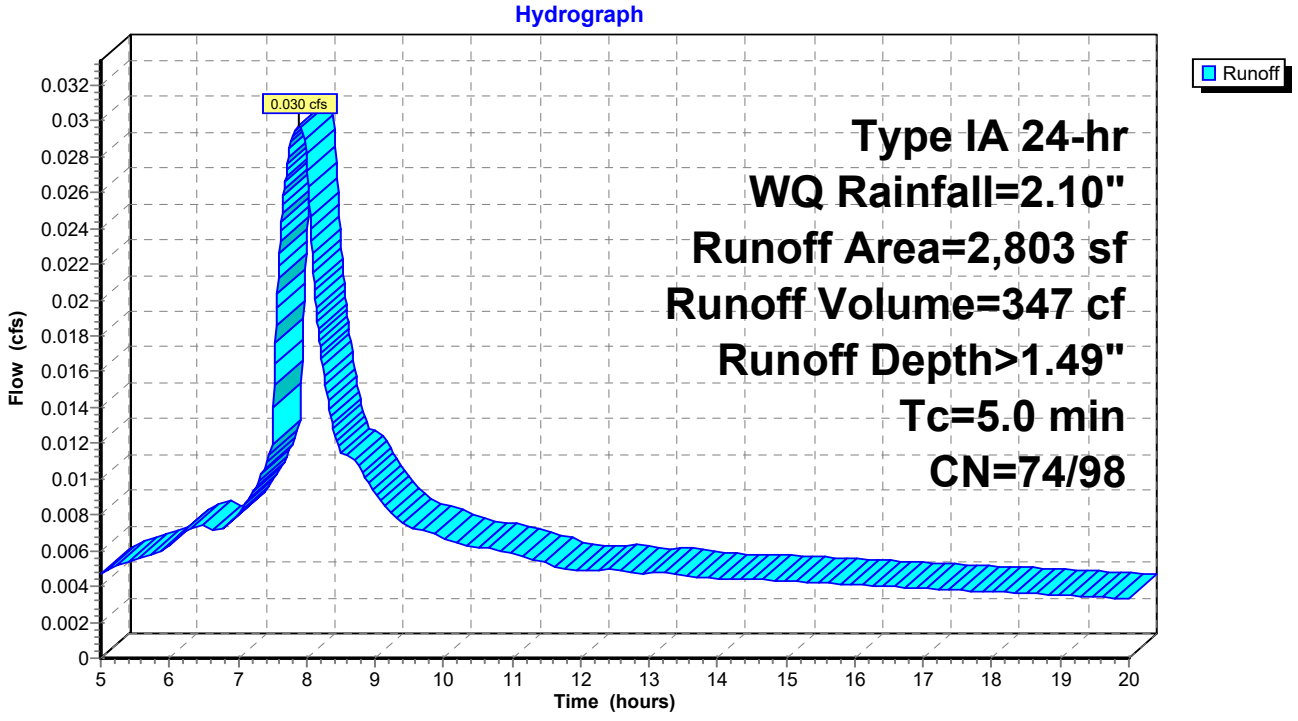
Runoff = 0.030 cfs @ 7.88 hrs, Volume= 347 cf, Depth> 1.49"
Routed to Reach 24R : SD CDS-2

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=2.10"

	Area (sf)	CN	Description
*	96	74	
*	2,707	98	
	2,803	97	Weighted Average
	96	74	3.42% Pervious Area
	2,707	98	96.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: EAST 6



Summary for Subcatchment 7S: EAST 7

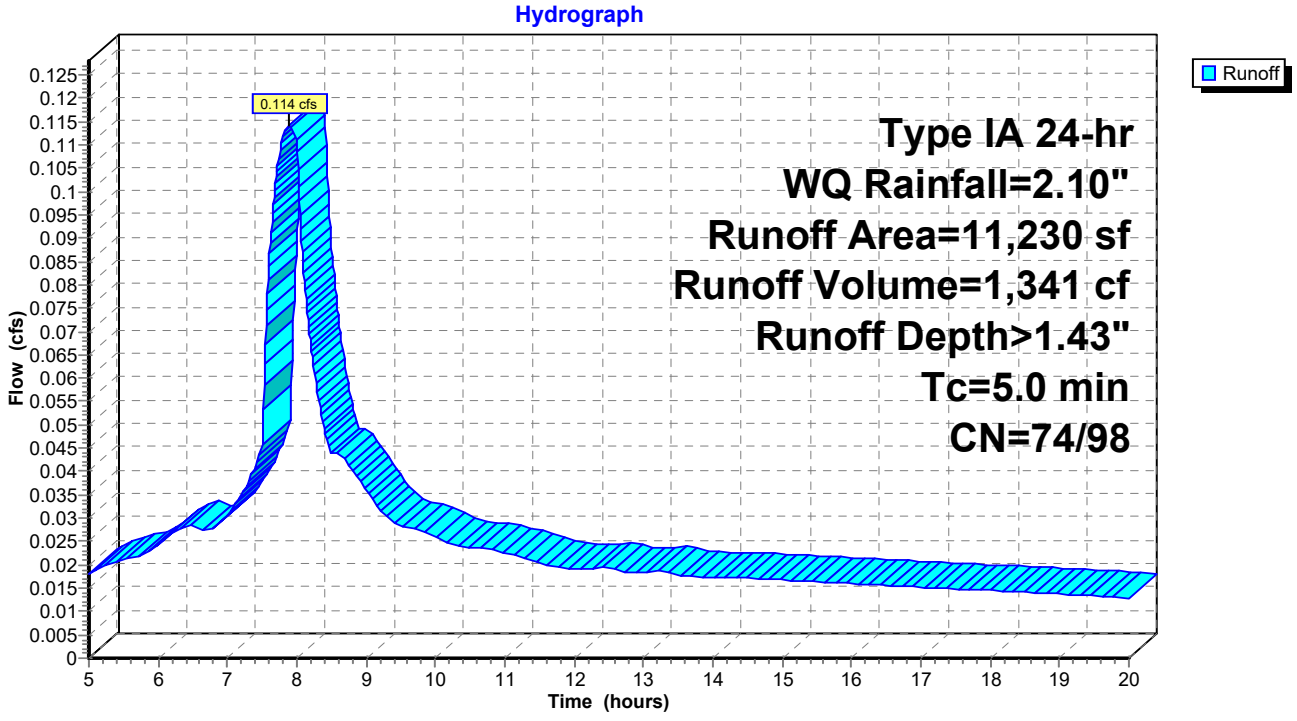
Runoff = 0.114 cfs @ 7.89 hrs, Volume= 1,341 cf, Depth> 1.43"
Routed to Reach 24R : SD CDS-2

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=2.10"

	Area (sf)	CN	Description
*	869	74	
*	10,361	98	
	11,230	96	Weighted Average
	869	74	7.74% Pervious Area
	10,361	98	92.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7S: EAST 7



Summary for Subcatchment 8S: EAST 8

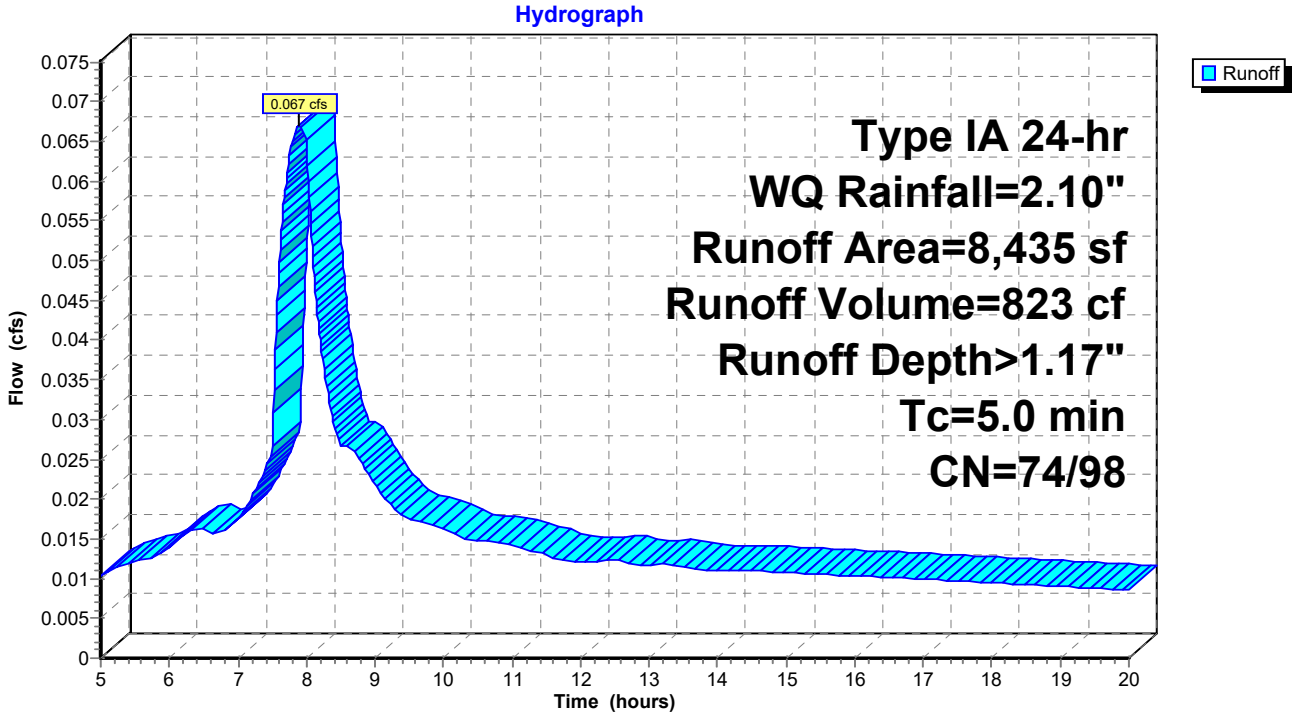
Runoff = 0.067 cfs @ 7.90 hrs, Volume= 823 cf, Depth> 1.17"
Routed to Reach 24R : SD CDS-2

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=2.10"

	Area (sf)	CN	Description
*	2,463	74	
*	5,972	98	
	8,435	91	Weighted Average
	2,463	74	29.20% Pervious Area
	5,972	98	70.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 8S: EAST 8



Summary for Subcatchment 9S: EAST 9

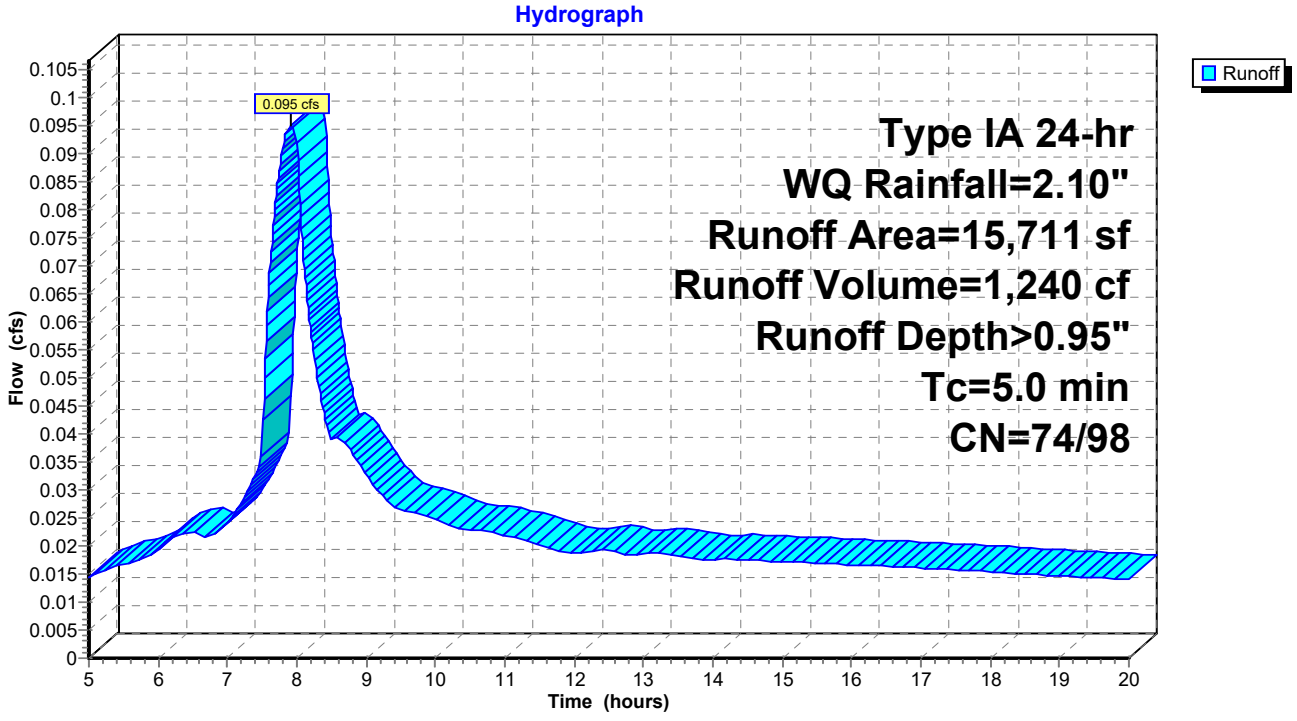
Runoff = 0.095 cfs @ 7.93 hrs, Volume= 1,240 cf, Depth> 0.95"
Routed to Reach 24R : SD CDS-2

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=2.10"

	Area (sf)	CN	Description
*	7,488	74	
*	8,223	98	
	15,711	87	Weighted Average
	7,488	74	47.66% Pervious Area
	8,223	98	52.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 9S: EAST 9



Summary for Subcatchment 10S: EAST 10

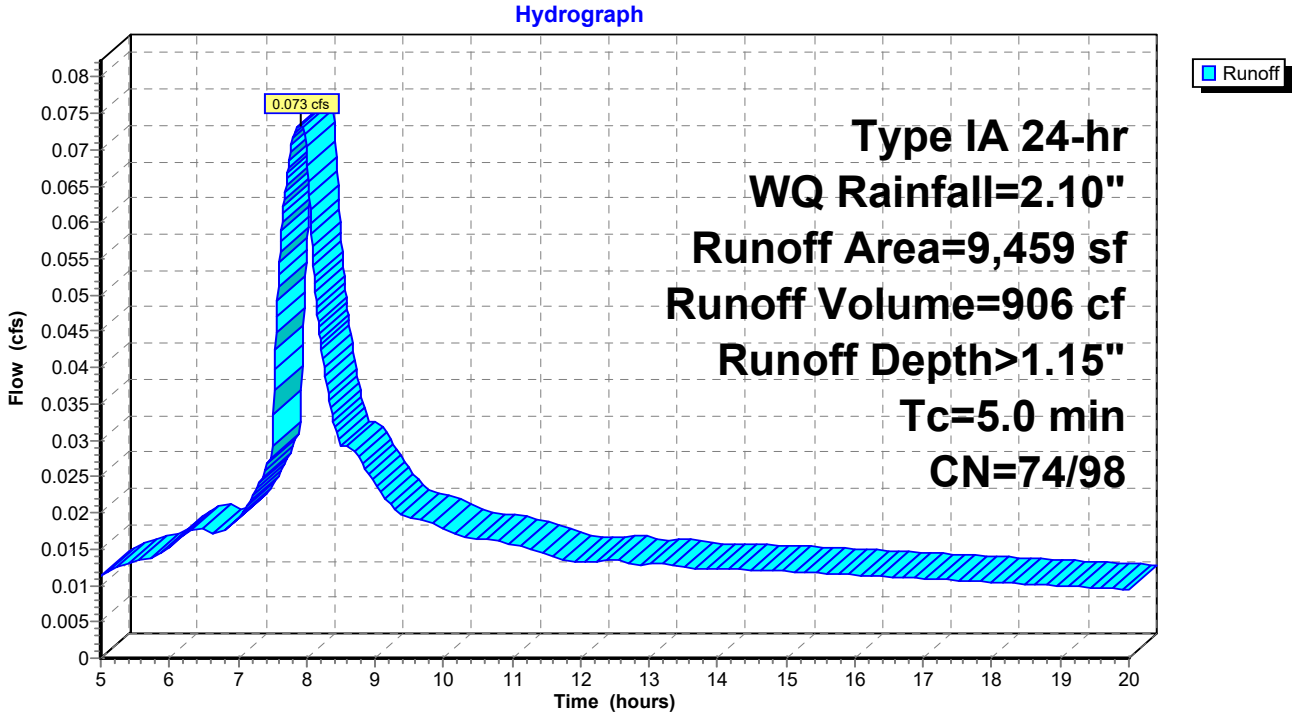
Runoff = 0.073 cfs @ 7.90 hrs, Volume= 906 cf, Depth> 1.15"
Routed to Reach 24R : SD CDS-2

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=2.10"

	Area (sf)	CN	Description
*	2,933	74	
	6,526	98	Paved roads w/curbs & sewers, HSG C
	9,459	91	Weighted Average
	2,933	74	31.01% Pervious Area
	6,526	98	68.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 10S: EAST 10



Summary for Subcatchment 11S: EAST 11 & EAST 12

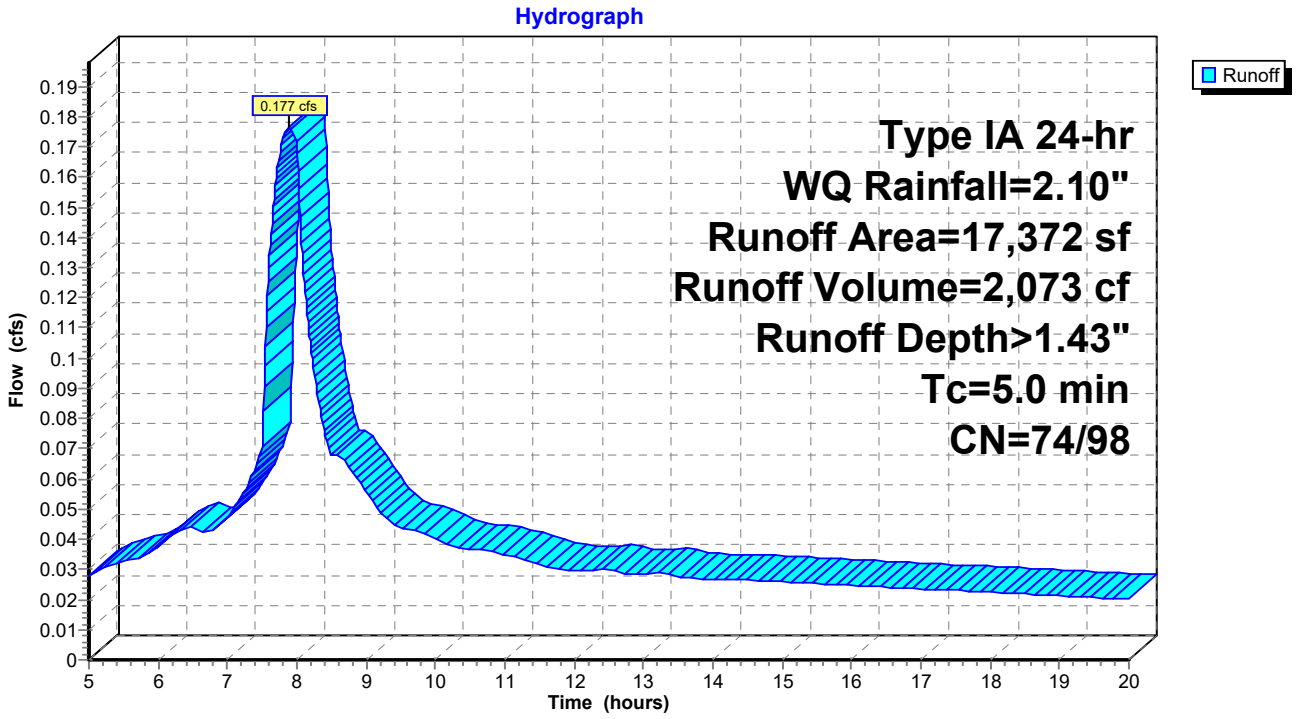
Runoff = 0.177 cfs @ 7.89 hrs, Volume= 2,073 cf, Depth> 1.43"
Routed to Reach 24R : SD CDS-2

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type IA 24-hr WQ Rainfall=2.10"

	Area (sf)	CN	Description
*	439	74	
*	7,391	98	
*	913	74	
*	8,629	98	
	17,372	96	Weighted Average
	1,352	74	7.78% Pervious Area
	16,020	98	92.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 11S: EAST 11 & EAST 12

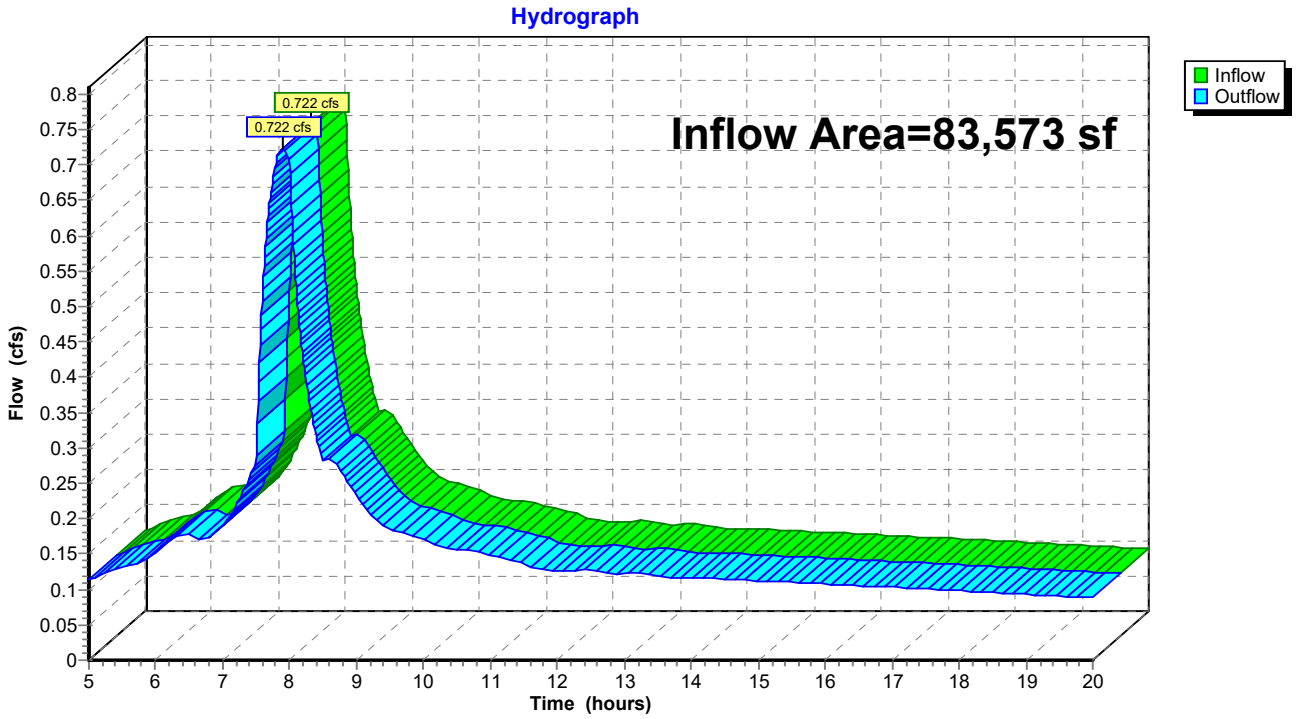


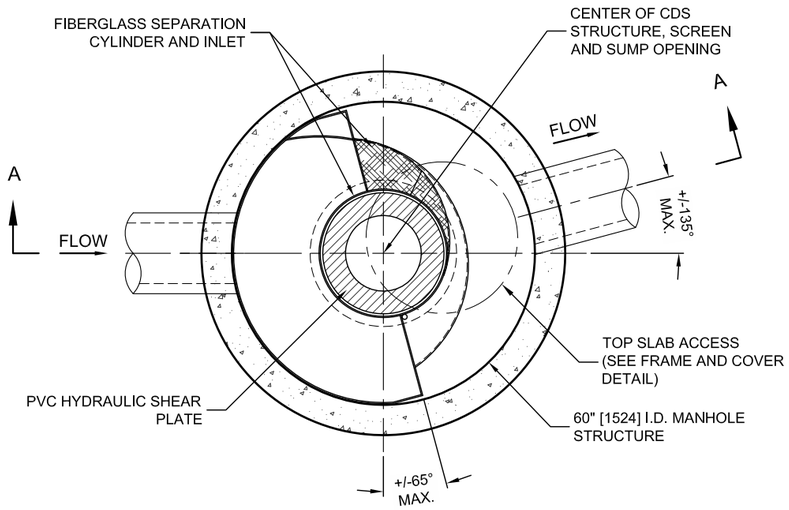
Summary for Reach 24R: SD CDS-2

Inflow Area = 83,573 sf, 77.49% Impervious, Inflow Depth > 1.25" for WQ event
Inflow = 0.722 cfs @ 7.90 hrs, Volume= 8,726 cf
Outflow = 0.722 cfs @ 7.90 hrs, Volume= 8,726 cf, Atten= 0%, Lag= 0.0 min

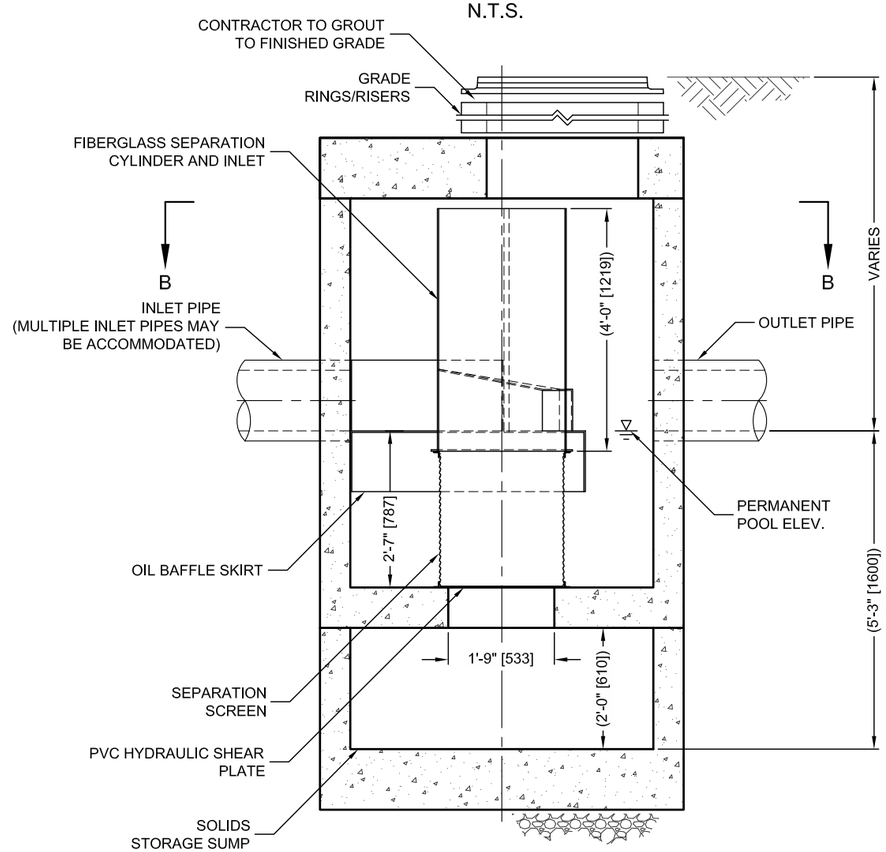
Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

Reach 24R: SD CDS-2





PLAN VIEW B-B
N.T.S.

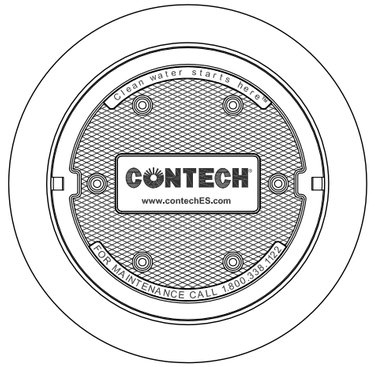


ELEVATION A-A
N.T.S.

CDS2020-5-C DESIGN NOTES

THE STANDARD CDS2020-5-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES
SEPARATE OIL BAFFLE (SINGLE INLET PIPE REQUIRED FOR THIS CONFIGURATION)
SEDIMENT WEIR FOR NJDEP / NJCAT CONFORMING UNITS



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	
WATER QUALITY FLOW RATE (CFS OR L/s)	*
PEAK FLOW RATE (CFS OR L/s)	*
RETURN PERIOD OF PEAK FLOW (YRS)	*
SCREEN APERTURE (2400 OR 4700)	*

PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*

RIM ELEVATION	*

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET HS20 (AASHTO M 306) LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

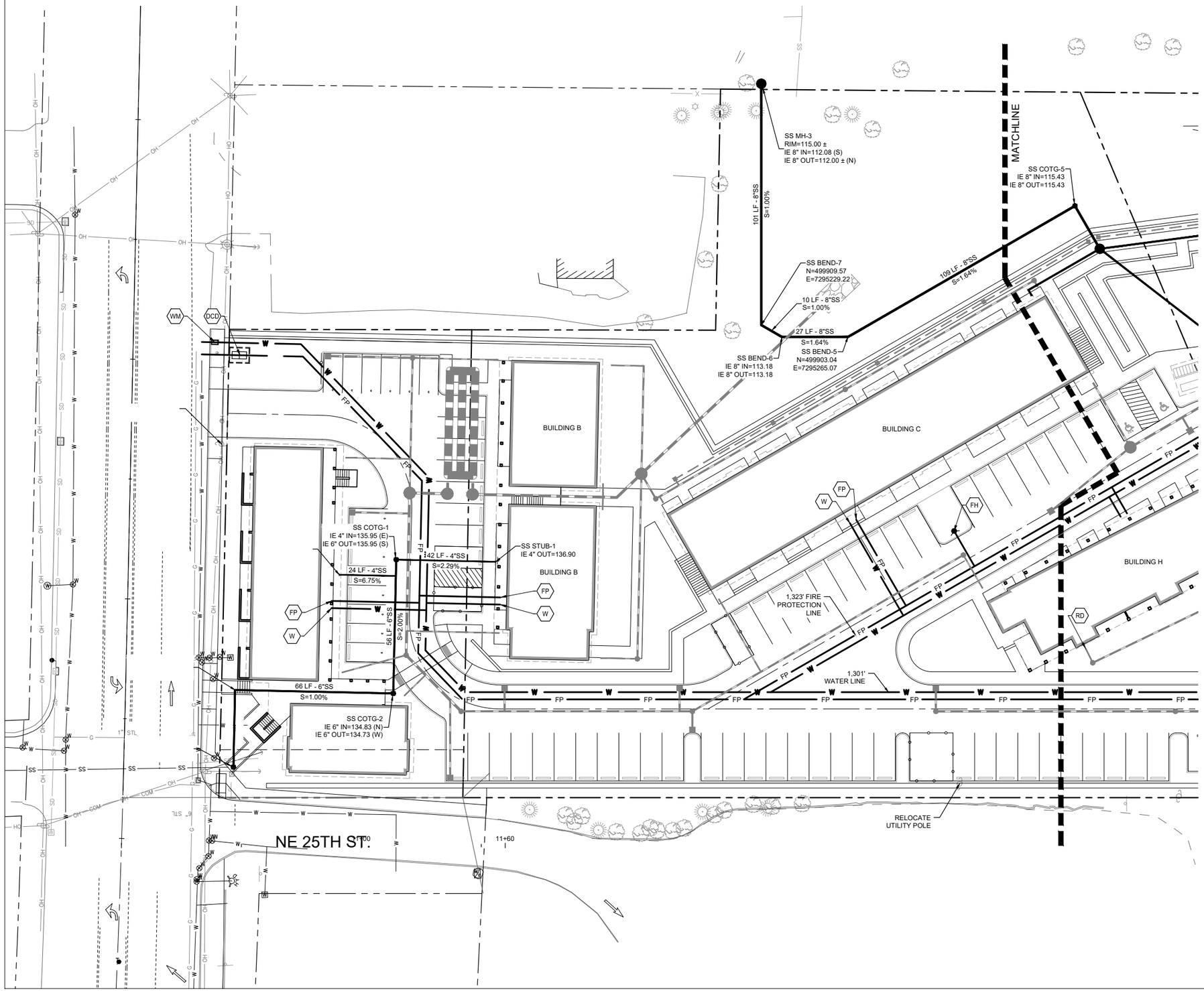
INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
C. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH® ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS2020-5-C
INLINE CDS
STANDARD DETAIL

Appendix I: Utility Plan / Details

WATER AND FIRE PROTECTION SYSTEM IS SHOWN FOR REFERENCE ONLY. SYSTEM REQUIRES BOOSTER PUMP THAT HAS NOT YET BEEN DESIGNED



SHEET NOTES

1. ALL MANHOLES ARE 48" DIAMETER U.N.O.
2. PIPE SIZE SHOWN ARE BASED ON PRELIMINARY SIZING ANALYSIS. FINAL SIZES TO BE PROVIDED BY MEP DESIGN BUILD CONTRACTOR.
3. PIPE BEDDING AND BACKFILL FOR ALL UTILITIES SHALL BE DONE PER DETAIL X/CX.X.
4. STRUCTURES LOCATIONS ARE BASED ON CENTER OF STRUCTURE.
5. ALL PRESSURE PIPES SHALL BE FULLY RESTRAINED.
6. ASSUME 6" FIRE PROTECTION LINE
7. ASSUME 4" DOMESTIC WATER LINE

UTILITY LABEL LEGEND

STRUCTURE LABEL

- UTILITY TYPE (SD=STORM DRAINAGE, S=SANITARY SEWER, W=WATER, FP=FIRE PROTECTION)
- STRUCTURE TYPE CALLOUT
- ID NUMBER (WHERE APPLICABLE)

XX XX-XXX
X+XX.X RT X.X' ← LOCATION (WHERE APPLICABLE)
RIM=
IE IN = XX.X
IE OUT = XX.X ← STRUCTURE INFO (WHERE APPLICABLE)

PIPE LABEL

- UTILITY LENGTH
- UTILITY SIZE
- UTILITY TYPE

XXLF - XX" XX
S=X.XX% ← SLOPE (WHERE APPLICABLE)

STRUCTURE TYPE

CALLOUT	DESCRIPTION
BEND	BEND, USE FITTING IF APPLICABLE
COTG	CLEANOUT TO GRADE
CONN	CONNECTION
GV	GATE VALVE
MH	48" DIA. MH
STUB	BUILDING STUB-OUT
TEE	TEE CONNECTION
WYE	WYE CONNECTION

SHEET LEGEND

- WM — 3" WATER METER
- FH — FIRE HYDRANT
- DCD — COMBINED DOUBLE CHECK DETECTOR VAULT
- FP — CONNECT TO FIRE PROTECTION SYSTEM. SIZE AS NOTED. SEE PLUMBING PLANS FOR CONTINUATION.
- W — CONNECT TO COLD WATER SYSTEM. SEE PLUMBING PLANS FOR CONTINUATION. SIZE AS NOTED.

SCALE 1 INCH = 20 FEET
20 0 20 40

LRS ARCHITECTS

PRELIMINARY NOT FOR CONSTRUCTION

CONSULTANT:
FROELICH ENGINEERS
CIVIL · STRUCTURAL
Portland, OR. | Bend, OR. | Denver, CO.
(503) 624-7005

PROJECT NUMBER: *XXXXXX*

LINCOLN CITY AFFORDABLE HOUSING

2510 NE HWY 101
LINCOLN CITY, OR
97367

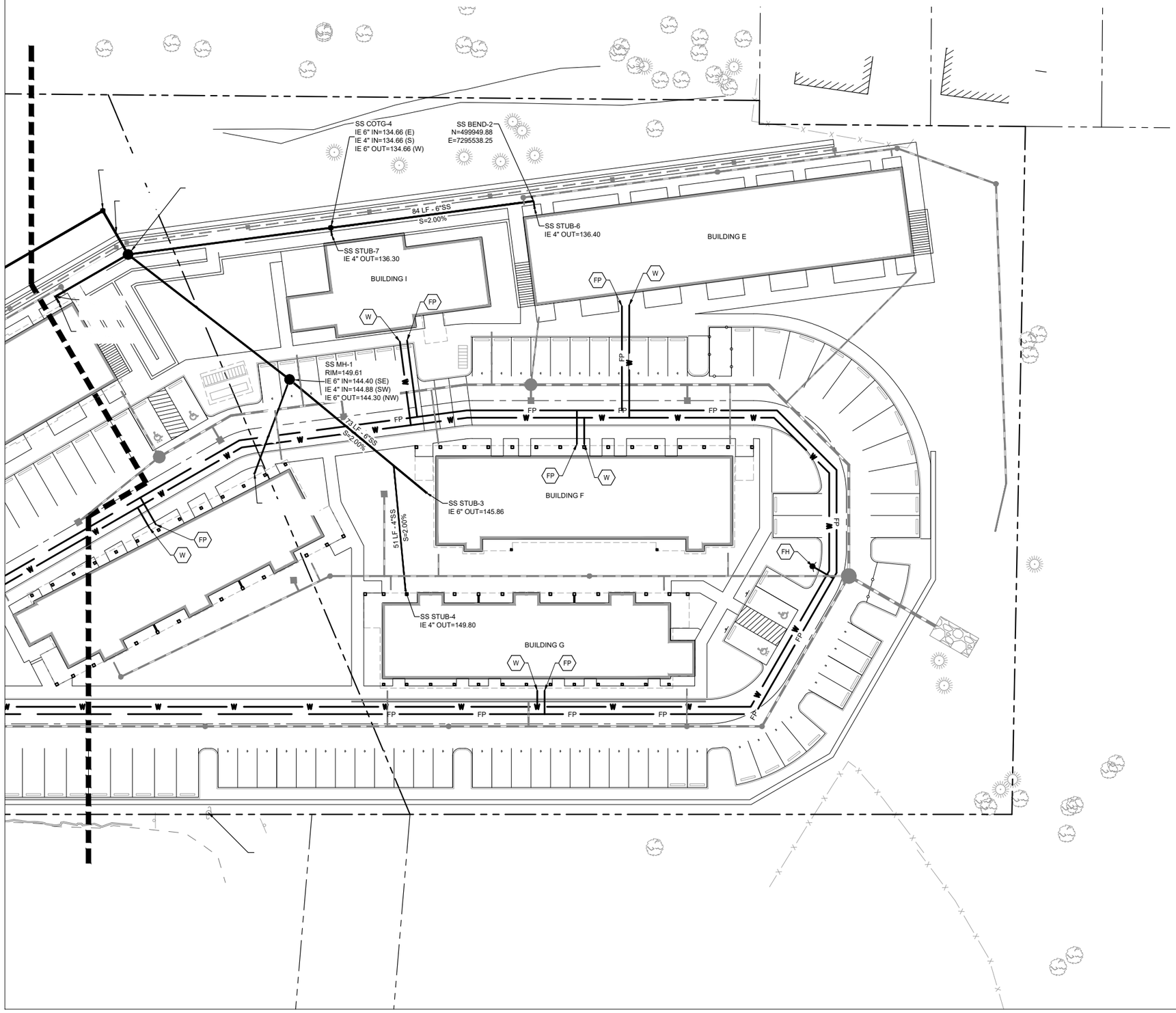
SHEET TITLE:

UTILITY PLAN - WEST - WATER - FIRE - SEWER

DRAWN BY: *Author*

SHEET:
C400
DEVELOPMENT REVIEW
01/31/2022

WATER AND FIRE PROTECTION SYSTEM IS SHOWN FOR REFERENCE ONLY. SYSTEM REQUIRES BOOSTER PUMP THAT HAS NOT YET BEEN DESIGNED

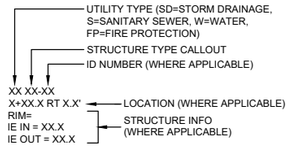


SHEET NOTES

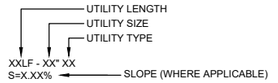
1. ALL MANHOLES ARE 48" DIAMETER U.N.O.
2. PIPE SIZE SHOWN ARE BASED ON PRELIMINARY SIZING ANALYSIS. FINAL SIZES TO BE PROVIDED BY MEP DESIGN BUILD CONTRACTOR.
3. PIPE BEDDING AND BACKFILL FOR ALL UTILITIES SHALL BE DONE PER DETAIL X/CX.X.
4. STRUCTURES LOCATIONS ARE BASED ON CENTER OF STRUCTURE.
5. ALL PRESSURE PIPES SHALL BE FULLY RESTRAINED.
6. ASSUME 6" FIRE PROTECTION LINE
7. ASSUME 4" DOMESTIC WATER LINE

UTILITY LABEL LEGEND

STRUCTURE LABEL



PIPE LABEL



STRUCTURE TYPE

CALLOUT	DESCRIPTION
BEND	BEND, USE FITTING IF APPLICABLE
COTG	CLEANOUT TO GRADE
CONN	CONNECTION
GV	GATE VALVE
MH	48" DIA. MH
STUB	BUILDING STUB-OUT
TEE	TEE CONNECTION
WYE	WYE CONNECTION

SHEET LEGEND

- WM — 3" WATER METER
- FH — FIRE HYDRANT
- DCD — COMBINED DOUBLE CHECK DETECTOR VAULT
- FP — CONNECT TO FIRE PROTECTION SYSTEM. SIZE AS NOTED. SEE PLUMBING PLANS FOR CONTINUATION.
- W — CONNECT TO COLD WATER SYSTEM. SEE PLUMBING PLANS FOR CONTINUATION. SIZE AS NOTED.

SCALE 1 INCH = 20 FEET

20 0 20 40

LRS ARCHITECTS

PRELIMINARY NOT FOR CONSTRUCTION

CONSULTANT:

FROELICH ENGINEERS
CIVIL · STRUCTURAL
Portland, OR. | Bend, OR. | Denver, CO.
(503) 624-7005

PROJECT NUMBER: *XXXXXX*

LINCOLN CITY AFFORDABLE HOUSING

2510 NE HWY 101
LINCOLN CITY, OR
97367

SHEET TITLE:

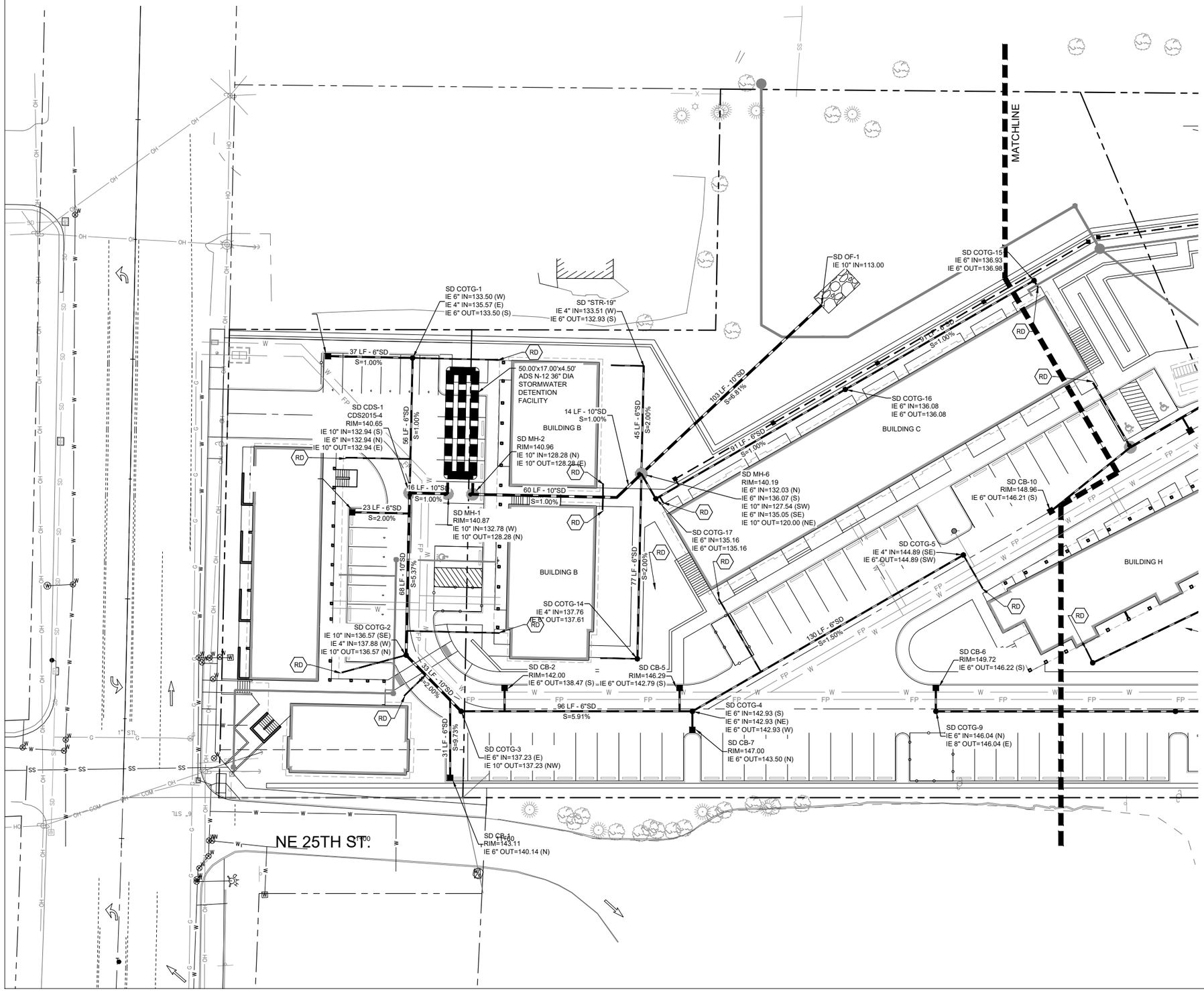
UTILITY PLAN - EAST - WATER - FIRE - SEWER

DRAWN BY: *Author*

SHEET:

C401

DEVELOPMENT REVIEW
01/31/2022



SHEET NOTES

1. ALL MANHOLES ARE 48" DIAMETER U.N.O.
2. CATCH BASINS SHALL BE ODOT TYPE G2 W/ ACF ENVIRONMENTAL TRASH GUARD PLUS.
3. STORMWATER OUTFALLS WILL INCLUDE CONCRETE WING WALLS AND BASE SLAB AS WELL AS RIP RAP ENERGY DISSIPATER.
4. PIPE SIZE SHOWN ARE BASED ON PRELIMINARY SIZING ANALYSIS.
5. PIPE BEDDING AND BACKFILL FOR ALL UTILITIES SHALL BE DONE PER DETAIL X/CX.X.
6. STRUCTURES LOCATIONS ARE BASED ON CENTER OF STRUCTURE.

UTILITY LABEL LEGEND

STRUCTURE LABEL

- UTILITY TYPE (SD=STORM DRAINAGE, S=SANITARY SEWER, W=WATER, FP=FIRE PROTECTION)
- STRUCTURE TYPE CALLOUT
- ID NUMBER (WHERE APPLICABLE)

XX XX-XX
X+XX.X RT X.X' ← LOCATION (WHERE APPLICABLE)
RIM= ← STRUCTURE INFO (WHERE APPLICABLE)
IE IN = XX.X
IE OUT = XX.X

PIPE LABEL

- UTILITY LENGTH
- UTILITY SIZE
- UTILITY TYPE

XXLF - XX" XX
S=X.XX% ← SLOPE (WHERE APPLICABLE)

STRUCTURE TYPE

CALLOUT	DESCRIPTION
AD	AREA DRAIN
BEND	BEND, USE FITTING IF APPLICABLE
CB	TRAPPED CATCH BASIN (ODOT TYPE G2)
CB2	INLINE CATCH BASIN
CDS	CONTECH CONTINUOUS DEFLECTIVE SEPARATOR
COTG	CLEANOUT TO GRADE
FCMH	FLOW CONTROL MANHOLE
FD	FOUNDATION DRAINAGE
GV	GATE VALVE
OF	OUTFALL
MH	48" DIA. MH
RD	ROOF DRAIN
TEE	TEE CONNECTION
WYE	WYE CONNECTION

SHEET LEGEND

RD ROOF DRAIN. COORDINATE CONNECTION, SIZE, AND LOCATION WITH ARCHITECTURAL PLANS

SCALE 1 INCH = 20 FEET
20 0 20 40

LRS ARCHITECTS

PRELIMINARY NOT FOR CONSTRUCTION

CONSULTANT:

FROELICH ENGINEERS
CIVIL · STRUCTURAL
Portland, OR. | Bend, OR. | Denver, CO.
(503) 624-7005

PROJECT NUMBER: *XXXXXX*

LINCOLN CITY AFFORDABLE HOUSING

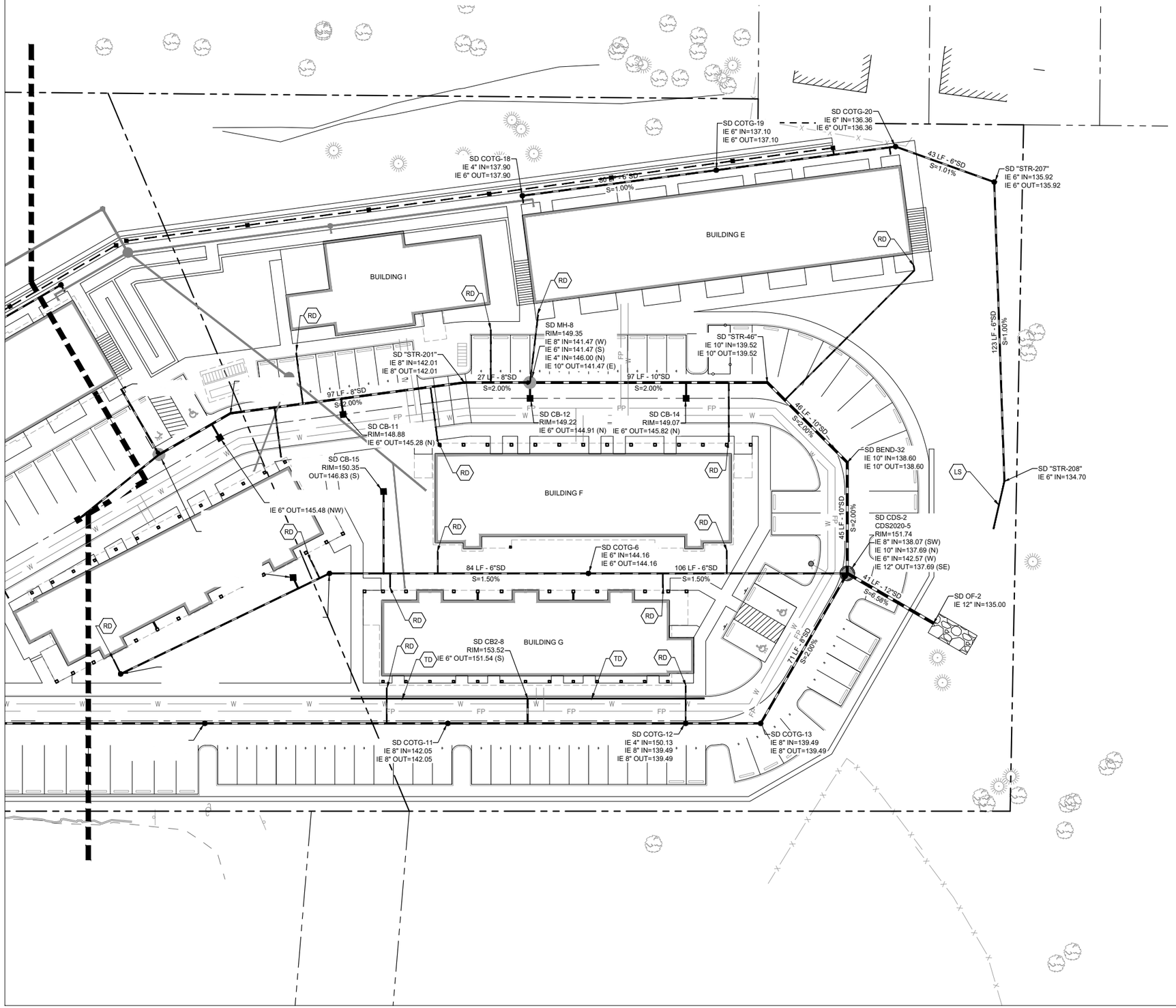
2510 NE HWY 101
LINCOLN CITY, OR
97367

SHEET TITLE:

UTILITY PLAN - WEST - STORM

DRAWN BY: *Author*

SHEET:
C402
DEVELOPMENT REVIEW
01/31/2022



SHEET NOTES

1. ALL MANHOLES ARE 48" DIAMETER U.N.O.
2. CATCH BASINS SHALL BE ODOT TYPE G2 W/ ACF ENVIRONMENTAL TRASH GUARD PLUS.
3. STORMWATER OUTFALLS WILL INCLUDE CONCRETE WING WALLS AND BASE SLAB AND RIP RAP ENERGY DISSIPATER.
4. PIPE SIZE SHOWN ARE BASED ON PRELIMINARY SIZING ANALYSIS.
5. PIPE BEDDING AND BACKFILL FOR ALL UTILITIES SHALL BE DONE PER DETAIL X/CX.X.
6. STRUCTURES LOCATIONS ARE BASED ON CENTER OF STRUCTURE.

UTILITY LABEL LEGEND

STRUCTURE LABEL

- UTILITY TYPE (SD=STORM DRAINAGE, S=SANITARY SEWER, W=WATER, FP=FIRE PROTECTION)
- STRUCTURE TYPE CALLOUT
- ID NUMBER (WHERE APPLICABLE)

XX XX-XX
X+XX.X RT X.X' ← LOCATION (WHERE APPLICABLE)
RIM= ← STRUCTURE INFO (WHERE APPLICABLE)
IE IN = XX.X
IE OUT = XX.X

PIPE LABEL

- UTILITY LENGTH
- UTILITY SIZE
- UTILITY TYPE

XXLF - XX" XX
S=X.XX% ← SLOPE (WHERE APPLICABLE)

STRUCTURE TYPE

CALLOUT	DESCRIPTION
AD	AREA DRAIN
BEND	BEND, USE FITTING IF APPLICABLE
CB	TRAPPED CATCH BASIN (ODOT TYPE G2)
CB2	INLINE CATCH BASIN
CDS	CONTECH CONTINUOUS DEFLECTIVE SEPARATOR
COTG	CLEANOUT TO GRADE
FCMH	FLOW CONTROL MANHOLE
FD	FOUNDATION DRAINAGE
GV	GATE VALVE
OF	OUTFALL
MH	48" DIA. MH
RD	ROOF DRAIN
TEE	TEE CONNECTION
WYE	WYE CONNECTION

SHEET LEGEND

- TD — TRENCH DRAIN
- LS — LEVEL SPREADER
- RD — ROOF DRAIN. COORDINATE CONNECTION, SIZE, AND LOCATION WITH ARCHITECTURAL PLANS

SCALE 1 INCH = 20 FEET
20 0 20 40

LRS ARCHITECTS

PRELIMINARY NOT FOR CONSTRUCTION

CONSULTANT:

FROELICH ENGINEERS
CIVIL · STRUCTURAL
Portland, OR. | Bend, OR. | Denver, CO.
(503) 624-7005

PROJECT NUMBER: *XXXXXX*

LINCOLN CITY AFFORDABLE HOUSING

2510 NE HWY 101
LINCOLN CITY, OR
97367

SHEET TITLE:

UTILITY PLAN - EAST - STORM

DRAWN BY: *Author*

SHEET:

C403

DEVELOPMENT REVIEW
01/31/2022

Appendix J: Operations and Maintenance

TO BE COMPLETED AS PART OF THE FINAL REPORT