

PRE-FINAL DESIGN REPORT (90%)

FORMER HANSON PIPE SITE
755 NE COLUMBIA BOULEVARD, PORTLAND, OREGON
ECSI SITE NO. 3893



Prepared for
BRIDGE DEVELOPMENT PARTNERS

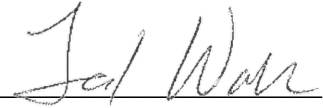
October 18, 2019
Project No. 1648.02.06

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*The material and data in this report were prepared
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ACRONYMS AND ABBREVIATIONS

BES	City of Portland Bureau of Environmental Services
cfs	cubic-foot-per-second
DEQ	Oregon Department of Environmental Quality
EES	Easement and Equitable Servitudes
HDPE	high-density polyethylene
IDLH	immediately dangerous to life and health
LEL	lower explosive limit
LFG	landfill gas
LGHCP	LFG hazard communication plan
LGMCP	LFG monitoring and contingency plan
MCDD	Multnomah County Drainage District
MFA	Maul Foster & Alongi, Inc.
NFA	No Further Action
NIOSH	National Institute for Occupational Safety and Health
OAR	Oregon Administrative Rules
pbv	percent by volume
ppm	parts per million
PVC	polyvinyl chloride
RBC	risk-based concentration
Site	former Hanson Pipe, 755 NE Columbia Boulevard, Portland, Oregon (ECSI No. 3893)
SMP	soil management plan
UEL	upper explosive limit

1 INTRODUCTION

This report discusses the basis of design for the selected remedial action for the former Hanson Pipe Site (Environmental Site Cleanup Information database No. 3893) at 755 NE Columbia Boulevard, Portland, Oregon 97211 (the Site).

The approximately 40-acre Site comprises tax parcels 1N1E11C 200, 1N1E11C 600, 1N1E11C 900, 1N1E11C 1000, 1N1E11C 1100, 1N1E11CB 400, and 1N1E11CB 700 in Multnomah County, township 1 north, range 1 east, section 11 of the Willamette Meridian.

1.1 BACKGROUND

In the 1970s, a portion of the Site was used as an Oregon Department of Environmental Quality (DEQ)-permitted landfill. Between 2001 and 2012, multiple investigations were conducted at the Site regarding impacted stormwater discharges from maintenance areas and potential methane generation from the landfill. Landfill material on site varies between 5 and 30 feet in thickness and consists generally of wood, cardboard, wire, plastic, sheetrock, gravel, and other miscellaneous construction debris, capped with about 3 feet of well-graded, gravelly fill composed largely of concrete. The landfill footprint comprises much of the northwest portion of the Site.

In 2012, based on the results of the investigations, human health and ecological risk assessments, remedial investigation, and institutional controls (i.e., landfill cap, use restrictions, and landfill gas [LFG] monitoring), the DEQ issued a conditional No Further Action (NFA) determination for the upland portion of the Site (further investigation was pending for the Columbia Slough).

In June 2018, the DEQ issued a conditional NFA for the entire Site and outlined the following:

- Methane had been detected at levels above the action level (at explosion hazard levels) in monitoring points on site, including building exterior confined spaces and permanent monitoring point locations. Methane had been detected at explosive levels in storm drain structures that transect the landfill. Methane had been detected below the action level (except for one detection in 2017) in the City of Portland stormwater collection and conveyance elements off site (west-adjacent). Hydrogen sulfide had been detected at levels exceeding the action level in a permanent monitoring point within the landfill footprint along the western site boundary but had not been detected in on-site confined spaces in building interiors. The DEQ determined that the institutional controls in place addressed the explosive hazard from LFG. To remain protective, the Site had an LFG hazard communication plan (LGHCP) (PBS, 2015a) for site workers, visitors, and contractors; and an LFG monitoring and contingency plan (LGMCP) (PBS, 2015b). The LGMCP describes the requirements for annual monitoring, DEQ reporting, and a five-year periodic review.

- As documented in a soil management plan (SMP) prepared for the Site, approximately 15 cubic yards of petroleum-contaminated soil at the Site exceeded DEQ cleanup levels (PBS, 2015c). The SMP is to be implemented during work involving site disturbance.
- The DEQ reviewed results of a stormwater source control evaluation and sediment testing adjacent to the Site that showed concentrations at or below DEQ estimates of baseline levels. Management of stormwater discharge from the Site was regulated under a DEQ National Pollutant Discharge Elimination System 1200-COLS permit, and the stormwater management was deemed adequate to address concerns about the landfill and underlying groundwater.

Site requirements are documented in an Easement and Equitable Servitudes (EES),¹ which was recorded on the property deed in March 2018. The EES defines property owner obligations associated with the environmental conditions at the Site.

2 PROPOSED REMEDIATION/REDEVELOPMENT

The proposed facility includes two industrial warehouse buildings with a total footprint of approximately 675,000 square feet, plus associated site parking, landscape, stormwater management facilities, and utilities. Remediation activities will include the following:

- Import of clean fill to accommodate proposed building foundation improvements (load transfer platform) and keep proposed utilities (storm, sanitary, water and dry utilities) above the site soils, eliminating excavating the existing cap on the former landfilled area
- Installation of an LFG collection system
- Installation of an LFG barrier system
- Installation of an LFG collection trench (lined with high-density polyethylene [HDPE] geomembrane on top and along west trench wall) by the western property line to prevent off-site migration of the LFG
- Construction of lined stormwater management facilities

3 DESIGN CRITERIA/STANDARDS

The design adheres to DEQ solid waste regulations and City of Portland development standards. Maul Foster & Alongi, Inc. (MFA) is applying standard techniques, protocols, materials, and equipment

¹ Easement and Equitable Servitudes between Oregon Department of Environmental Quality (Grantee) and 755 Portland Property LLC (Grantor). January 2018. Recorded in Multnomah County on March 12, 2018.

associated with proposed remediation systems (stormwater management, LFG collection and control, landfill cap).

The design for the LFG collection system components followed the City of Los Angeles Department of Building and Safety methane mitigation standards. The subslab impervious geomembrane liner was specified in accordance with the DEQ's Solid Waste Landfill Guidance Manual. Additionally, the U.S. Environmental Protection Agency's Technical Guide for Assessing and Mitigating Vapor Intrusion Pathway from Subsurface Vapor Source to Indoor Air (USEPA, 2015) was followed, in conjunction with a[the?] building foundation plan and a geotechnical memorandum discussing transitions between varying foundation depths (Terra Associates, 2019) for LFG monitoring components.

Stormwater management system components were designed in accordance with the City of Portland Bureau of Environmental Services (BES) stormwater manual. The selected stormwater management facilities, i.e., lined bioretention facilities (two grassy swales and one basin) and mechanical media filters, were designed to meet the facility and conveyance design criteria offset forth in the BES stormwater manual.

4 DESIGN/ANALYSIS CALCULATIONS

The only environment-related design calculations are associated with stormwater management. These calculations are summarized in a stormwater report submitted to the City of Portland on June 28, 2019; see Appendix A. Although the engineering associated with other environmental design features does not include calculations per se, work products are being prepared as described below. Design calculations pertaining to site features, such as those for retaining wall design (prepared by the project geotechnical consultant), are not included in this submittal.

The building permit drawing set revised to address City of Portland's first-round review comments is attached. Further LFG collection system specifications have been incorporated into the permit drawing set.

5 CONSTRUCTION SCHEDULE

Initial site preparation began in April 2019. Load transfer platform and subgrade improvements are ongoing and are scheduled for completion by January 2020. Site improvements will begin in November 2019 and are scheduled to be completed in August 2020.

6 REMEDIAL ACTION ACTIVITIES TO BE PERFORMED

Remedial actions will address the design components described in the following sections:

- LFG
- Stormwater Management
- Landfill Caps
- Utilities
- Institutional Controls

A construction quality assurance plan is being prepared (as a separate report) to ensure that the remedy fulfills the requirements of the DEQ and meets or exceeds all performance standards, design criteria, and plans.

6.1 Landfill Gas

LFG monitoring at the Site found concentrations of methane higher than 1.25 percent by volume (pbv), which is the Oregon Administrative Rules (OAR) action level. OAR 340-122-0040 (3) defines the methane concentration at which remedial action will be required:

In the event of a release of methane from a historic solid waste landfill, removal or remedial actions shall be implemented to prevent concentrations of methane exceeding or likely to exceed 1.25 percent by volume in confined spaces and structures, other than in equipment, piping, wells, or other structures designed for the collection and management of methane and approved by the Department (DEQ).

Hydrogen sulfide has also detected during Site LFG monitoring. See the following section for a summary of the most recent monitoring at the Site. Based on the above information, an LFG collection and conveyance system was designed (shown in the design drawings, Sheets C9.0 through C9.5, provided following the report), consistent with City of Los Angeles Department of Building and Safety methane mitigation standards, with the following features:

- LFG collection trenches consisting of perforated pipe in a rock trench along the west property line to limit LFG migration off site. The rock trench will be lined with 60-mil HDPE geomembrane at the top and along the west wall of the trench.
- A passive methane venting system under impervious surfaces (e.g., building slab, paving) consisting of perforated pipe in a rock trench, connected to aboveground vent stacks. The passive venting system can be converted to an active venting system with the addition of a blower unit, if necessary.
- An impervious vapor barrier under the proposed building slabs, with a passive gas venting system installed below the barrier (designed for conversion to an active venting system if necessary).

- A condensate conveyance system joined to the site sanitary sewer system with “p trap” connections to prevent LFG migration.
- Trench dams (see description in Section 6.4, Utilities) to prevent migration of LFG through utility trenches.
- Limited trench excavation over former landfill areas to minimize the potential for LFG migration.
- Limited installation of subsurface utility vaults and structures over former landfill areas.
- An LFG-detection system installed inside the proposed buildings.
- Gas-monitoring probes installed below building slab vapor barriers, as warranted.

6.1.1 Baseline Landfill Gas Monitoring

MFA conducted two baseline monitoring events in May and August 2019, consistent with the DEQ-approved baseline LFG monitoring plan (MFA, 2019). The purpose of monitoring was to obtain LFG readings to be used in informing (1) site design, (2) safety protocols for the construction work, and (3) the long-term LFG monitoring program. The May 2019 event was conducted to evaluate LFG conditions prior to load transfer platform placement. The August 2019 event was conducted during load transfer platform placement, and the third event will evaluate conditions post-placement of the load transfer platform.

Methane concentrations fluctuated between the May and August 2019 sampling events, but were generally consistent with the range of values observed during previous events within and near the landfill footprint. Generally, methane is considered explosive between 5 pbv (or 100% of the lower explosive limit [LEL]) and approximately 15 to 17 pbv (the upper explosive limit [UEL]); measurements below 5 or above 17 are either too lean or too rich to be explosive, respectively. A total of 42 monitoring points were assessed during the August 2019 event; methane levels at 16 locations were below the action level of 1.25 pbv (25% LEL), three locations had methane values above the action level of 1.25 pbv (25% LEL), and 23 were above 5 pbv (100% LEL). Values greater than the action level of 1.25 pbv (25% LEL) ranged from 1.5 pbv (30% LEL) to 71.7 pbv (1,434% LEL). One location had a methane measurement between the LEL and the UEL at 8.4 pbv (168% LEL).

In the May 2019 monitoring event, two locations showed hydrogen sulfide at 140 ppm and 420 ppm—above the National Institute for Occupational Safety and Health (NIOSH) immediately dangerous to life and health (IDLH) value (of 100 parts per million [ppm]). Of the 42 monitoring points assessed during the August 2019 event, 19 locations did not have detections of hydrogen sulfide and 23 locations had detections of hydrogen sulfide ranging from 1 to 47 ppm. During the August 2019 monitoring event, no detected hydrogen sulfide concentrations exceeded the NIOSH IDLH value and, similar to methane, values fluctuated primarily within and near the landfill footprint.

MFA concluded that, based on the first and second baseline event results, no changes to the LFG control systems were warranted. The long-term LFG monitoring program, including permanent monitoring point locations (i.e., near the trenches), is being considered concurrently with the design

phase. Design and long-term monitoring will be revisited after the next baseline monitoring event, estimated for early to mid-December.

To remain protective of health and safety during site preparation activities, the Site has an LGHCP (PBS, 2015a) for site workers, visitors, and contractors; and an LGMCP (PBS, 2015b) for LFG monitoring. Again, the long-term monitoring plan will be developed after the third baseline monitoring event.

6.1.2 Methane-Control System

Methane-control systems for occupied structures will be included to prevent the potential for LFG intrusion. The systems will generally consist of a subslab membrane and a passive venting system of perforated collection pipes, solid wall header pipes, and a vent stack to direct the collected gas to a safe location. Each component is described in this section.

6.1.3 Membrane

An impervious membrane will be installed below concrete building slabs and foundations to prevent methane intrusion through cracks, penetrations, or expansion joints. The membrane will be installed below the building slabs surrounded by the inner face of the exterior footings and on the exterior surface of walls from the finished grade level to a minimum of 6 inches below the bottom of the adjoining building slab. Impervious membrane will not be installed under exterior or interior footings. The membrane will consist of 60-mil HDPE. Installation will comply with the manufacturer's installation manual. Floor penetrations for utilities and conduits will be connected directly to the membrane and will be terminated in the slab.

Where footings, plumbing pipes, electrical conduits, and other materials penetrate the impervious membrane, the penetrations will be sealed by using sleeves or boots composed of the same material or other approved materials and methods in accordance with the specifications of the membrane manufacturer. A gas-tight seal will be provided where the impervious membrane is attached to all interior footings and exterior wall footings.

A gravel blanket will be installed under the impervious membrane and above the compacted soil subgrade. The thickness of the gravel blanket will be a minimum of 2 inches. The gravel will consist of washed particles that have no more than one fractured face. Acceptable gradations for gravel and sand are listed in the design drawings (Sheet C9.5).

The impervious membrane protection will be installed in the following sequence:

- Finish the gravel blanket surfacing smooth using mechanical means (e.g., roller).
- Place geotextile filter fabric over the gravel blanket to protect the smooth finish of the gravel blanket and prevent sand migration into the gravel blanket.
- Prepare protective course for impervious membrane:

- Option a: if sand is used as gravel blanket, then the impervious membrane may be placed directly on the geotextile.
- Option b: if gravel is used as for the gravel blanket, then place a minimum 1-inch-thick sand layer directly over the geotextile.
- Option c: if gravel is used as for the gravel blanket, then place a geotextile with a minimum weight of 16 ounces per square yard.
- Place a minimum 1-inch-thick lean concrete mix over the impervious membrane (slurry as specified in the specifications).
- Place concrete, reinforcing steel, piping, and other forms so that they will not be supported directly on the impervious membrane. Equipment will not be driven over the impervious membrane or its protective covering.

6.1.4 Passive Venting System

Passive venting will be provided below building slabs of enclosed structures to allow collection and venting of potential methane gases that could become trapped. Passive vents will consist of perforated horizontal pipes connected to solid wall header pipes at the building perimeter and discharging to vents located above the structure. The perforated pipes will be approved and listed, minimum Schedule 40, slotted or perforated PVC pipe or approved equal for the intended use. Pipes used only as vents may be installed in the horizontal position. Combination vent/condensation pipes will be at a 0.5 percent slope. Undulations in the perforated pipes, which may impede the passage of gas, will be avoided (e.g., perforated pipes will not be deformed to pass below interior footings). Collection pipes will be installed on approximately 55-foot horizontal spacing, with a maximum distance of 25 feet from the edge of the slab. Header pipes will be installed at the building perimeter for slabs requiring multiple collection pipes.

Perforated pipes will be installed in a gravel blanket beneath the impervious membrane and above the compacted soil subgrade. The gravel thickness around perforated pipes will be a minimum of 2 inches. When sand is used as the gravel blanket, a geofabric will be placed around the perforated pipes to prevent sand from entering them. Gravel will be composed entirely of particles that have no more than one fractured face.

Passive vents will be installed for each building to discharge methane from the subsurface collection system. Vents will consist of a solid wall vertical pipe stack connected directly to the header or collection pipe. Vertical pipes will be installed inside the buildings or on the building exterior. Vent outlets will be located a minimum of 10 feet horizontally from other building system vents (plumbing, heating, etc.), and 4 feet vertically above the roof line. All ventilation piping will be clearly labeled with placards or adhesive labels indicating the presence of gases. Vents will also be equipped with a vent cap to prevent intrusion of rainwater to the system.

Vent risers, constructed of cast iron, will be connected to the perforated pipes. The risers will be spaced at a maximum of 100 feet.

To protect the performance of the venting system, perforations will be oriented downward to prevent the accumulation of condensation or other moisture (i.e., groundwater) in the pipe. The passive ventilation system will include sumps for collection and removal of condensation from the collection piping system. Sumps will be connected to discharge pipes leading directly to the site sanitary sewer system.

All passive venting systems are designed to allow simple conversion to an active venting system, to address the scenario where the passive system would be determined to be inadequate. Conversion may consist of the addition of a powered fan to create suction on the collection piping and increase LFG removal efficiency.

6.1.5 Interior Methane Detection and Alarm System

Detection systems are required in order to determine the concentration of methane that may be occurring within or underneath a structure. The systems described above will be paired with an interior detection system or a gas monitoring probe.

A methane detection and alarm system will be installed in enclosed structures and occupied buildings. An alarm system will activate should methane accumulate inside a building. Detection levels will be set to prevent accumulation at an unsafe level that could cause asphyxiation or ignition. Detectors will be placed in all enclosed buildings; preferred locations will be near smaller enclosure spaces such as mechanical rooms or storage areas, which require smaller amounts of gas to reach higher concentration per room volume.

Detectors will consist of interconnected detection units with a control panel and central alarm system. Systems will operate continuously, even when buildings are not occupied.

Alarm systems will consist of audible and visual signals to notify occupants of significant levels of methane intrusion into the building. Audible alarms will be at least 15 decibels above ambient noise level in all areas subject to methane gas intrusion. Visual alarms will be a minimum of 15-candela output and will be located at each audible device. The audible signal warning building occupants of significant levels of methane gas will be distinctively different from the fire alarm system. Signs stating “methane alarm—evacuate building” will be posted adjacent to each alarm signaling device.

At this juncture, no internal wall articulations have been designated, as no tenants have been identified (and the interior parapets will be constructed under tenant improvements). The design drawings reference a methane detector spacing table as outlined in the City of Los Angeles Building Department’s methane collection system standards. The required minimum number of detectors and the detector spacing table can be found in Design Drawings C9.0 and C9.5, respectively.

6.1.6 Methane Gas Probes/Sampling Ports

To measure the effectiveness of the collection system, horizontal methane gas probes will be installed below building slabs in conjunction with the passive venting system. The probes will consist of a small-diameter (typically 0.75-inch) solid wall PVC pipe installed parallel to the building slab, fitted with a perforated screen at the end. The pipe will be installed directly below the membrane liner, with a

vertical separation of 2 to 4 inches above the collection pipes. The probe will terminate with a valve outside the membrane in a sealed access box.

A minimum of one sampling port is to be provided for each LFG collection manifold and each type of foundation group (based on their depth), as shown on Design Drawing C9.0. The perforated screen termination of the probe pipe shall be extended mid-way between the outer most collector pipe and the edge of slab (approximately 13 feet from edge of slab).

Interior methane monitoring for enclosed structures will also be completed periodically. Multiple readings will be collected throughout enclosed spaces on a quarterly basis concurrently with site monitoring activities as described in the site Operations, Maintenance and Monitoring plan, which will be prepared per the requirements of the DEQ.

6.1.7 Interior Venting for Occupied Structures

All spaces will require venting to prevent the accumulation of LFG or to evacuate any gas that does accumulate. The means of venting these spaces can be mechanical or natural.

Naturally vented enclosed spaces—at least 25 percent open wall area at the top and bottom of two walls in order to accommodate natural movement of air through the space. Spaces meeting this requirement do not require any supplemental means of mechanical ventilation.

Passive venting for enclosed spaces—periodic openings at the bottom and top of the lowest level of enclosed spaces. These spaces should have mechanical backup vents to clear air space in the event that gas accumulates beyond the passive system's venting capability.

Powered venting for enclosed spaces—mechanical vent fans for methane environments required for these spaces without natural venting. Spaces will allow for make-up air at a minimum rate of one exchange per hour. The fan may be always on, or may periodically cycle. The space must be equipped with a methane detector in the primary space at the building entry.

All outdoor enclosures with open bottoms, when installed on grade or finished floors, will be mounted on a minimum 2-inch-thick concrete pad over a 60-mil HDPE impervious membrane. All membrane penetrations will be suitably sealed against transmission of gas into the enclosure.

6.2 Stormwater Management

Site stormwater will be managed in compliance with the BES stormwater manual.

The following design criteria are considered for the proposed stormwater collection and conveyance system to avoid stormwater runoff contact with exposed waste and/or chemicals of concern:

- Avoid infiltration over or adjacent to waste by using BES's prescriptive 30-mil HDPE geomembrane.

- Minimize excavation within waste limits (i.e., minimum use of subsurface vaults, stormwater structures).
- The following stormwater collection, conveyance, and treatment elements were designed per the BES's Stormwater Management Manual as discussed in detail in the stormwater management report provided as Appendix A.
 - Conveyance system and private outfall: As discussed in the attached stormwater report, all proposed stormwater conveyance elements (i.e., stormwater piping and swales) are sized to convey the runoff generated during the 25-year design storm. The existing private outfall is a 30-inch-diameter, reinforced-concrete pipe at a 0.005-foot-per-foot slope and with a 29.0 cubic-foot-per-second (cfs) conveyance capacity (calculated using 0.013 as Manning's value), assuming free discharge condition. The calculated peak flows from the 25-year and 100-year design storms are 22.6 cfs and 25.8 cfs, respectively, not exceeding the existing outfall capacity.
 - Flow Control Exemption: The Site is exempt from the flow control requirements because its discharge point at the Columbia Slough is located at the most downstream end to the west of the Multnomah County Drainage District (MCDD) boundary. The MCDD's flow control exemption letter addressed to City of Portland can be found in Appendix B.
 - Lined bioretention stormwater treatment facilities: Landscape areas are proposed to be utilized as stormwater treatment facilities, where applicable. The landscape island located at the southwest corner of the Site, and the central landscape island between Building A and Building B, are proposed stormwater swale 1 and swale 2, respectively. As a large section of each swale extends over the former landfill footprint, BES-required 30-mil HDPE liner will be provided at the base of the storage rock section of the facilities. A larger lined bioretention facility (stormwater basin) will be located at the southeast corner of the Site to provide treatment for most of the stormwater runoff generated in the Building A pavement area.
 - Mechanical/media filter stormwater treatment facility: The pavement area around Building B will be routed to an underground media filter vault, as the MCDD does not allow vegetative stormwater facilities along the northern curb because of seepage concerns associated with the existing levee.

6.3 Landfill Caps

Based on previous subsurface investigations, the preconstruction landfill cap material was approximately 3 feet of "well graded gravelly fill largely comprised of concrete" (DEQ, 2018). The landfill cap will consist largely of the existing landfill cap with additional imported fill soil (up to 12 feet thick and one small area up to 20 feet thick) to facilitate site development. Fill will be placed to level the building pad area to subgrade levels, and load transfer platforms will be installed. Each load transfer platform will extend 10 feet laterally from the building footprints and will consist of a cement-treated soil with geogrid layers designed to distribute loads evenly over the entire footprint for each building. This will be followed by temporary soil surcharges to consolidate the waste below.

Development will consist of warehouse buildings, asphalt driveway and parking areas, landscaped areas, and required utilities/stormwater treatment infrastructure. Buildings and other impervious surfaces will be constructed over a passive LFG venting system (which can be converted to an active system if necessary) that will include an impervious vapor barrier. These features will serve as a contiguous cap.

The following proposed site features/surfacing will provide a cap additional to the existing landfill cap:

- Buildings
- Pavement
- Sidewalks

Areas that are not covered with impervious surfaces (paving, concrete, structures) will be planted with vegetation complying with the city's landscape buffer requirements. Flat landscaped areas will also have area drains to collect surface stormwater runoff and reduce infiltration to the landfill soil cap. Landscaping will be monitored for signs of stress such as patches of dead vegetation or soil and plant discoloration.

6.4 Utilities

Sewer and potable water systems do not require specialized design elements, although trench backfill must be considered. Specifically, subsurface utility trenches and conduits can potentially provide preferential pathways for gas migration to the ground surface. Therefore, utility trenches within the waste boundary will utilize a trench dam consisting of cement/bentonite grout backfill to provide a nonporous channel that will prevent gas migration to other portions of the Site and adjacent properties. Gasketed pipe will also be used to prevent gas intrusion into open conduits. This trench backfill method will also prevent infiltration to the drainage system of groundwater that could potentially contain leachate.

A trench dam will have a minimum length of twice the width of the trench or a minimum of 36 inches in length. The entire cross section of trenches will be backfilled to provide a minimum of 6 inches of trench dam material around all conduits and pipes. Trench dam materials may be of the following:

- Bentonite cement slurry—a mixture of 4 percent type ii cement and 2 percent powdered bentonite, or
- Compacted native backfill—native soil will be compacted to at least 90 percent relative compaction in accordance with ASTM International D-1557 testing procedures.

All manholes and other underground electric enclosures that are intended for personnel entry will be naturally ventilated at all times to open air in an approved manner to prevent the buildup of methane. Mechanical ventilation may be used in lieu when backup power enough to run the system for 24 hours is provided and there is a visual and audible main power failure alarm at a readily accessible location. Approved seals will be used to prevent water and methane gas from entering the sides of the underground electrical enclosures. Personnel entry access cover will be provided with an approved

restraining system. All wiring terminations, equipment, and insulating materials in the enclosure will be suitable for a wet location. Approved duct seals will be used to prevent water from the conduits entering or leaving the manholes and other underground electrical enclosures intended for personnel entry. The seal will have a depth not less than the diameter of the conduit.

6.5 Institutional Controls

Institutional controls currently in place are described in the EES and include the following documents:

- LGHCP (PBS, 2015a)
- LGMCP (PBS, 2015b)
- SMP (PBS, 2015c)

These will be modified or replaced in the future, based on post-development site features and conditions.

7 IMPORT FILL CRITERIA AND EVALUATION/APPROVAL PROTOCOLS

Prior direction from the DEQ established occupational risk-based concentrations as the acceptance criteria for import soil. Soil samples are collected from prospective sources and analyzed for diesel- and oil-range hydrocarbons, organochlorine pesticides and herbicides (as needed based on historical use of the proposed sites), polychlorinated biphenyls as Aroclors, polycyclic aromatic hydrocarbons, and priority pollutant metals. The DEQ has established occupational risk-based concentrations (RBCs) as the acceptance criteria for soil import to the Site. Consequently, sample results are screened against RBCs for soil ingestion, dermal contact, and inhalation (i.e., direct contact) for occupational receptors. MFA also screens the results for priority pollutant total metals against DEQ background metals for the Portland Basin. At the DEQ's direction, DEQ clean fill criteria were also used for general comparison purposes. Results are reported to the DEQ with an approval request. A total of 11 import sources have been evaluated and approved by the DEQ. At the writing of this report, it is anticipated that at least four more import sources will require evaluation.

8 DETAILED SITE LAYOUT DRAWINGS

Detailed site layout drawings reflecting the proposed grading are included in the design drawings following this report. The site grading design proposes limited excavation (only to level the building pad subgrades) and calls for approximately 275,000 cubic yards of soil import to raise the site grades to accommodate the load transfer platforms overlain by the proposed LFG collection system.

9 PERMITTING REQUIREMENTS

The following discusses the permits required for the project:

- The DEQ construction stormwater permit (1200C) was issued on January 11, 2019, before the start of initial site preparation, and was updated on February 1, 2019, and again on June 17, 2019.
- The City of Portland demolition permits: on March 12, 2019, individual permits were obtained for each structure slated to be removed from the Site, and the demolition phase of the project was completed in May 2019.
- The City of Portland partial grading permit for initial site preparation was obtained on May 24, 2019.
- The City of Portland building permit application was submitted on June 28, 2019.
- Portland Bureau of Transportation/BES Public Works permitting is under way for off-site improvements (nonenvironmental).

10 EROSION AND SEDIMENT CONTROL, NOISE ABATEMENT, AND SITE SECURITY

The contractor will continue to implement and maintain the erosion- and sediment-control best management practices (silt fence, construction entrance, inlet protection, and wheel wash) consistent with the erosion- and sediment-control plan submitted and approved for the Site's 1200-C Construction Stormwater Permit.

The contractor will continue to comply with the city's noise abatement ordinance (18.10.060 Construction Activities and Equipment).

During work hours, on-site personnel provide site security. The Site is fenced. The LGHCP is in effect and is administered by the general contractor. The City of Portland does not require specific security measures.

LIMITATIONS

The services undertaken in completing this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

REFERENCES

DEQ. 2018. Letter (re: conditional no further action determination for the Hanson Pipe site) To G. Knapp, Lehigh Hanson Region West Materials, 10-2 from K. Parrett, Oregon Department of Environmental Quality, Portland, Oregon. June 12.

MFA. 2019. Baseline landfill gas monitoring plan, 755 NE Columbia Blvd, Portland, Oregon. Maul Foster & Alongi, Inc. April 15.

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Terra Associates. 2019. Design memorandum for load transfer platform sloped transition. Terra Associates, Inc., Seattle, Washington. June 3.

USEPA. 2015. OSWER technical guide for assessing and mitigating the vapor intrusion pathway from subsurface vapor to indoor air. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. June.

APPENDIX A

STORMWATER MANAGEMENT REPORT



STORMWATER MANAGEMENT REPORT

BRIDGE POINT I-5 SITE



Prepared for
BRIDGE POINT I-5, LLC
June 21, 2019
Project No. 1648.02.04

Prepared by
Maul Foster & Alongi, Inc.
2001 NW 19th Avenue, Suite 200, Portland, OR 97209

STORMWATER MANAGEMENT REPORT

BRIDGE POINT I-5, LLC

*The material and data in this report were prepared
under the supervision and direction of the undersigned.*

DESIGNER'S CERTIFICATION STATEMENT

I hereby certify that this Stormwater Management Report for Bridge Point I-5 has been prepared by me or under my supervision and meets minimum standards of the City of Portland 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 designed by me.

MAUL FOSTER & ALONGI, INC.



EXPIRES: 6/30/2019

This digital seal certifies the signatory
and document content.

*Cem Gokcora, PE
Senior Engineer*

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- 5-2 STORMWATER ROUTING AND FACILITY PERFORMANCE

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- 4-1 STORM DRAINAGE PLAN
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- C3.1 EROSION AND SEDIMENT CONTROL DETAILS
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ACRONYMS AND ABBREVIATIONS

25-year storm the applicant	25-year, 24-hour design storm Bridge Point I-5, LLC
BES	Bureau of Environmental Services
cfs	cubic feet per second
City	City of Portland
COE	U.S. Army Corps of Engineers
DEQ	Oregon Department of Environmental Quality
LFG	landfill gas
MCDD	Multnomah County Drainage District
MFA	Maul Foster & Alongi, Inc.
NFA	No Further Action
PAH	polycyclic aromatic hydrocarbon
stormfilter vault	Contech Stormwater Solutions' StormFilter® Vault
SWMM	Stormwater Management Manual

1 INTRODUCTION

On behalf of Bridge Point I-5, LLC (the applicant), Maul Foster & Alongi, Inc. (MFA) has prepared this stormwater management report, which proposes stormwater management controls required for the second-phase development of Bridge Point I-5. This analysis considers preexisting and post-development conditions for the site.

The purpose of this report is to demonstrate that the proposed stormwater management system is designed in compliance with the Bureau of Environmental Services (BES) Stormwater Management Manual (SWMM).

The first phase of the project, which includes import fill, subgrade preparation, cement-treated soil layer construction, and installation of pre-load on top of future building footprints, is currently under construction under City of Portland (City) partial grading permit no. 19-109704-GRD-01-C0.

2 SITE DESCRIPTION/BACKGROUND

2.1 Site Description

The approximately 38-acre site is located at 755 NE Columbia Boulevard in Portland, Oregon (Figure 2-1) and is referred to as the Bridge Point I-5 site (formerly known as Lehigh Hanson or Hanson Pipe). The Oregon Department of Environmental Quality (DEQ) assigned the site Environmental Cleanup Site Information Number 3893. The site is zoned heavy industrial and is bordered on the north by the Columbia Slough (part of the property boundary extends into the slough) and by industrial properties to the east, south, and west. NE Grand Avenue also borders the southern half of the west side of the site. The northernmost portion of the site is in the Environmental Conservation (c) overlay zone. Immediately before the applicant's land transaction, the site was used by a tenant for parking and storing semitrailers.

2.2 Site Background

In the 1970s, a portion of the site was used as a DEQ-permitted landfill. Between 2001 and 2012, multiple investigations related to impacted stormwater discharges from maintenance areas and potential methane generation from the landfill were conducted at the site. The thickness of landfill material on site varies between 5 and 30 feet; this material consists generally of wood, cardboard, wire, plastic, sheetrock, gravel and other, miscellaneous, construction debris, and is capped with approximately 3 feet of well-graded, gravelly fill largely composed of concrete. The landfill footprint is comprised of much of the northwest portion of the site (see Figure 2-2).

Based on the results of the investigations, human health and ecological risk assessments, remedial investigation, and institutional controls (i.e., landfill cap, use restrictions, and landfill gas [LFG] monitoring), DEQ issued a conditional No Further Action (NFA) determination for the upland portions of the site in 2012 (further investigation was pending for the slough).

In June 2018, DEQ issued a conditional NFA for the entire site (DEQ, 2018) stating the following:

- The results of DEQ's review of a stormwater source control evaluation and results of sediment testing adjacent to the site showed concentrations at or below DEQ estimates of baseline levels. Management of stormwater discharge from the site was regulated under a DEQ National Pollutant Discharge Elimination System 1200-COLS permit and the stormwater management was deemed to be adequate to address concerns from the landfill and underlying groundwater.

After the land transaction, former landowner Lehigh Hanson requested termination of the 1200-COLS permit. Subsequently, the applicant communicated with DEQ and confirmed that proposed site use would not trigger the requirement for a new industrial stormwater permit.

2.3 Proposed Remedial Action

After purchase of the property, the applicant started coordinating with DEQ to remediate and redevelop the site through a remedial action approval track. The proposed project will remediate the current site conditions by providing a more robust impervious cap with a more effective LFG-collection system, ensuring protection of human health and the environment. A focused feasibility study, outlining proposed remedial action (alternatives), was prepared by MFA and reviewed by DEQ between February and April 2019. The applicant will continue working with DEQ to provide remediation design documents for DEQ's approval. A Consent Judgment is expected to be filed by early to mid-September, 2019.

2.4 Demolition and Phase 1 Improvements Under Way

The implementation of the proposed project started with the demolition of the former site structures under separate demolition permits obtained in March 2019. A 1200-C Construction Stormwater permit was obtained from DEQ in January 2019, prior to issuance of individual demolition permits. Following demolition of the site structures, a partial grading permit, No. 19-109704-GRD-01-C0, was obtained (in May 2019) for the first phase of the proposed development. Phase 1 improvements includes soil import (approximately 290,000 cubic yards), construction of cement-amended subgrade load transfer platforms under two proposed buildings, and construction of a building pad topped with associated preloading. At the time of writing of this report, Phase 1 grading and subgrade improvements are under way.

2.5 Existing Stormwater System

The preexisting conditions of the site surfacing included pavement and compacted rock. The existing site stormwater conveyance system comprises a network of catch basins, stormwater manholes, and

conveyance piping that eventually discharges to the slough at site's private permitted outfall (30-inch-diameter concrete). The existing stormwater conveyance system will be decommissioned/abandoned (all the way down to a manhole immediately upstream of the existing outfall) during Phase 1 improvements.

3 POSTDEVELOPMENT CONDITIONS OVERVIEW

The final phase (Phase 2) of the Bridge Point I-5 site development will include fine grading; construction of two warehouse buildings with an approximate total building area of 675,000 square feet; and associated site improvements, including utilities, stormwater management, and paving. Dock high loading is planned on the northern side of each building. Site access will be from the existing driveway off NE Columbia Boulevard in the southeast corner of the site, and from a new approach on NE Grand Avenue (along with proposed right-of-way improvements, currently under review by Portland Bureau of Transportation, Permit Application no. 2019-175667).

As described above, the site's northernmost section (Columbia Slough shoreline) is in the Environmental Conservation overlay zone. The proposed development will not encroach into the Resource Area, but will encroach into the outermost (upland) 10 feet of the Transition Area.

The applicant submitted a development review application to Multnomah County Drainage District (MCDD) in January 2019 regarding the proposed site improvements (MCDD-18-30516-LV). MCDD reviewed and routed the application to the U.S. Army Corps of Engineers (COE). At the time of writing of this report, the applicant had been notified that COE had determined that the application would not need to go through further COE review (Section 408 review), and MCDD will issue a development review approval letter upon receipt of the COE's formal determination letter. MFA will amend this report upon receipt of the MCDD approval letter.

Stormwater generated from impervious areas on the site will be managed on site in facilities maintained by the property owner.

4 METHODOLOGY

The applicant proposes to redevelop the subject site with a stormwater management system designed, consistent with requirements of the City's SWMM, to route stormwater runoff to the existing private outfall after proposed water quality treatment.

4.1 Stormwater Hierarchy Justification

Infiltration is the preferred disposal method in the stormwater hierarchy discharge criteria (Section 1.3.1 of the SWMM). As identified in the focused feasibility study (MFA, 2019), the U.S.

Environmental Protection Agency presumptive remedy primary response action objectives include preventing direct contact with landfill contents; minimizing infiltration and resulting contaminant leaching to groundwater; controlling surface water runoff and erosion; collecting and treating contaminated groundwater and leachate to contain the contaminant plume and prevent further migration from the source area; and controlling and treating LFG.

The subsurface of the western half of the property consists of organic and inorganic landfill debris 25 to 45 feet deep, as well as explosive levels of methane. Native soils composed of varying layers of low-permeability silt and sandy silt are found on the remainder of the site. The full geotechnical report may be found in Appendix A.

The 2018 conditional NFA for the site (DEQ, 2018) identifies arsenic, chromium, heavy oil, and polycyclic aromatic hydrocarbons (PAHs) as contaminants of potential concern for human health in soil. The landfill material is currently capped with approximately 3 feet of “well graded gravelly fill largely comprised of concrete” (DEQ, 2018). The planned development includes minimal excavation over former landfill areas; the development also includes placing large quantities of fill (up to a 20-foot-thick layer) over the existing landfill cap, which will dramatically reduce the potential for direct contact with landfill contents. Concentrations of contaminants in the landfill contents will require management as solid waste should this material be excavated or otherwise disturbed (DEQ, 2018).

The NFA also found that hazardous substances in groundwater, primarily PAHs, did not present a risk to the Columbia Slough through groundwater migration and discharge. The proposed development will reduce infiltration at the site, further decreasing the potential for contaminants to leach to the groundwater and reducing the need for collecting and treating the leachate.

The site has known soil contamination as described above and, to avoid exacerbation of leachate/groundwater contamination, infiltration is not allowed and therefore is not feasible for this site. Because site stormwater is discharged to Columbia Slough at a private permitted outfall, the proposed stormwater management system is evaluated under SWMM Stormwater Hierarchy Category 3.

4.2 Facility Design Approach

Performance Approach is used to size proposed stormwater treatment facilities (i.e., vegetated stormwater facilities [swales and basin facility] and a BES-approved manufactured stormwater treatment technology). The proposed stormwater facilities are designed using the hydrologic analysis method described in the following section.

4.3 Design Storm

A water quality storm is a storm event that generates 0.83 inch of rainfall in 24 hours, as listed in the SWMM.

The SWMM requires that the stormwater conveyance system be designed to convey the 25-year, 24-hour design storm (25-year storm) of 3.90 inches. The 25-year storm is used to check the anticipated flow through proposed conveyance system elements against the capacities of those conveyance elements.

Vegetated stormwater facilities are designed to comply with BES details SW 240, 250, and 252, with a 60-mil high-density polyethylene liner to avoid infiltration. In order to meet the performance criteria listed in the SWMM for vegetative stormwater treatment facilities, the proposed facilities are sized to have a ponding depth of no more than 4 inches during the water quality storm event, and to convey the runoff generated during the 25-year design storm. The runoff generated during the 100-year, 24-hour storm will be contained within the vegetated stormwater facilities.

The media filter vault is sized to treat the water quality flowrate of the contributing drainage basin (Basin 7). A flow diversion manhole will be installed upstream of the media filter unit to bypass flows exceeding the water quality flow. The flow diversion structure and the outgoing pipes will be able to bypass runoff generated during the 100-year, 24-hour storm event.

4.4 Hydrologic Model

The hydrologic conditions were modeled using HydroCAD® software, version 10.0. Consistent with the SWMM requirements, stormwater runoff volumes and peak flow rates were estimated using the Santa Barbara Urban Hydrograph method and utilized the Natural Resource Conservation Service Type IA hydrograph. The HydroCAD output report is included in Appendix B.

4.5 Drainage Basins

For purposes of this analysis, the site is divided into seven drainage basins, as shown on Figure 2-2.

The northern basin (Basin 7) will be graded to sheetflow toward the northern curb line to low spots with catch basins, directing the runoff to the Contech Stormwater Solutions' StormFilter® Vault (stormfilter vault).

A flow diversion manhole will be installed upstream of the stormfilter vault to bypass flows in excess of the water quality flow (1.21 cubic feet per second [cfs]). The stormwater treated in the stormfilter vault will be conveyed to the site's existing private outfall (which discharges to Columbia Slough at river mile 8.3).

It is proposed that most of the southern part of the site, south of Building B (Basins 1 and 5), be graded to sheetflow into the vegetative stormwater facilities (Swales 1 and 2). The area east and southeast of Building A (Basins 2 and 4) is proposed to drain to the Stormwater Basin Facility, located at the southeast corner of the site, via a network of catch basins and stormwater pipes.

The Stormwater Basin Facility area is accounted for as an impervious area contributing to this facility in the hydrological calculations.

An outlet structure will be installed at the east end of Swale 1 to direct both treated and overflowed stormwater to the site's conveyance system, which eventually discharges into the slough at the site's outfall.

An outlet structure will be installed at the east end of Swale 2 restricting the flow to the site's conveyance system (eventually discharging Columbia Slough at the site's existing outfall) to that of the flow that can be infiltrated through the growth media during the water quality event; and directing in excess of this flow to the basin facility for further treatment.

An outlet device, which will direct treated and overflowed runoff to the site's conveyance system, will be installed at the downstream end of the Stormwater Basin Facility.

4.6 Proposed Drainage and Conveyance

The site stormwater runoff that requires treatment (all runoff except roof runoff) will be routed to the proposed stormwater treatment facilities either by sheetflowing or through a closed pipe system (see Figure 4-1 and the drawings). Roof runoff from both buildings will be routed directly to the existing outfall, bypassing the proposed treatment facilities. The proposed stormwater treatment facilities will include lined bioretention facilities (i.e., grassy swales, Stormwater Basin Facility) and a media filter vault.

Grassy Swale and Stormwater Basin Facility, as described in the SWMM, are selected for vegetative stormwater treatment facilities. These bioretention facilities are designed to meet performance criteria as listed in the SWMM, with a liner to prevent infiltration. Contech Stormwater Solutions' StormFilter® Vault (stormfilter vault) with ZPG® media cartridges are proposed for water quality treatment for areas to the west and north of Building B. The stormfilter vault (see Figure 4-2) is an underground stormwater treatment device that houses rechargeable, media-filled cartridges that trap particulates and adsorb pollutants from stormwater runoff. The media selected for this application is ZPG filter media (BES approved), a proprietary blend of zeolite, perlite, and granular activated carbon selected to treat total suspended solids, oil, grease, organics, soluble metals, and other pollutants.

5 ANALYSIS

5.1 Flow Control Exemption

Based on previous correspondence with MCDD, the site is exempt from the flow control requirements because its discharge point at Columbia Slough is located at the most downstream end to the west of the MCDD district boundary.

5.2 Conveyance Requirements and Design

5.2.1 Site Conveyance System

All proposed stormwater conveyance elements (i.e., stormwater piping and swales) are sized to convey the runoff generated during the 25-year design storm.

5.2.2 Existing Outfall Capacity

The existing private outfall is a 30-inch-diameter, reinforced-concrete pipe at a 0.005-foot-per-foot slope and with a 29.0 cfs conveyance capacity (calculated using 0.013 as Manning's value), assuming free discharge condition. The calculated peak flows from the 25-year and 100-year design storms are 22.6 cfs and 25.8 cfs, respectively, not exceeding the existing outfall capacity.

5.3 Facility Sizing

5.3.1 Swales/Basin Facility

Vegetative facilities are sized to meet the minimum cross-section requirements (i.e. 2' min bottom width, 3H:1V side slopes) shown on detail SW 240 of SWMM. The growth medium, and drain layer sections are designed to match the minimum requirements listed on SW 240 (with the exception that basin facility is designed to have two feet drain layer thickness for additional storage and conveyance capacity). These facilities are designed to have flat bottom slopes with perforated underdrain piping within the drain layer. The overflow configurations are sized to meet the ponding depth and conveyance requirements identified in section 4.2.

5.3.2 Stormfilter Vault

Stormfilter vault is sized to treat the calculated 1.21 cfs peak flow generated from Basin 7 during the water quality storm. The upstream flow diversion manhole is designed to limit the flow that gets directed to the stormfilter vault to 1.4 cfs (during 100-yr storm). The stormfilter vault has a peak flow capacity of 1.8 cfs.

5.4 Routing Summary/Facility Performance

The table below lists the drainage basins information and the associated treatment facilities:

Table 5-1—Drainage Basins/Treatment Facilities

Basin ID	Impervious Area Type/Use	Impervious Area (acres)	Curve Number	Ownership	Treatment Facility Type	Facility Size (acres)
Basin 1	Parking lot/road	0.74	96	Private	Swale	.07
Basin 2	Parking lot/road	1.49	97	Private	Storm Basin	.43
Basin 3	Roof	5.40	98	Private	N/a	N/A

Basin 4	Parking lot/road	0.46	97	Private	Storm Basin	.43
Basin 5	Parking lot/road/loading	4.66	98	Private	Swale/Storm Basin Facility	.30
Basin 6	Roof	10.08	98	Private	N/a	N/A
Basin 7	Parking lot/road/loading	7.14	98	Private	Stormfilter® Vault	(8' x 22' vault)
Storm Basin	Stormwater basin facility	0.27	93	Private	Storm Basin Facility	.43

The table below provides the HydroCAD result showing calculated surface water elevations for proposed facilities after routing of the design storm events:

Table 5-2—Stormwater Routing/Facility Performance

Facility ID	Contributing Basins	Facility Depth (feet)	Calculated Ponding Depth (feet)		
			@ water quality storm	@25-year storm	@100-year storm
Swale 1	Basin 1	1	0.31	0.47	0.48
Swale 2	Basin 5	1.25	0.34	0.46	0.47
Basin Facility	Basins 2, 4, and 5	4	0.14	3.17	3.30

6 ENGINEERING CONCLUSIONS

The proposed stormwater management system outlined in this report satisfies the requirements outlined in the SWMM. Stormwater will be treated by grassy swales/basins and a water quality vault prior to discharge at a private permitted outfall on the Columbia Slough. The proposed stormwater facilities will have an emergency overflow and underdrain system that drains to the site's stormwater main discharging to the Columbia Slough.

The project maximizes the use of vegetated stormwater facilities to the extent possible. The proposed stormwater infiltration facilities are designed to meet the City's requirements for hierarchy Category 3. This report and the associated design drawings were prepared under the guidelines of generally accepted engineering practices and principles.

LIMITATIONS

The services undertaken in completing this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

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MFA. 2019. Focused feasibility study, Bridge Point I-5 site, Portland, Oregon, ECSI No. 3893. Maul Foster & Alongi, Inc., Portland, Oregon. May 10.

FIGURES

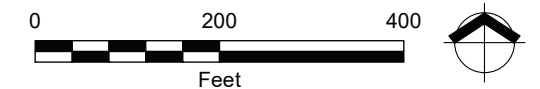




Figure 1
Site Location Map
Bridge Point I-5, LLC
755 NE Columbia Blvd
Portland, Oregon 97211

Legend

 Property Boundary
(approximate)



Source: Aerial photograph obtained from Mapbox.
Property boundary obtained from RLIS.

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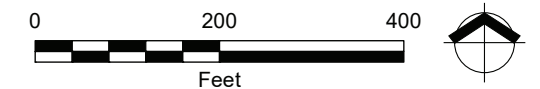
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Figure 2-1
Site Location Map
Bridge Point I-5, LLC
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Portland, Oregon 97211

Legend

 Property Boundary
(approximate)



Source: Aerial photograph obtained from Mapbox.
Property boundary obtained from RLIS.

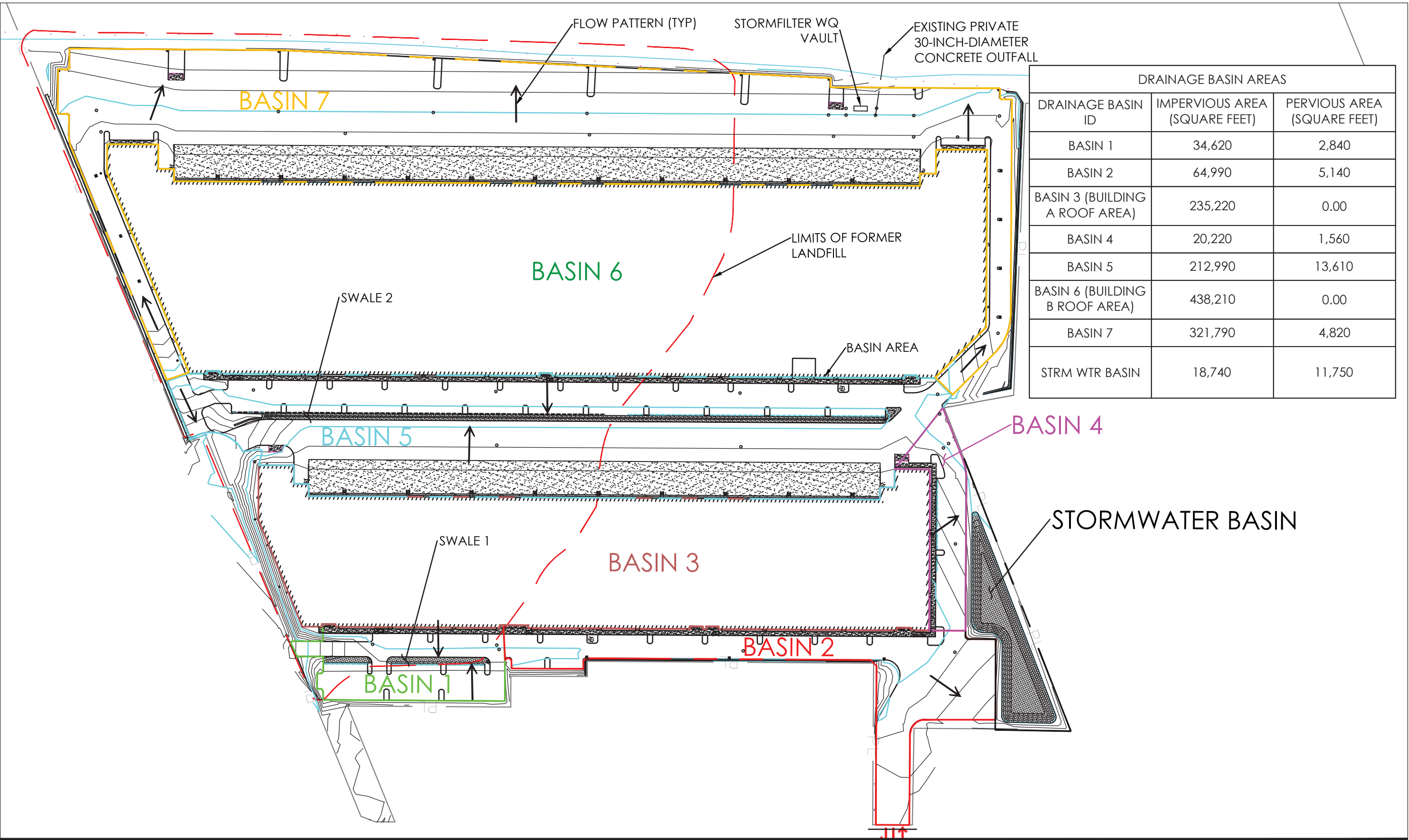
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NOTE: BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE ACCORDINGLY.

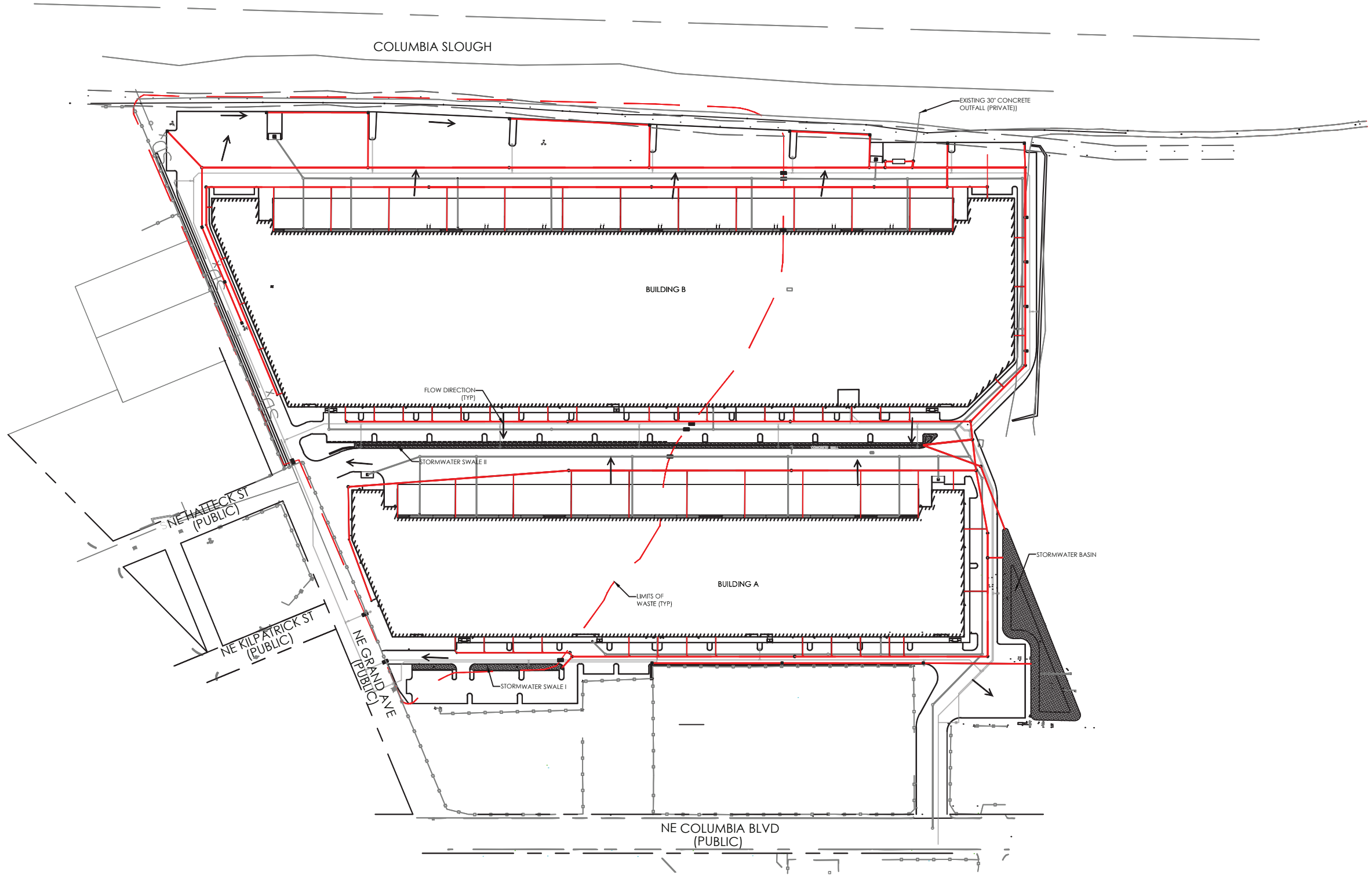


Figure 2-2
Post Development Drainage Basin Map
Bridge Point I-5 Development
Portland, Oregon

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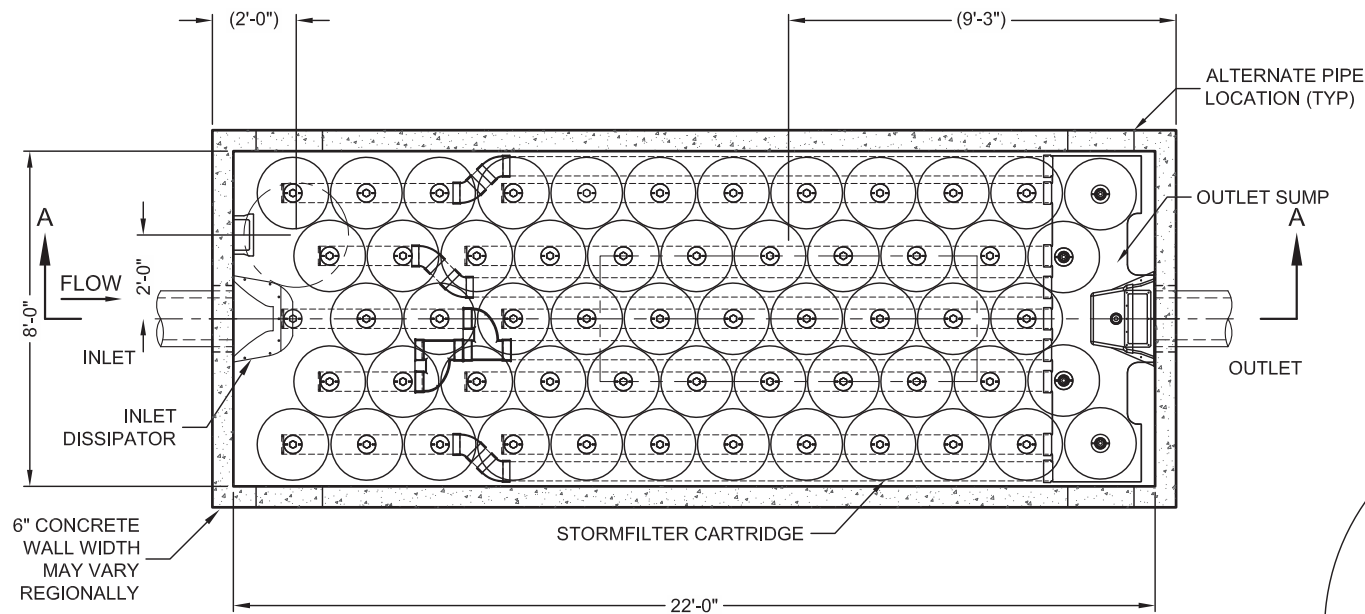


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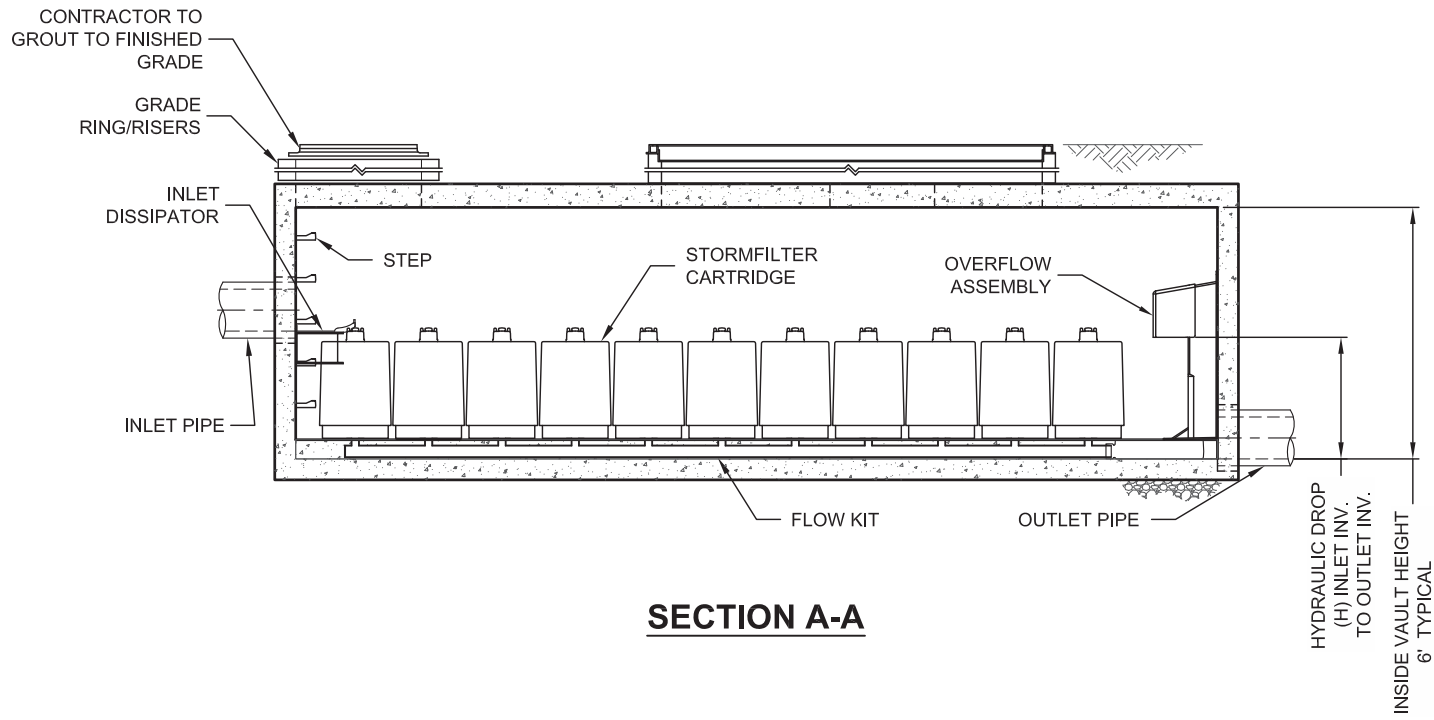


Figure 4-1
Storm Drainage Plan
Bridge Point I-5
Portland, Oregon

1:COMMONCADD\TREATMENT\10 STORMFILTER\40 STANDARD DRAWINGS\SF VAULT\DWG\SF0822-DTL.DWG 7/8/2016 3:16 PM



PLAN VIEW
VAULT STYLE: OUTLET SUMP (NIB)



SECTION A-A



THE PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING:
U.S. PATENTS: 5,322,229; 5,344,476; 6,179,071; 5,846,187; 6,022,439; 6,045,040;
RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

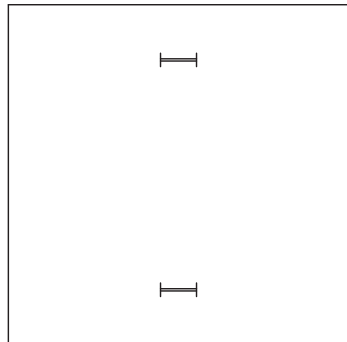
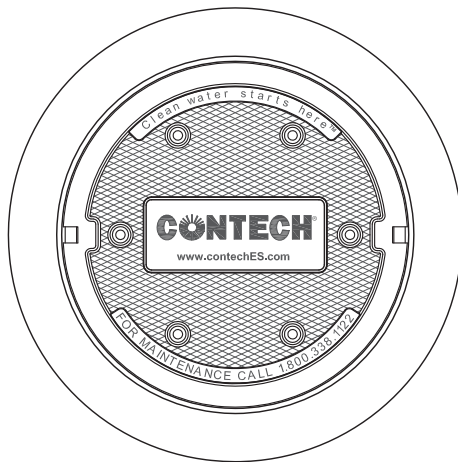
STORMFILTER DESIGN NOTES

STORMFILTER TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. THE STANDARD VAULT STYLE IS SHOWN WITH THE MAXIMUM NUMBER OF CARTRIDGES (56). VAULT STYLE OPTIONS INCLUDE INLET BAY (49), INLET BAY/OUTLET BAY (46), OUTLET BAY (51), NLET BAY/FULL HEIGHT BAFFLE WALL (41), FULL HEIGHT BAFFLE WALL (46). STORMFILTER 8X22 PEAK HYDRAULIC CAPACITY IS 1.8 CFS. IF THE SITE CONDITIONS EXCEED 1.8 CFS AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

CARTRIDGE SELECTION

CARTRIDGE HEIGHT	27"			18"			LOW DROP		
RECOMMENDED HYDRAULIC DROP (H)	3.05'			2.3'			1.8'		
SPECIFIC FLOW RATE (gpm/sf)	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf	2 gpm/sf	1.67* gpm/sf	1 gpm/sf
CARTRIDGE FLOW RATE (gpm)	22.5	18.79	11.25	15	12.53	7.5	10	8.35	5

* 1.67 gpm/sf SPECIFIC FLOW RATE IS APPROVED WITH PHOSPHOSORB® (PSORB) MEDIA ONLY



FRAME, COVER, AND HATCH
(SIZE AND CONFIGURATION VARY)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	*
WATER QUALITY FLOW RATE (cfs)	1.21
PEAK FLOW RATE (cfs)	1.40
RETURN PERIOD OF PEAK FLOW (yrs)	*
CARTRIDGE HEIGHT (27", 18", LOW DROP(LD))	27"
NUMBER OF CARTRIDGES REQUIRED	53
CARTRIDGE FLOW RATE	22.5
MEDIA TYPE (PERLITE, ZPG, PSORB)	ZPG

PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE #1	*	see permit set	
INLET PIPE #2	*	sheets C5.1-C6.2)	
OUTLET PIPE	*		

UPSTREAM RIM ELEVATION	*
DOWNSTREAM RIM ELEVATION	*

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES

- CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
- DIMENSIONS MARKED WITH () ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
- FOR SITE SPECIFIC DRAWINGS WITH DETAILED VAULT DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
- STORMFILTER WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
- STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 5' 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.
- FILTER CARTRIDGES SHALL BE MEDIA-FILLED, PASSIVE, SIPHON ACTUATED, RADIAL FLOW, AND SELF CLEANING. RADIAL MEDIA DEPTH SHALL BE 7-INCHES. FILTER MEDIA CONTACT TIME SHALL BE AT LEAST 38 SECONDS.
- SPECIFIC FLOW RATE IS EQUAL TO THE FILTER TREATMENT CAPACITY (gpm) DIVIDED BY THE FILTER CONTACT SURFACE AREA (sq ft).
- STORMFILTER STRUCTURE SHALL BE PRECAST CONFORMING TO ASTM C-857 AND AASHTO LOAD FACTOR DESIGN METHOD.

INSTALLATION NOTES

- ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
- CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STORMFILTER VAULT (LIFTING CLUTCHES PROVIDED).
- CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL VAULT SECTIONS AND ASSEMBLE VAULT.
- CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH OUTLET PIPE INVERT WITH OUTLET BAY FLOOR.
- CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.

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

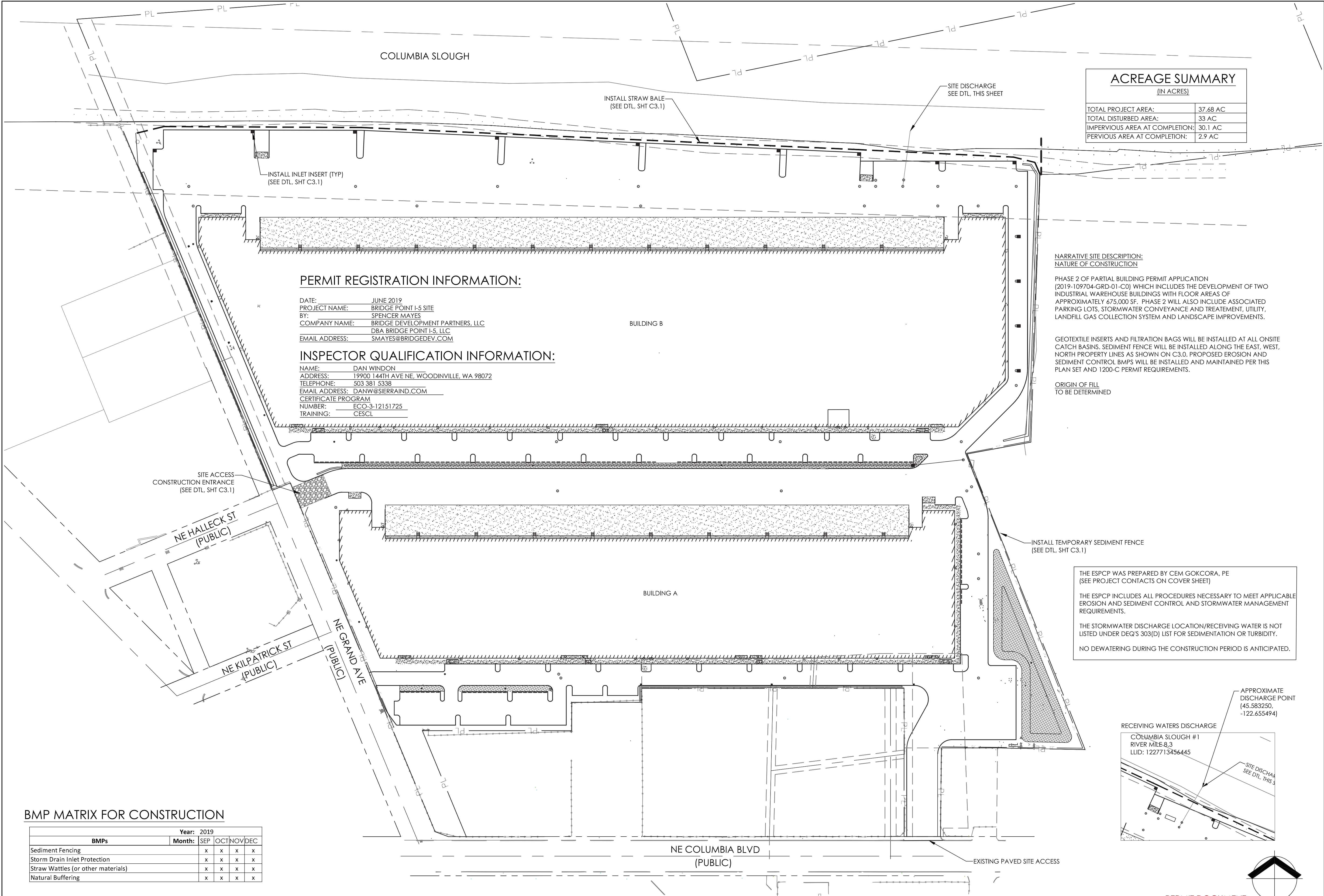
SF0822
STORMFILTER
STANDARD DETAIL

FIGURE 4-2

DRAWINGS



PLOTTED BY: Corrick Kumbhoj BIRNAME, C:\VOLUME\PROJECTS\1448\B2 Bridge Development\PLANS\On-Site\CLUTTERSON AND SEDIMENT CONTROL PLAN.dwg
 PLOTTED ON: 2019/06/21 3:36 PM



ACREAGE SUMMARY (IN ACRES)	
TOTAL PROJECT AREA:	37.68 AC
TOTAL DISTURBED AREA:	33 AC
IMPERVIOUS AREA AT COMPLETION:	30.1 AC
PERVIOUS AREA AT COMPLETION:	2.9 AC

PERMIT REGISTRATION INFORMATION:

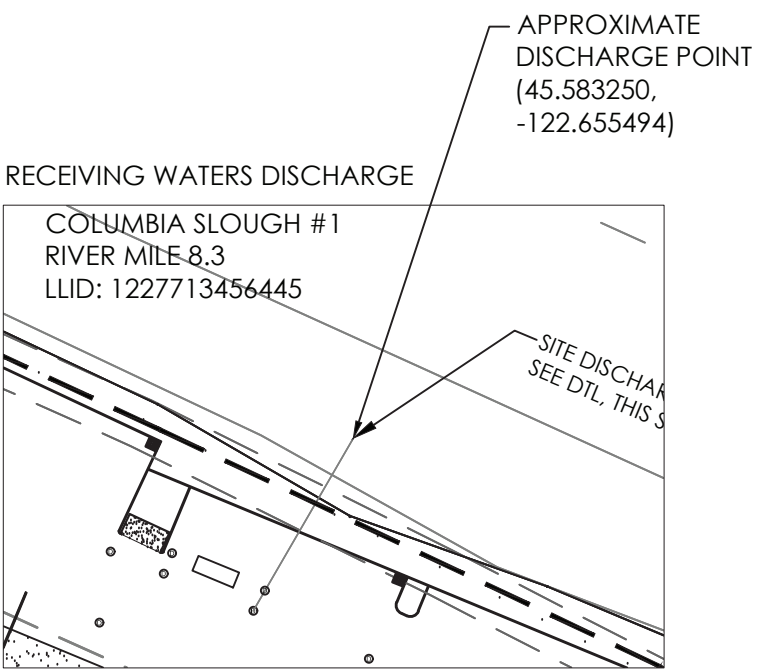
DATE: JUNE 2019
 PROJECT NAME: BRIDGE POINT I-5 SITE
 BY: SPENCER MAYES
 COMPANY NAME: BRIDGE DEVELOPMENT PARTNERS, LLC
 DBA BRIDGE POINT I-5, LLC
 EMAIL ADDRESS: SMAYES@BRIDGEDEV.COM

INSPECTOR QUALIFICATION INFORMATION:

NAME: DAN WINDON
 ADDRESS: 19900 144TH AVE NE, WOODINVILLE, WA 98072
 TELEPHONE: 503.381.5338
 EMAIL ADDRESS: DANW@SIERRAIND.COM
 CERTIFICATE PROGRAM NUMBER: ECO-3-12151725
 TRAINING: CESCL

NARRATIVE SITE DESCRIPTION:
 NATURE OF CONSTRUCTION
 PHASE 2 OF PARTIAL BUILDING PERMIT APPLICATION (2019-109704-GRD-01-C0) WHICH INCLUDES THE DEVELOPMENT OF TWO INDUSTRIAL WAREHOUSE BUILDINGS WITH FLOOR AREAS OF APPROXIMATELY 675,000 SF. PHASE 2 WILL ALSO INCLUDE ASSOCIATED PARKING LOTS, STORMWATER CONVEYANCE AND TREATMENT, UTILITY, LANDFILL GAS COLLECTION SYSTEM AND LANDSCAPE IMPROVEMENTS.
 GEOTEXTILE INSERTS AND FILTRATION BAGS WILL BE INSTALLED AT ALL ONSITE CATCH BASINS. SEDIMENT FENCE WILL BE INSTALLED ALONG THE EAST, WEST, NORTH PROPERTY LINES AS SHOWN ON C3.0. PROPOSED EROSION AND SEDIMENT CONTROL BMPs WILL BE INSTALLED AND MAINTAINED PER THIS PLAN SET AND 1200-C PERMIT REQUIREMENTS.
 ORIGIN OF FILL TO BE DETERMINED

THE ESPCP WAS PREPARED BY CEM GOKCORA, PE (SEE PROJECT CONTACTS ON COVER SHEET)
 THE ESPCP INCLUDES ALL PROCEDURES NECESSARY TO MEET APPLICABLE EROSION AND SEDIMENT CONTROL AND STORMWATER MANAGEMENT REQUIREMENTS.
 THE STORMWATER DISCHARGE LOCATION/RECEIVING WATER IS NOT LISTED UNDER DEQ'S 303(D) LIST FOR SEDIMENTATION OR TURBIDITY.
 NO DEWATERING DURING THE CONSTRUCTION PERIOD IS ANTICIPATED.



BMP MATRIX FOR CONSTRUCTION

BMPs	Year: 2019				
	Month:	SEP	OCT	NOV	DEC
Sediment Fencing		x	x	x	x
Storm Drain Inlet Protection		x	x	x	x
Straw Wattles (or other materials)		x	x	x	x
Natural Buffering		x	x	x	x

MAUL FOSTER ALONG I
 109 E 13TH STREET
 VANCOUVER, WA 98660
 PHONE: 360.694.2691
 www.maulfooster.com

EXPIRES: 6/30/2019
 This digital seal certifies the signatory and document content.

BRIDGE POINT I-5
 BRIDGE POINT I-5, LLC
 PORTLAND OREGON

ISSUE	DATE	DESCRIPTION
A	06/18/19	PERMIT SET

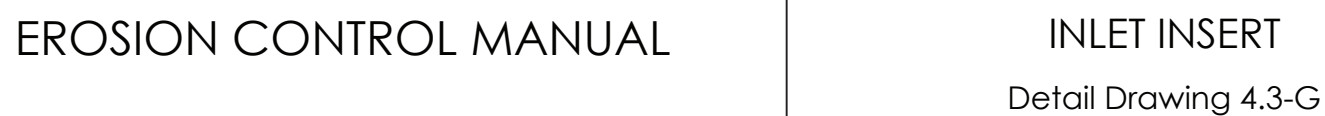
PROJECT: 1648.02.01
 DESIGNED: ALA
 DRAWN: ALA
 CHECKED: CEG
 SCALE

NOTE: BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE ACCORDINGLY.

SHEET TITLE
 EROSION AND SEDIMENT CONTROL PLAN
 SHEET
 C3.0

- A. Approval of this erosion, sediment and pollution control plan (ESPCP) does not constitute an approval of permanent road or drainage design (e.g., size and location of roads, pipes, restrictors, channels, retention facilities, utilities, etc.)
- B. The implementation of this ESPCP and the construction, maintenance, replacement, and upgrading of these ESPCP facilities is the responsibility of the applicant/contractor until all construction is completed and approved and vegetation/landscaping is established.
- C. The boundaries of the clearing limits shown on this plan shall be clearly flagged in the field prior to construction. During the construction period, no disturbance beyond the flagged clearing limits shall be permitted. The flagging shall be maintained by the applicant/contractor for the duration of construction.
- D. The ESPCP facilities shown on this plan must be constructed in conjunction with all clearing and grading activities, and in such a manner as to insure that sediment and sediment laden water do not enter the drainage system, roadways, or violate applicable water standards.
- E. The ESPCP facilities shown on this plan are the minimum requirements for anticipated site conditions. During the construction period, these ESPCP facilities shall be upgraded as needed for unexpected storm events and to ensure that sediment and sediment-laden water do not leave the site.
- F. The ESPCP facilities shall be inspected daily by the applicant/contractor and maintained as necessary to ensure their continued functioning.
- G. The ESPCP facilities on inactive sites shall be inspected and maintained a minimum of once a month or within the 24 hours following a storm event.
- H. Stabilized construction entrances shall be installed at the beginning of construction and maintained for the duration of the project. Additional measures may be required to insure that all paved areas are kept clean for the duration of the project.

1. The filter fabric shall be purchased in a continuous roll cut to the length of the barrier to avoid use of joints. When joints are necessary, filter cloth shall be spliced together only at a support post, with a minimum 6-inch overlap, and both ends securely fastened to the post, or overlap 2 inch x 2 inch posts and attach as shown on detail sheet 4-2A.
2. The filter fabric fence shall be installed to follow the contours where feasible. The fence posts shall be spaced a maximum of 6 feet apart and driven securely into the ground a minimum of 24 inches.
3. The filter fabric shall have a minimum vertical burial of 6 inches. All excavated material from filter fabric fence installation, shall be backfilled and compacted, along the entire disturbed area.
4. Standard or heavy duty filter fabric fence shall have manufactured stitched loops for 2 inch x 2 inch post installation. Stitched loops shall be installed on the up hill side of the sloped area.
5. Filter fabric fences shall be removed when they have served their useful purpose, but not before the upslope area has been permanently protected and stabilized.
6. Filter fabric fences shall be inspected by applicant/contractor immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately.



EROSION CONTROL MANUAL

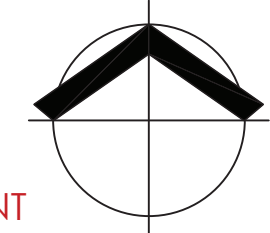
DITCH/SWALE INSTALLATION



FOR 24HR. PROTECTION ONLY



INLET PROTECTION MEASURES



MAUL FOSTER ALONG I
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VANCOUVER, WA 98660
PHONE: 360.694.2691
www.maulfoster.com



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and document content.

BRIDGE POINT I-5
BRIDGE POINT I-5, LLC
PORTLAND OREGON

[illegible]

PROJECT: 1648.02.01

DESIGNED:C. GOKCORA

DRAWN: G. KALMETA

CHECKED: C. GOKCORA

SCALE

A horizontal scale bar with a vertical tick mark at the left end labeled '0' and another vertical tick mark at the right end labeled '50'.

☐ ☐ ☐ ☐

NOTE: BAR IS ONE INCH ON ORIGINAL DRAWING. USE ONE INCH ON ALL REPRODUCTIONS.

SHEET, ADJUST SCALE ACCORDING

SHEET TITLE

EROSION AND...

EROSION AND
SEDIMENTATION

SEDIMEN

CONTROL DE

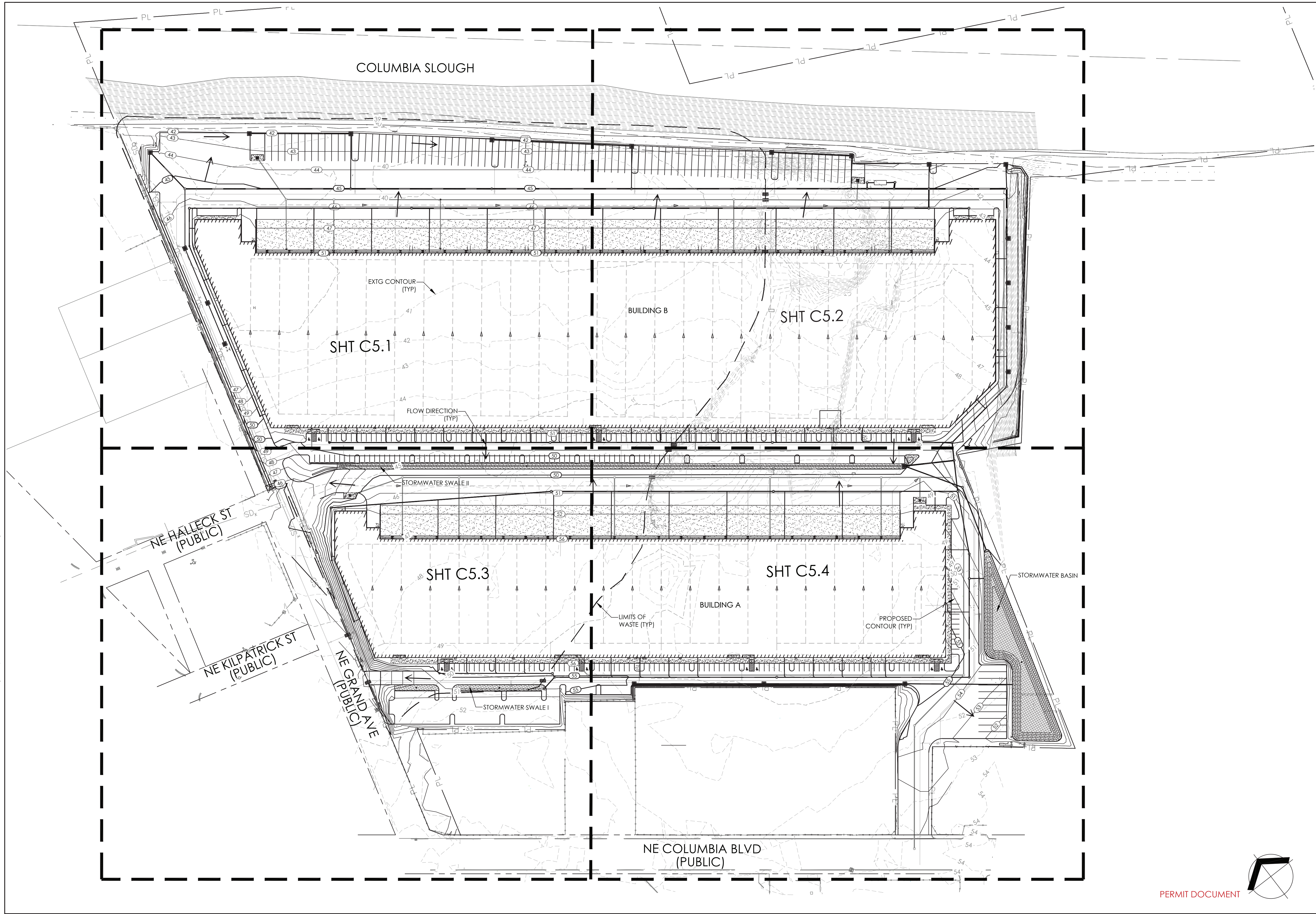
QUEST

SHEET

C3.1

PROJECT: 1648.02.01
DESIGNED: G. KALMETA
DRAWN: G. KALMETA
CHECKED: C. GOKCORA
SCALE
0 10' 1.0'

NOTED: 04/20/19 04/18/19 PM
PLOTED BY: JESSY SHERIDAN
RENAME: G:\01_MPA_Civil\3D\01_PROJECTS\1648.02_Bridge_Development\PLANS\01_Site\CS.5_Street_and_Storm_Drainage_Plan.dwg





MAUL FOSTER ALONGI
2001 NW 19TH AVE, SUITE 200
PORTLAND, OR 97209
PHONE: 971.544.2139
www.maulfooster.com



REGISTERED PROFESSIONAL ENGINEER
70867PE
OREGON
JAN. 11, 2005
CEN. E. GOKCORA
EXPIRES: 6/30/2019
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BRIDGE POINT I-5
BRIDGE POINT I-5, LLC
PORTLAND OREGON

ISSUE	DATE	DESCRIPTION
A	04/18/19	PERMIT SET

PROJECT: 1648.02.01
DESIGNED: G. KALMETA
DRAWN: G. KALMETA
CHECKED: C. GOKCORA
SCALE
0 10' 1.0'

NOTE: BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE ACCORDINGLY.

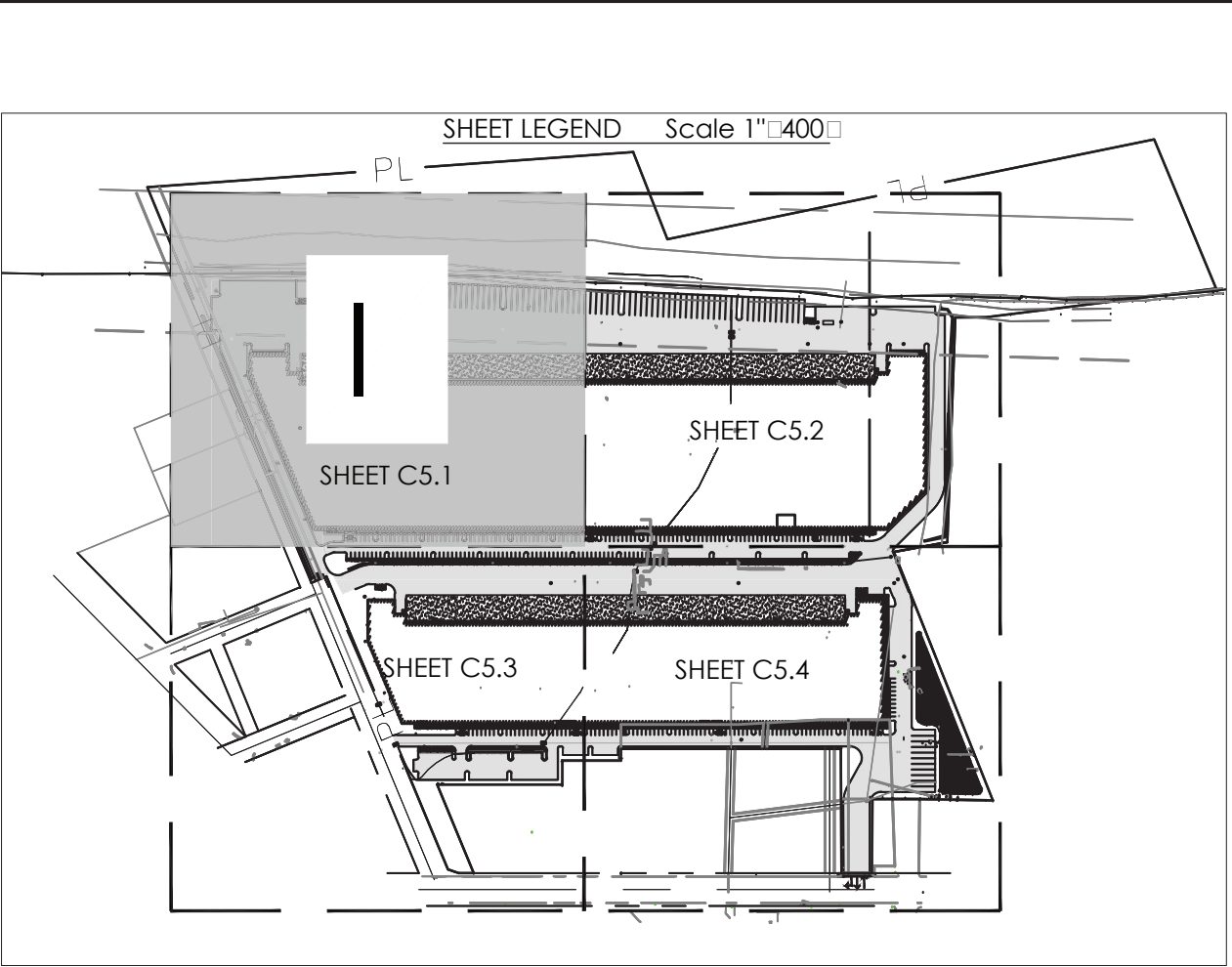
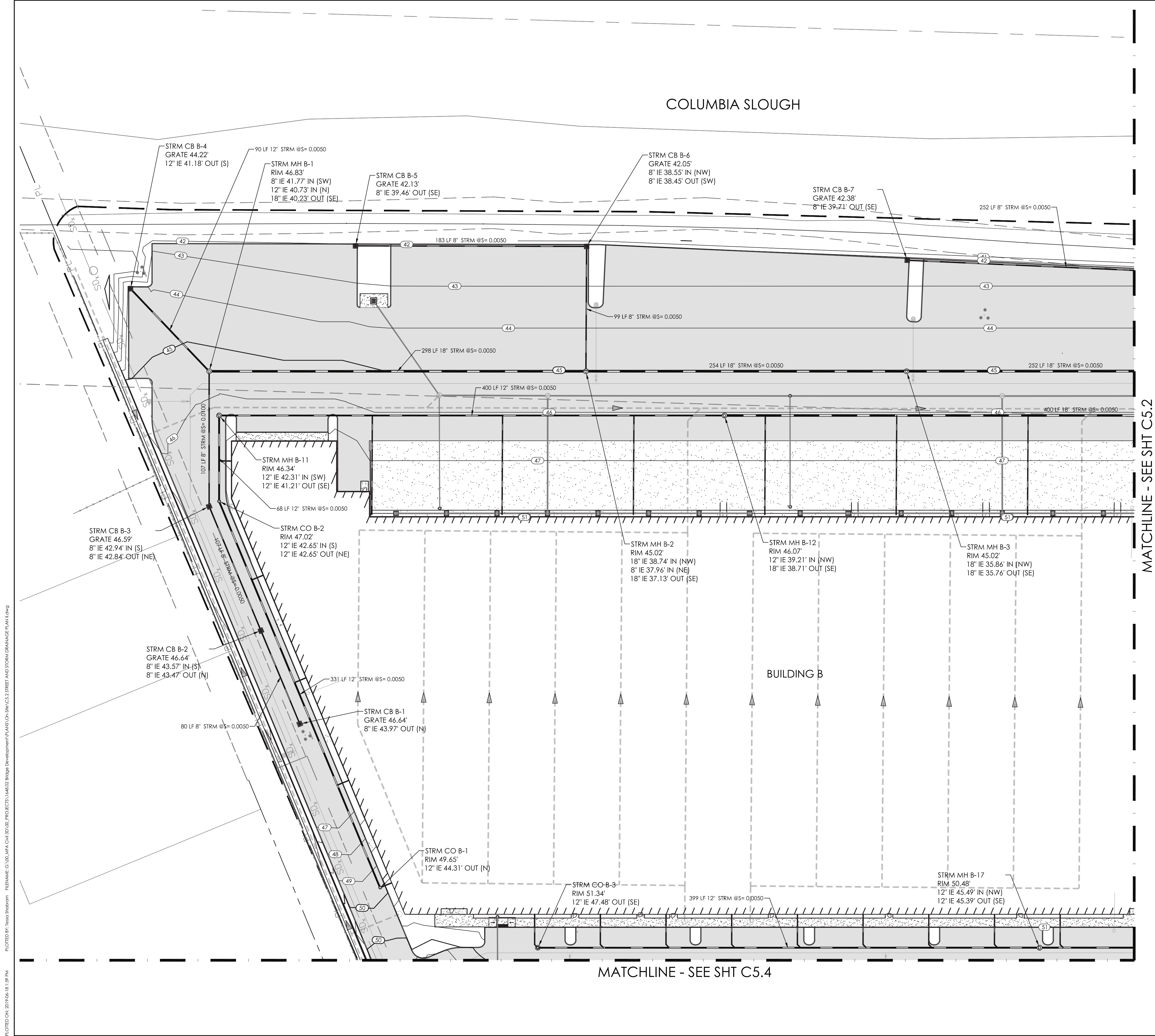
SHEET TITLE

MASTER STORM DRAINAGE PLAN

SHEET

C5.0

PROJECT: 1648.02.01
DESIGNED: G. KALMETA
DRAWN: G. KALMETA
CHECKED: C. GOKCORA
SCALE
0 10' 20'
NOTE: BAR IS ONE INCH ON ORIGINAL
DRAWING. IF NOT ONE INCH ON THIS
SHEET, ADJUST SCALE ACCORDINGLY.
SHEET TITLE
STORM DRAINAGE
PLAN I
SHEET
C5.1



- NOTES:
- SEE C9.3 FOR TRENCH DAM CONSTRUCTION WHERE THE WATER LINES CROSS WASTE BOUNDARY.
 - SEE SHT. C6.0 THROUGH C6.2 FOR STORMWATER DETAILS.



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www.mauioster.com



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ENGINEER
OREGON
NO. 70867PE
EXP. 6/30/2019
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and document content.

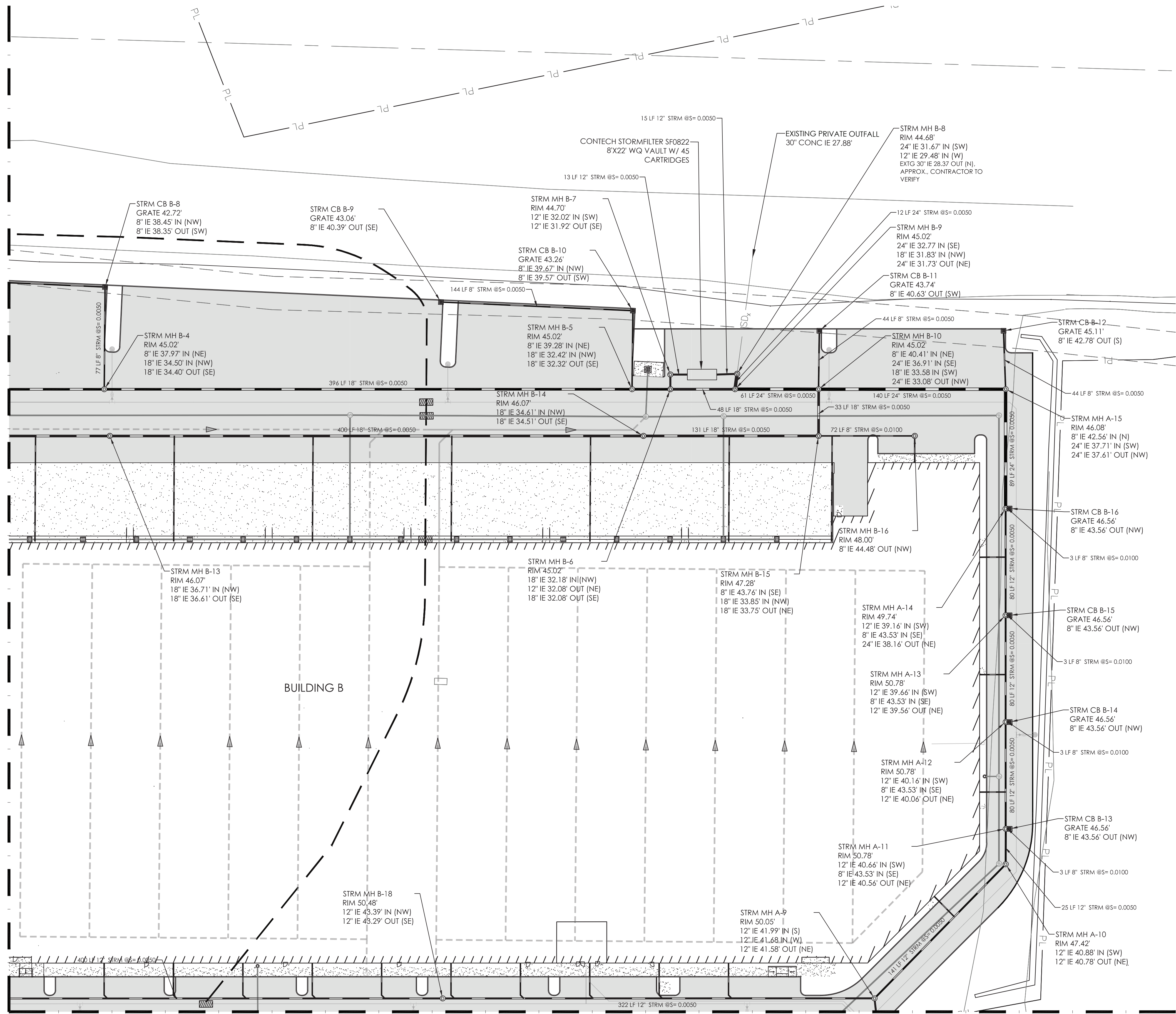
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BRIDGE POINT I-5, LLC
PORTLAND OREGON

ISSUE	DATE	DESCRIPTION
A	06/18/19	PERMIT SET

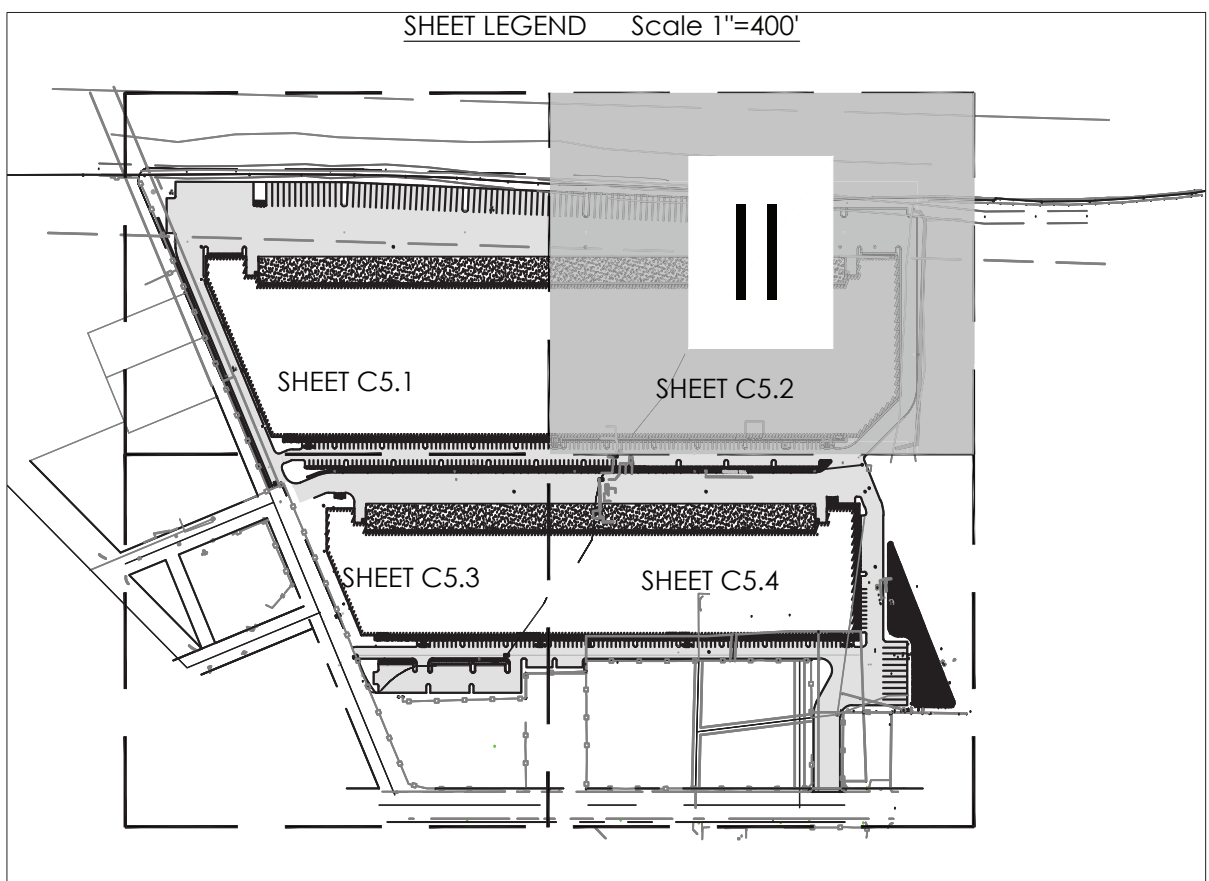
PROJECT: 1648.02.01
DESIGNED: G. KALMETA
DRAWN: G. KALMETA
CHECKED: C. GOKCORA
SCALE
0 10' 20'
NOTE: BAR IS ONE INCH ON ORIGINAL
DRAWING. IF NOT ONE INCH ON THIS
SHEET, ADJUST SCALE ACCORDINGLY.
SHEET TITLE
STORM DRAINAGE
PLAN I
SHEET
C5.1

PLOTTED ON: 2019/06/18 2:39 PM PLOTTED BY: ARIANNE LAGUNA REDEFINE C:\VOLUME\PROJECTS\144812 Bridge Development\PLANS\ON-SITE\C5.2 STREET AND STORM DRAINAGE PLAN.dwg

MATCHLINE - SEE SHT C5.1



MATCHLINE - SEE SHT C5.4



- NOTES:
- SEE C9.3 FOR TRENCH DAM CONSTRUCTION WHERE THE WATER LINES CROSS WASTE BOUNDARY.
 - SEE SHT. C6.0 THROUGH C6.2 FOR STORMWATER DETAILS.



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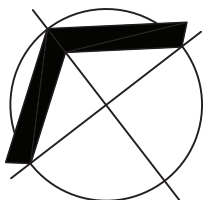
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	A	ISSUE

PROJECT: 1648.02.01
DESIGNED: G. KALMETA
DRAWN: G. KALMETA
CHECKED: C. GOKCORA
SCALE
NOTE: BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE ACCORDINGLY.

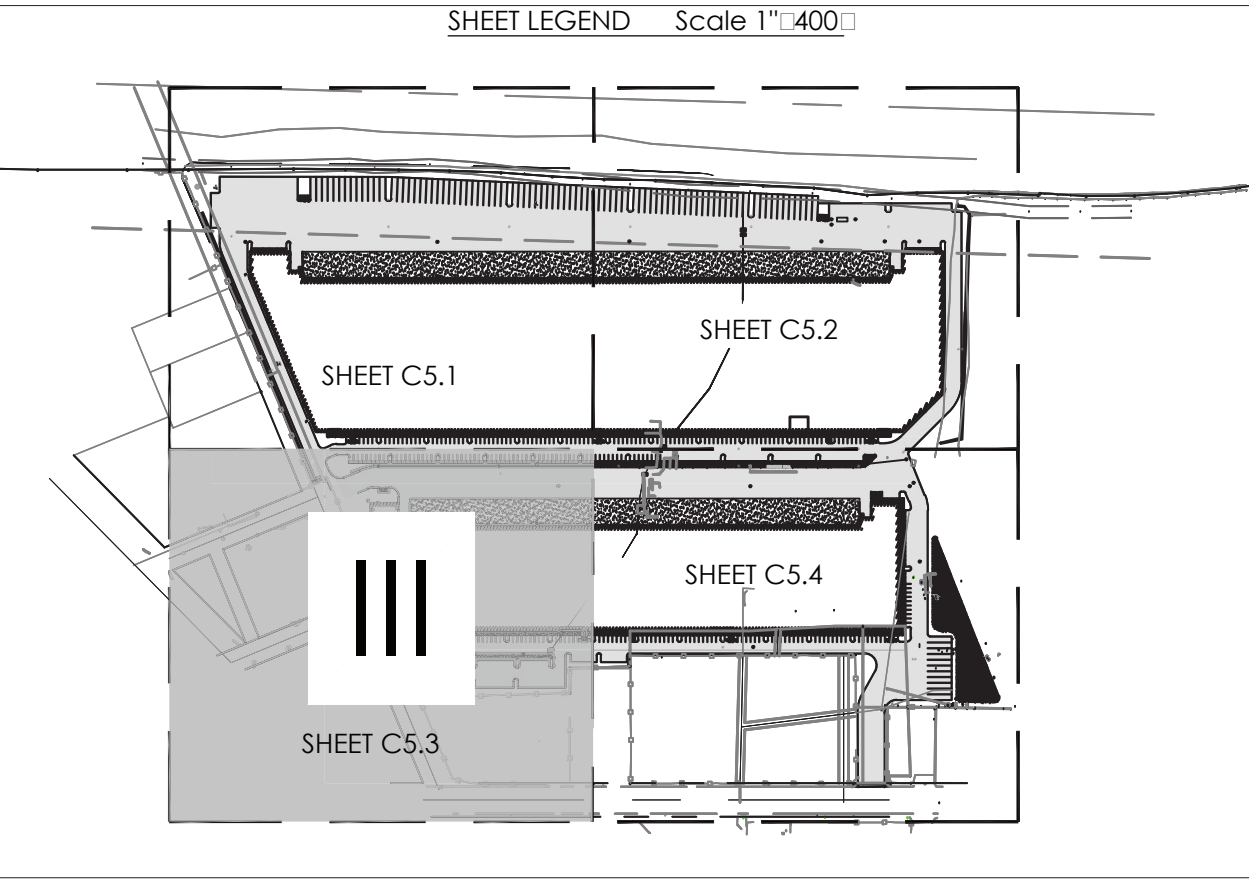
SHEET TITLE
STORM DRAINAGE
PLAN II

SHEET
C5.2

PERMIT DOCUMENT



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2001 NW 19TH AVE, SUITE 200
PORTLAND, OR 97209
PHONE: 971.544.2139
www.maulfooster.com



- NOTES:
1. SEE C9.3 FOR TRENCH DAM CONSTRUCTION WHERE THE WATER LINES CROSS WASTE BOUNDARY.
 2. SEE SHT. C6.0 THROUGH C6.2 FOR STORMWATER DETAILS.



BRIDGE POINT I-5
BRIDGE POINT I-5, LLC
PORTLAND OREGON

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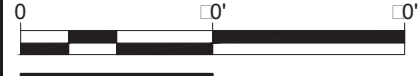
PROJECT: 1648.02.01

DESIGNED: G. KALMETA

DRAWN: G. KALMETA

CHECKED: C. GOKCOR

SCALE



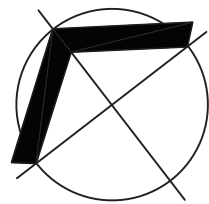
NOTE: BAR IS ONE INCH ON ORIGINAL
DRAWING. IF NOT ONE INCH ON THIS
SHEET, ADJUST SCALE ACCORDINGLY

SHEET TITLE

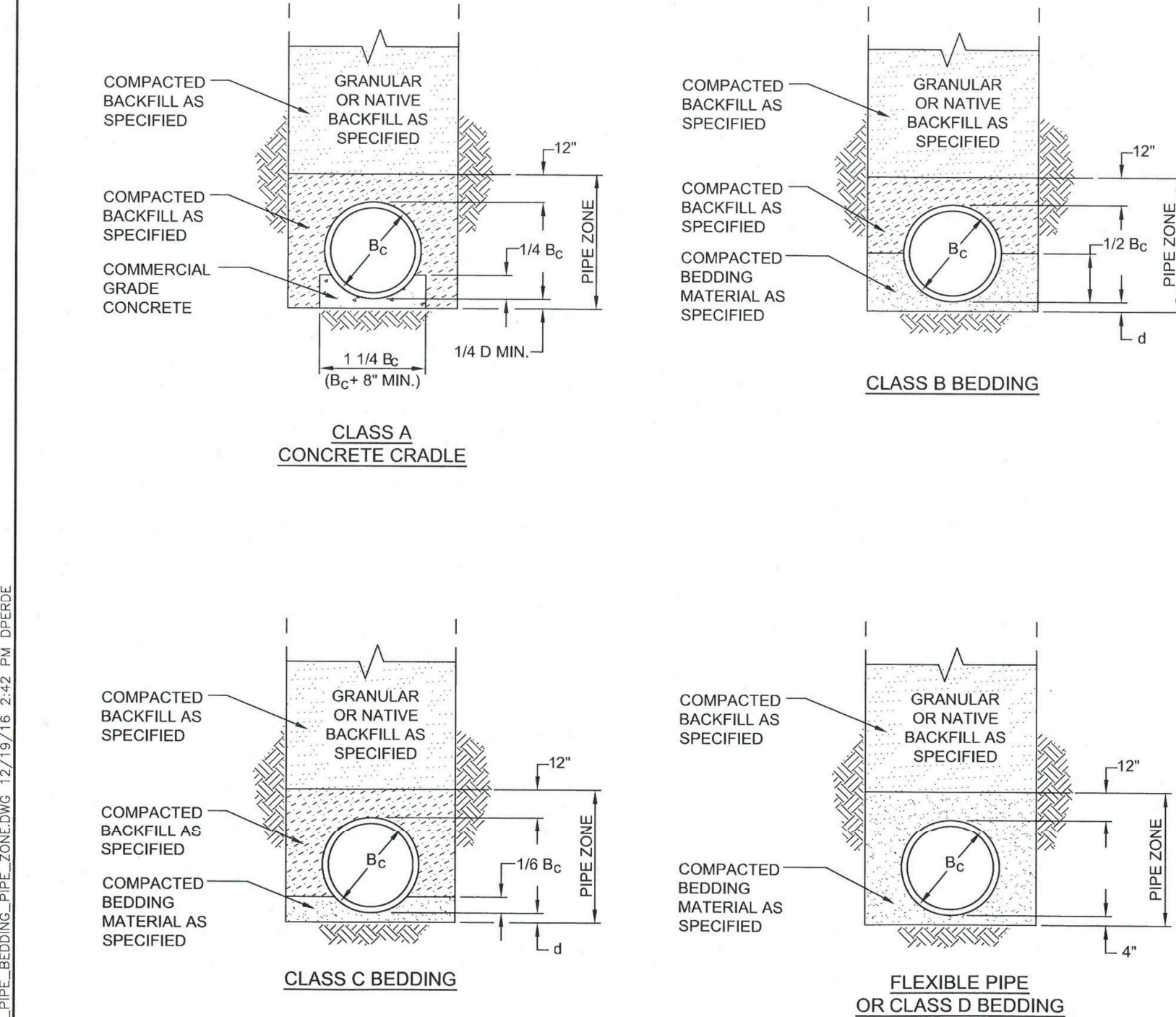
STORM DRAINAGE PLAN III

SHEET

C5.3



NOTED ON 2/19/24 8:21 PM
P-101_PIPE BEDDING PIPE ZONE DWG 12/19/18 2:42 PM DPEDE
P-152_TOP SLABS PRECAST CONC. MILDING 4/16/09 4:54 PM RICKS
P-179_TAMPERPROOF MANHOLE COVER 6-INCH DWG 4/6/09 6:10 PM RICKS

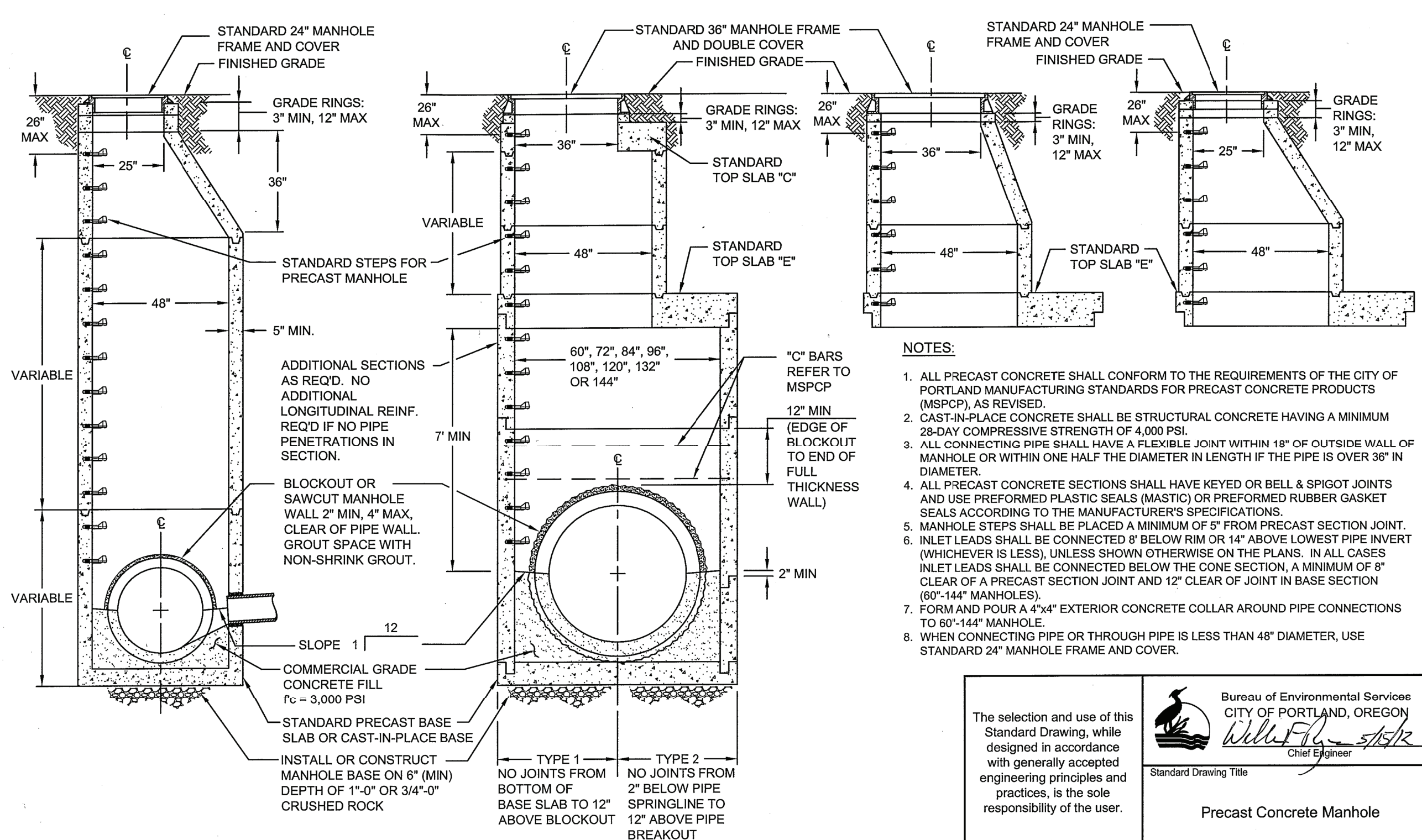


DEPTH OF BEDDING MATERIAL BELOW PIPE FOR CLASSES B AND C	
D	d (MIN.)
27" & SMALLER	3"
30" TO 60"	4"
66" & LARGER	6"

LEGEND:
B_c = OUTSIDE DIAMETER
d = DEPTH OF BEDDING MATERIAL BELOW PIPE
D = INSIDE DIAMETER

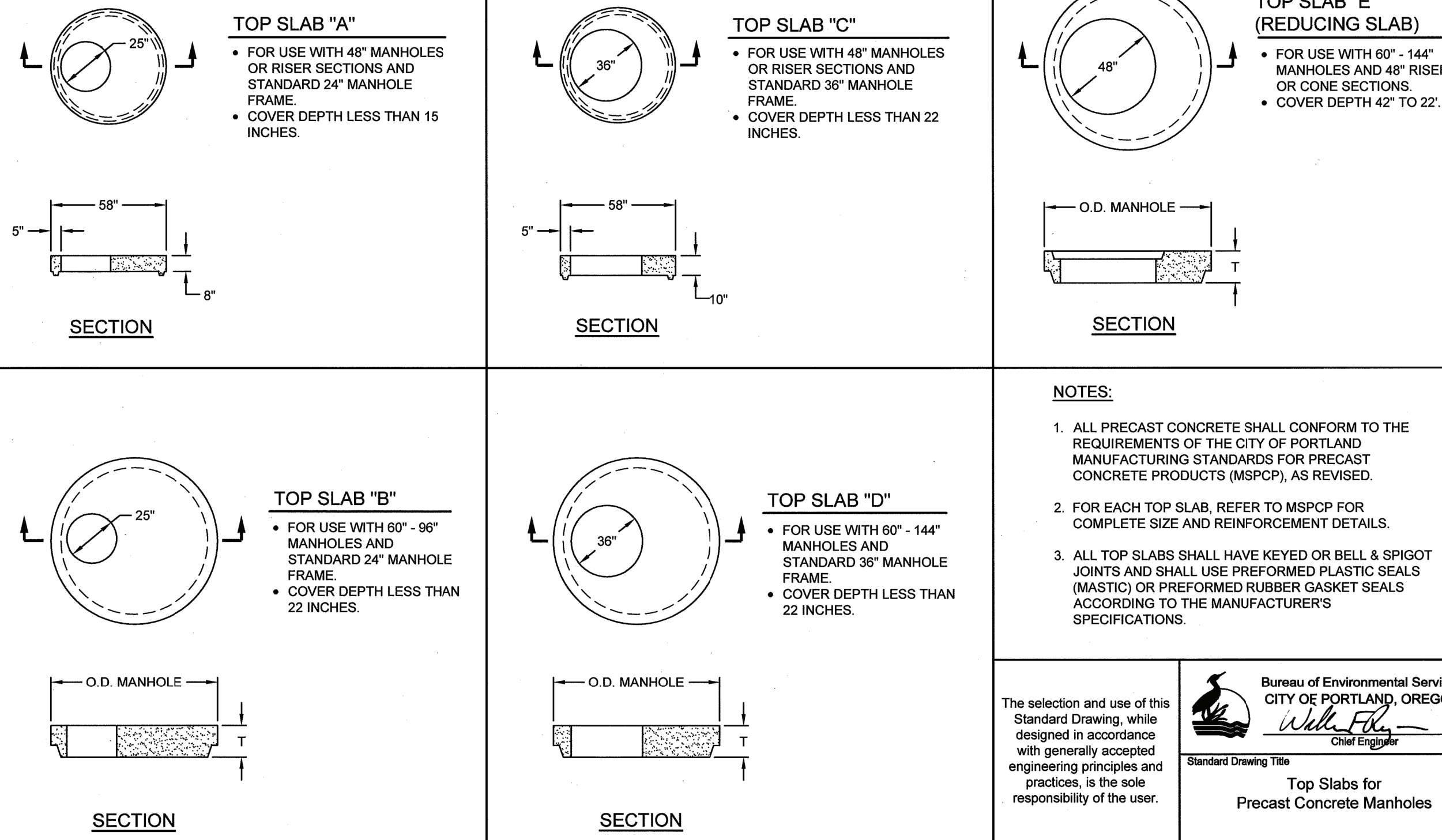
- NOTES:
- FOR ROCK OR OTHER INCOMPRESSIBLE MATERIALS, THE TRENCH SHALL BE OVEREXCAVATED A MINIMUM OF 6" AND REFILLED WITH GRANULAR MATERIAL AS DIRECTED BY THE ENGINEER.
 - FOUNDATION STABILIZATION: WHERE DIRECTED, FOUNDATION STABILIZATION SHALL BE PLACED PRIOR TO PLACEMENT OF PIPE BEDDING.
 - FOR TRENCH RESURFACING, REFER TO PLOT STANDARD DRAWINGS, AND AS OTHERWISE SPECIFIED.

The selection and use of this Standard Detail, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.	
Standard Detail Title	
Pipe Bedding and Pipe Zone	
Note: All material and workmanship shall be in accordance with the City of Portland Standard Construction Specifications.	
Effective Date: 12-15-16	Standard Detail No.
Calc. Book No.: N/A	P-101
Baseline Report Date: N/A	



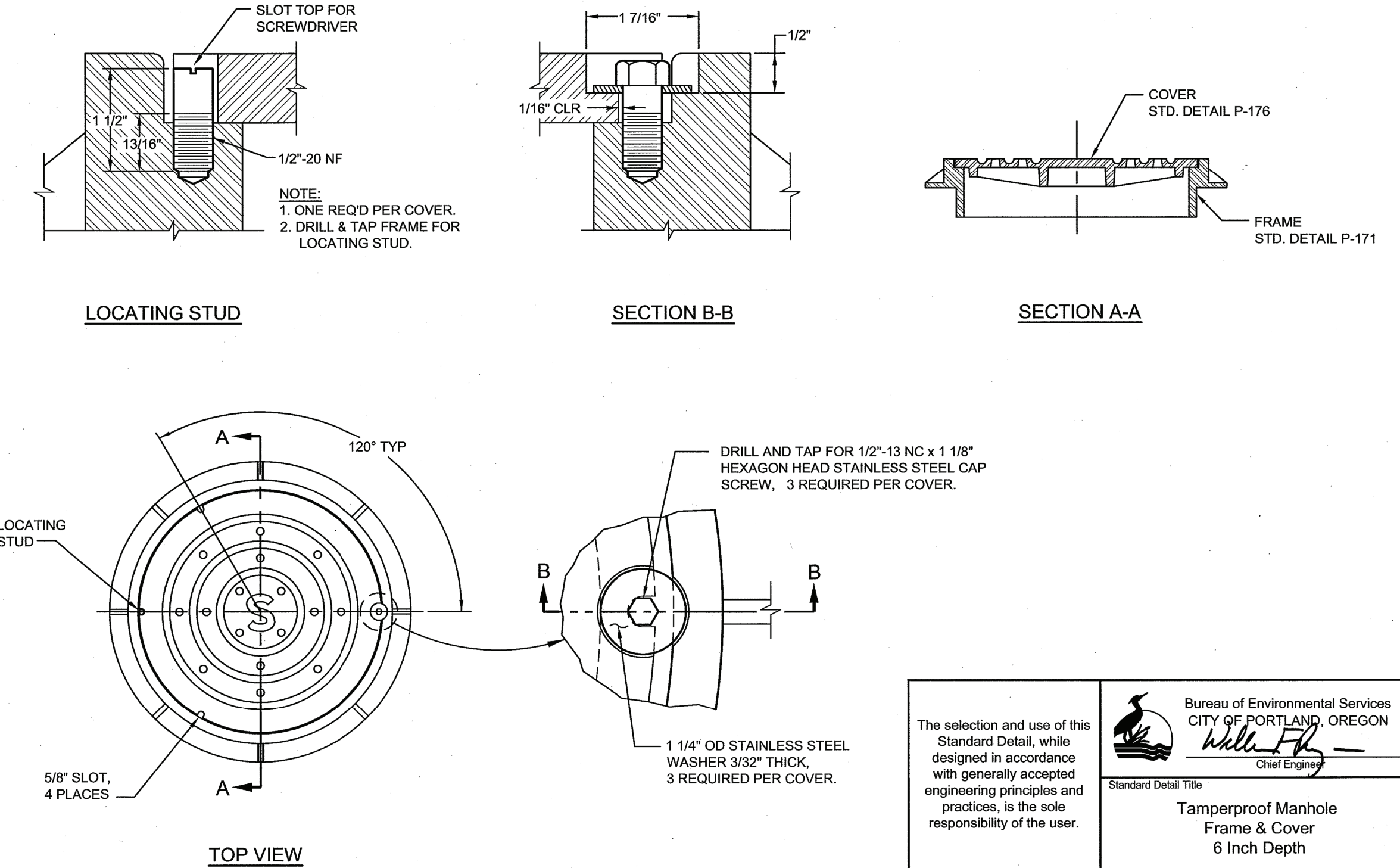
- NOTES:
- ALL PRECAST CONCRETE SHALL CONFORM TO THE REQUIREMENTS OF THE CITY OF PORTLAND MANUFACTURING STANDARDS FOR PRECAST CONCRETE PRODUCTS (MSPCP), AS REVISED.
 - CAST-IN-PLACE CONCRETE SHALL BE STRUCTURAL CONCRETE HAVING A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 4,000 PSI.
 - ALL CONNECTING PIPE SHALL HAVE A FLEXIBLE JOINT WITHIN 18" OF OUTSIDE WALL OF MANHOLE OR WITHIN ONE HALF THE DIAMETER IN LENGTH IF THE PIPE IS OVER 36" IN DIAMETER.
 - ALL PRECAST CONCRETE SECTIONS SHALL HAVE KEYED OR BELL & SPIGOT JOINTS AND USE PREFORMED PLASTIC SEALS (MASTIC) OR PREFORMED RUBBER GASKET SEALS ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.
 - MANHOLE STEPS SHALL BE PLACED A MINIMUM OF 8" FROM PRECAST SECTION JOINT.
 - INLET LEADS SHALL BE CONNECTED 8" BELOW RIM OR 14" ABOVE LOWEST PIPE INVERT (WHICHEVER IS LESS), UNLESS SHOWN OTHERWISE ON THE PLANS. IN ALL CASES INLET LEADS SHALL BE CONNECTED BELOW THE CONE SECTION, A MINIMUM OF 8" CLEAR OF A PRECAST SECTION JOINT AND 12" CLEAR OF JOINT IN BASE SECTION (60"-144" MANHOLES).
 - FORM AND POUR A 4"x4" EXTERIOR CONCRETE COLLAR AROUND PIPE CONNECTIONS TO 60"-144" MANHOLE.
 - WHEN CONNECTING PIPE OR THROUGH PIPE IS LESS THAN 48" DIAMETER, USE STANDARD 24" MANHOLE FRAME AND COVER.

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.	
Standard Drawing Title	
Precast Concrete Manhole	
Note: All material and workmanship shall be in accordance with the City of Portland Standard Construction Specifications.	
Effective Date: 01-01-09	Standard Drawing No.
Calc. Book No.: 001	P-150
Baseline Report Date: 03-24-09	



- NOTES:
- ALL PRECAST CONCRETE SHALL CONFORM TO THE REQUIREMENTS OF THE CITY OF PORTLAND MANUFACTURING STANDARDS FOR PRECAST CONCRETE PRODUCTS (MSPCP), AS REVISED.
 - FOR EACH TOP SLAB, REFER TO MSPCP FOR COMPLETE SIZE AND REINFORCEMENT DETAILS.
 - ALL TOP SLABS SHALL HAVE KEYED OR BELL & SPIGOT JOINTS AND SHALL USE PREFORMED PLASTIC SEALS (MASTIC) OR PREFORMED RUBBER GASKET SEALS ACCORDING TO THE MANUFACTURER'S SPECIFICATIONS.

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.	
Standard Drawing Title	
Top Slabs for Precast Concrete Manholes	
Note: All material and workmanship shall be in accordance with the City of Portland Standard Construction Specifications.	
Effective Date: 01-01-09	Standard Drawing No.
Calc. Book No.: 001	P-152
Baseline Report Date: 03-24-09	



The selection and use of this Standard Detail, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.	
Standard Detail Title	
Tamperproof Manhole Frame & Cover 6 Inch Depth	
Note: All material and workmanship shall be in accordance with the City of Portland Standard Construction Specifications.	
Effective Date: 01-01-09	Standard Detail No.
Calc. Book No.: N/A	P-179
Baseline Report Date: N/A	

MAUL FOSTER ALONGI
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PORTLAND, OR 97209
PHONE: 971.344.2139
www.maulfooster.com

REGISTERED PROFESSIONAL ENGINEER
70867PE
OREGON
JAN. 11, 2005
CEM E. GOKCORA
EXPIRES: 6/30/2019
This digital seal certifies the signatory and document content.

BRIDGE POINT I-5
BRIDGE POINT I-5, LLC
PORTLAND OREGON

ISSUE	DATE	DESCRIPTION
A	06/18/2019	PERMIT SET

PROJECT: 1648.02.01
DESIGNED: L. RAHIM
DRAWN: L. RAHIM
CHECKED: C. GOKCORA
SCALE

DRAWING NOT TO SCALE

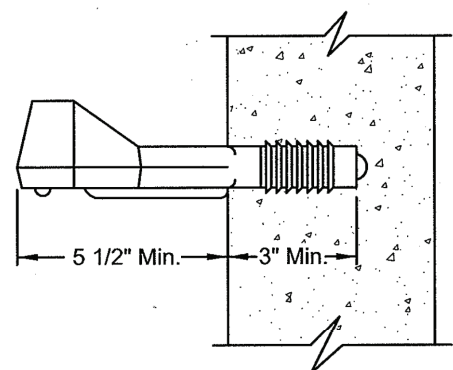
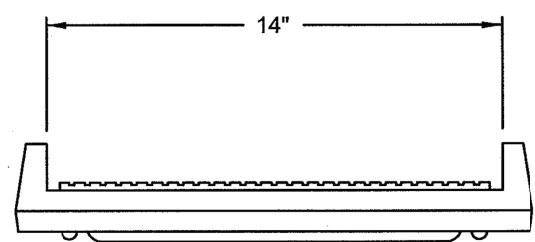
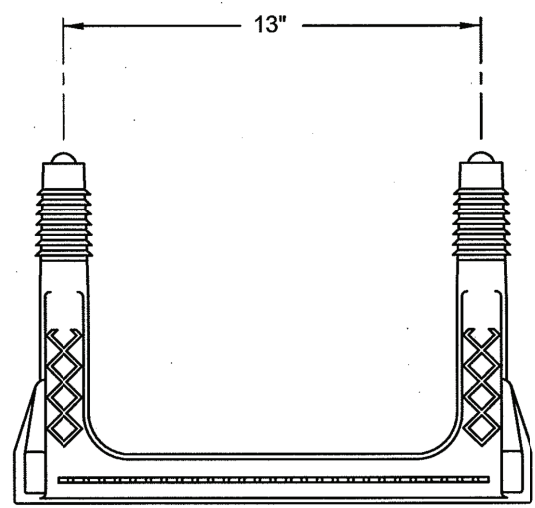
SHEET TITLE

STORM DRAINAGE DETAILS I

SHEET

C6.0

P-106 STEP PRECAST MANHOLE DWG 4/9/09 5:57 PM RCKS



NOTES:

1. ONLY USE CITY CERTIFIED STEPS IN ALL MANHOLES. A CURRENT LIST OF CERTIFIED STEPS CAN BE OBTAINED FROM THE CITY OF PORTLAND MATERIALS TESTING LAB (503) 823-2340.
2. ALL STEPS SHALL BE OF THE SAME DESIGN, TYPE AND SIZE AND INSTALLED IN CONFORMANCE WITH THE MSPCP AND THE MANUFACTURER'S RECOMMENDATIONS.
3. FOR PRECAST MANHOLES THE MANUFACTURER SHALL INSTALL THE STEPS BEFORE DELIVERY TO THE JOB SITE.
4. LOOSE STEPS WILL NOT BE ACCEPTED. IN PRECAST MANHOLES LOOSE STEPS SHALL BE CAUSE FOR REJECTION OF THE MANHOLE CONE OR SECTION.
5. LOCATE THE FIRST MANHOLE STEP 6 INCHES BELOW THE TOP OF CONE AND NOT MORE THAN 26 INCHES BELOW FINISH GRADE. SUCCEEDING STEP SHALL BE SPACED 12 INCHES ON CENTER.
6. STEPS SHALL BE ALIGNED VERTICALLY.

The selection and use of this Standard Detail, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user.

Note:
All material and workmanship shall be in accordance with the City of Portland Standard Construction Specifications.

Bureau of Environmental Services
CITY OF PORTLAND, OREGON

Walter F. H.
Chief Engineer

Standard Detail Title

Step for Precast Manhole

Effective Date: 01-01-09

Calc. Book No.: N/A

Baseline Report Date: N/A

Standard Detail No.

P-168

SECTION A-A

PLAN

SECTION B-B

DETAIL "A"

TYPE 3 CATCH BASIN GRATE

PRECAST RISER

GENERAL NOTES FOR ALL DETAILS:

1. Catch basin & grate shall meet H20 loading.
2. All concrete shall be commercial grade concrete.
3. Precast walls shall be a minimum of 4" thick.
4. For use by local agencies on low volume residential facilities as directed.
5. Depress gutter flowline and transition gutter as shown in Std. Dwg. RD366 perspective view.
6. Knockouts allowed for precast option.
7. If directed, install 3" dia. base drain with field installed mesh screen for subgrade drainage.
8. See Std. Dwg. RD336 for tracer wire details, or approved alternate.
9. Provide sump only where shown on plans, and allowed by jurisdiction.
10. For sump details, see Std. Dwg. RD364.
11. Max. pipe diameter varies with pipe material.
12. See Std. Dwg. RD339 for pipe to structure connections.
13. See project plans for details not shown.

CALC. BOOK NO.: N/A

BASELINE REPORT DATE: 21-JUL-2015

NOTE: All material and workmanship shall be in accordance with the current Oregon Standard Specifications.

OREGON STANDARD DRAWINGS

TYPE "3" CATCH BASIN, FRAME AND GRATE

2018

DATE: REVISION DESCRIPTION:

The selection and use of this Standard Drawing, while designed in accordance with generally accepted engineering principles and practices, is the sole responsibility of the user and should not be used without consulting a Registered Professional Engineer.

Effective Date: June 1, 2019 - November 30, 2019

RD378

PLOTTED ON: 2019/06/18 2:09 PM PLOTTED BY: Alfredo Aguirre REFNAME: C:\VOLUME\CH\3\0\0\PROJECTS\1448\02 Bridge Development\PLANS\01-Site\CA1 STORM DRAINAGE DETAILS.dwg

A STORM CB B-17
SCALE: NTS

B STORM MHB-6
SCALE: NTS

PERMIT DOCUMENT

MAUL FOSTER ALONGI
2001 NW 19TH AVE, SUITE 200
PORTLAND, OR 97209
PHONE: 971.544.2139
www.maulfooster.com

BRIDGE POINT I-5
BRIDGE POINT I-5, LLC
PORTLAND OREGON

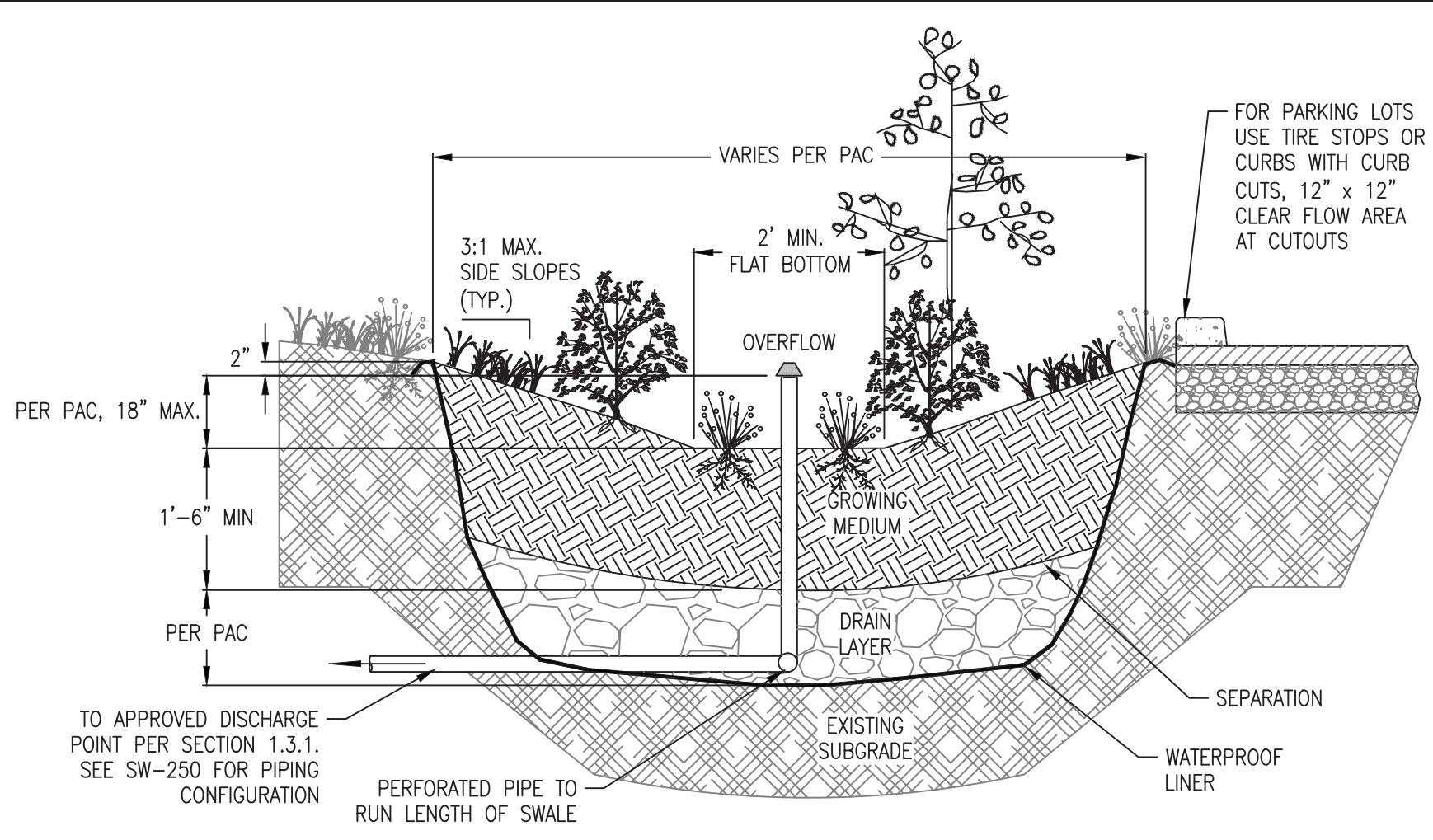
ISSUE	DATE	DESCRIPTION
A	06/18/2019	PERMIT SET

PROJECT: 1648.02.01
DESIGNED: L. RAHIM
DRAWN: L. RAHIM
CHECKED: C. GOKCORA
SCALE

DRAWING NOT TO SCALE

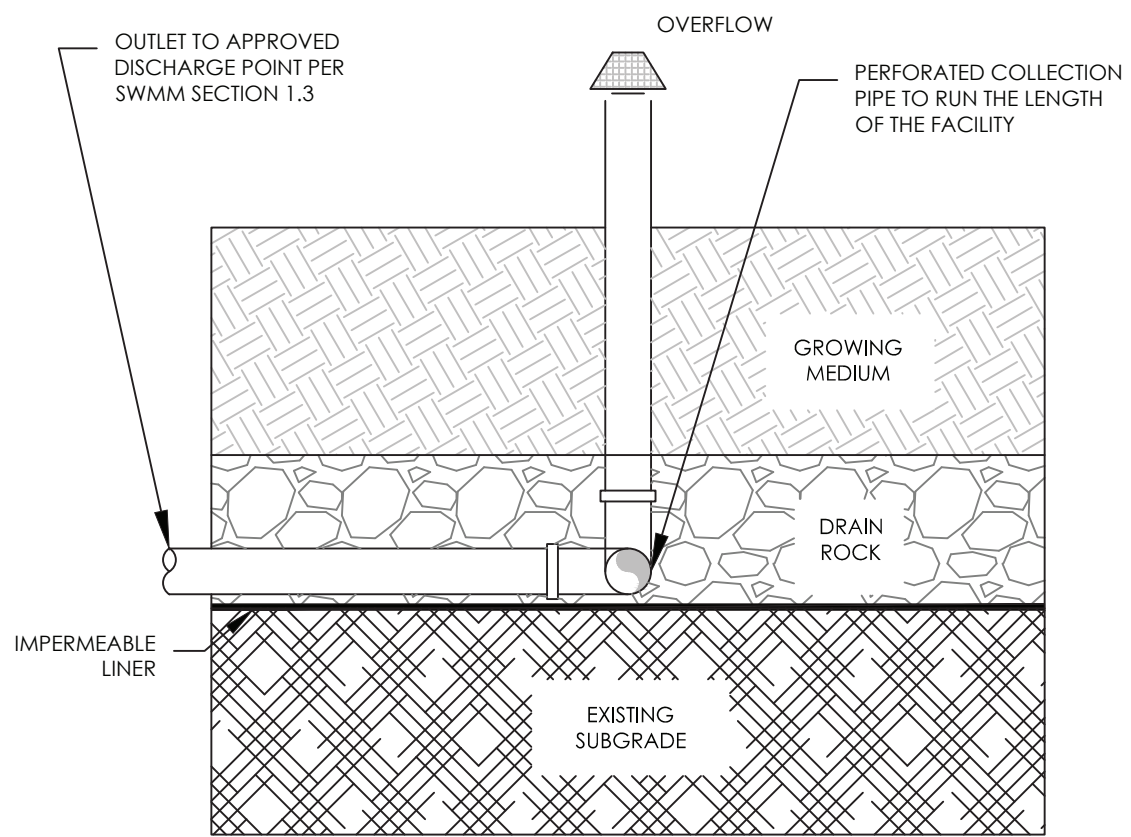
SHEET TITLE
STORM DRAINAGE
DETAILS II

SHEET
C6.1

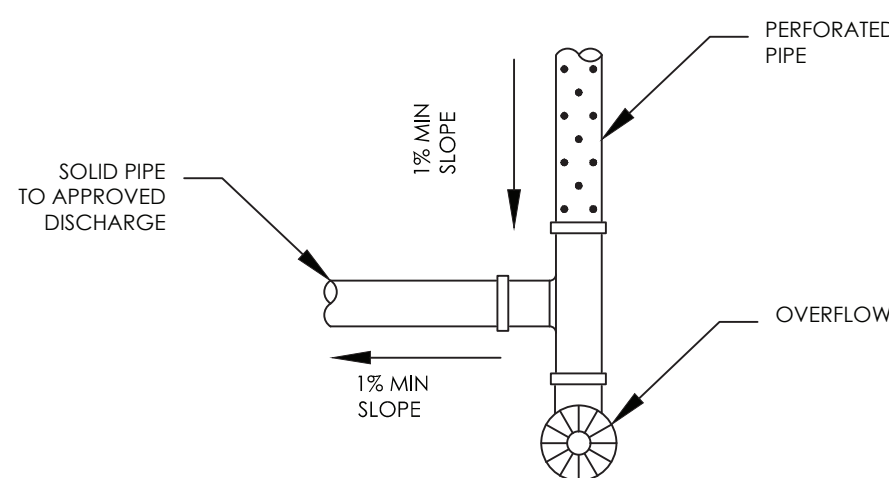


1. Detail intended as an example. Detail must match PAC assumptions and/or design report.
2. Dimensions:
Width of basin: 5' minimum
Depth of basin (from top of growing medium to overflow elevation): per PAC
Flat bottom width: 2' minimum.
Side slopes of swale: Per PAC, 3:1 maximum.
3. Setbacks: None required.
4. Overflow:
Basins must connect to approved discharge point according to SWMM Section 1.3.
Inlet elevation must allow for 2" of freeboard, minimum.
Protect from debris and sediment with strainer or grate.
5. Piping must be ABS Sch.40, cast iron, or PVS Sch.40. 3" pipe required for facilities draining up to 1500 s.f., otherwise 4" min. pipe. Piping must have 1% grade and follow the Uniform Plumbing Code.
6. Drain Layer:
Determined by designer. Options include, but are not limited to drain mat, 3/4" washed round rock, or other approved system.
7. Separation between drain and growing medium:
Use appropriate filter fabric or a gravel lens (3/4 - 1/4 inch washed, crushed rock 2 to 3 inches deep), or as per approved design.
8. Growing Medium:
18" minimum depth. Use sand/loam/compost 3-way mix, or approved mix that will support healthy plants.
24" minimum depth is required if the lined facility is also meeting BDS landscape requirements.
9. Vegetation: Follow landscape plans otherwise refer to plant list in SWMM Section 2.4.1. Minimum container size is #1 container. # of plantings per 100sf of facility area:
Zone A (wet): 80 herbaceous plants OR 72 herbaceous plants and 4 small shrubs.
Zone B (moderate to dry): 7 large or small shrubs AND 70 groundcover plants.
The delineation between Zone A and B shall be either at the outlet elevation or the check dam elevation, whichever is lowest.
If project area is over 200sf consider adding a tree.
10. Waterproof Liner: 30 mil EPDM, HDPE or approved equivalent.
11. Splash Block: Install 4-6" washed river rock or splash pad for erosion control at inlets and downspout.
12. Inspections: Call BDS IVR Inspection Line, (503) 823-7000, request 487. 3 inspections required.

A **STORMWATER FACILITY**
SCALE: NTS SOURCE: BES DTL SW-240

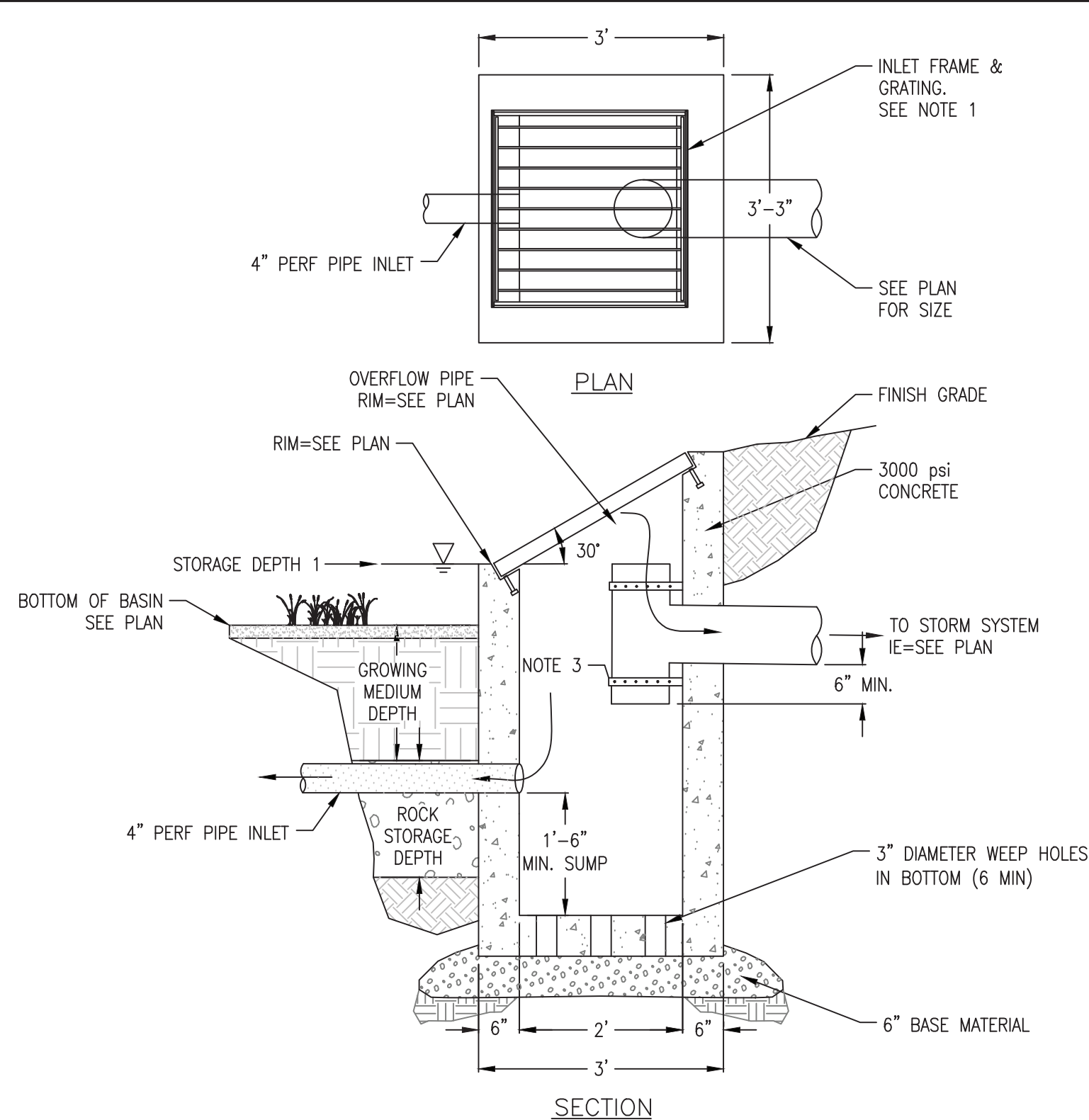


LINED
STORMWATER HIERARCHY CATEGORY 3 or 4
OVERFLOW AND UNDERDRAIN REQUIRED.
SET UNDERDRAIN AT BASE OF DRAIN ROCK LINER.
PAC CONFIGURATION D



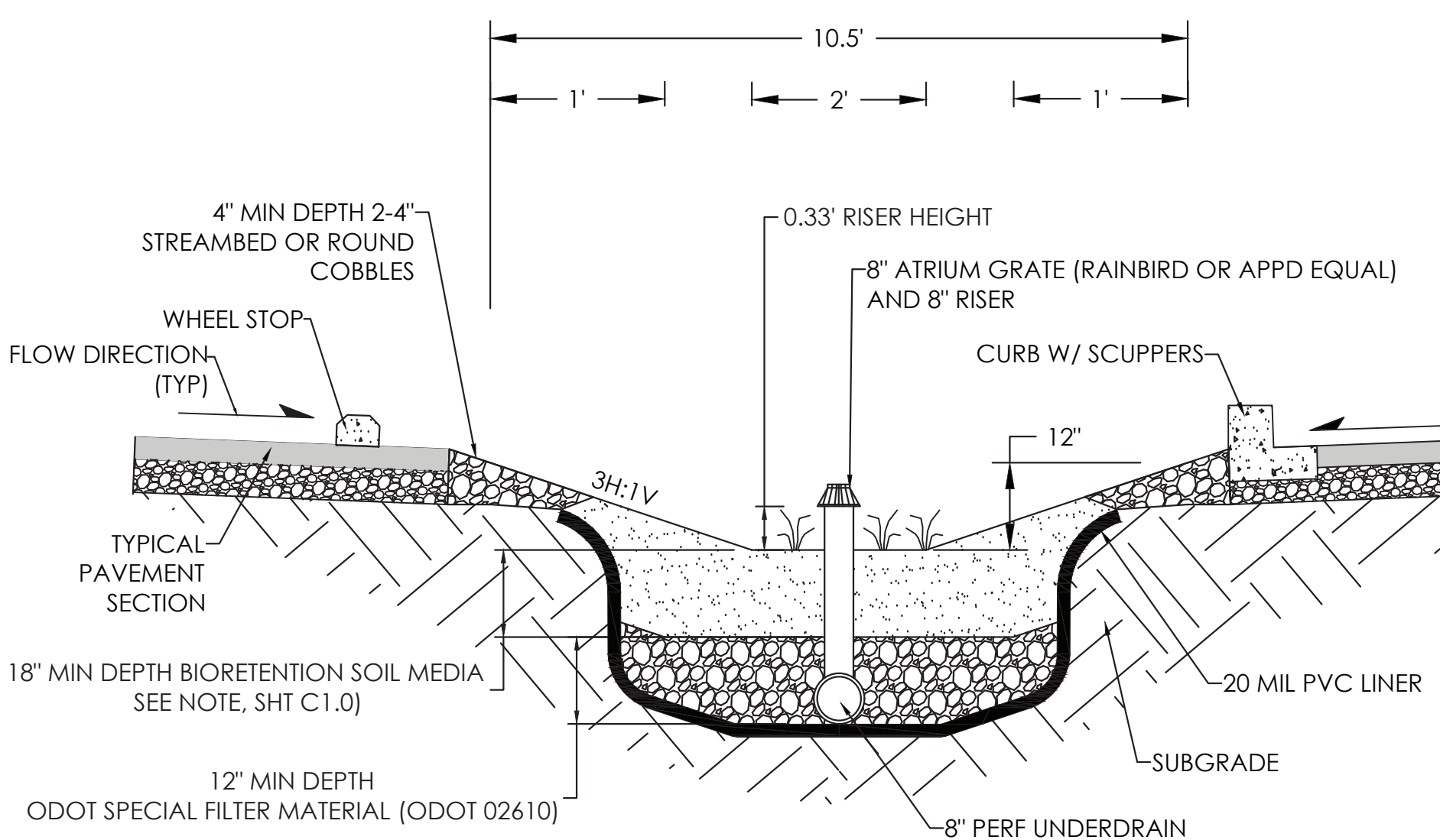
PLAN VIEW
PIPE W/ UNDERDRAIN & DISCHARGE POINT

B **FACILITY OVERFLOW CONFIGURATION**
SCALE: NTS SOURCE: BES DTL SW-250

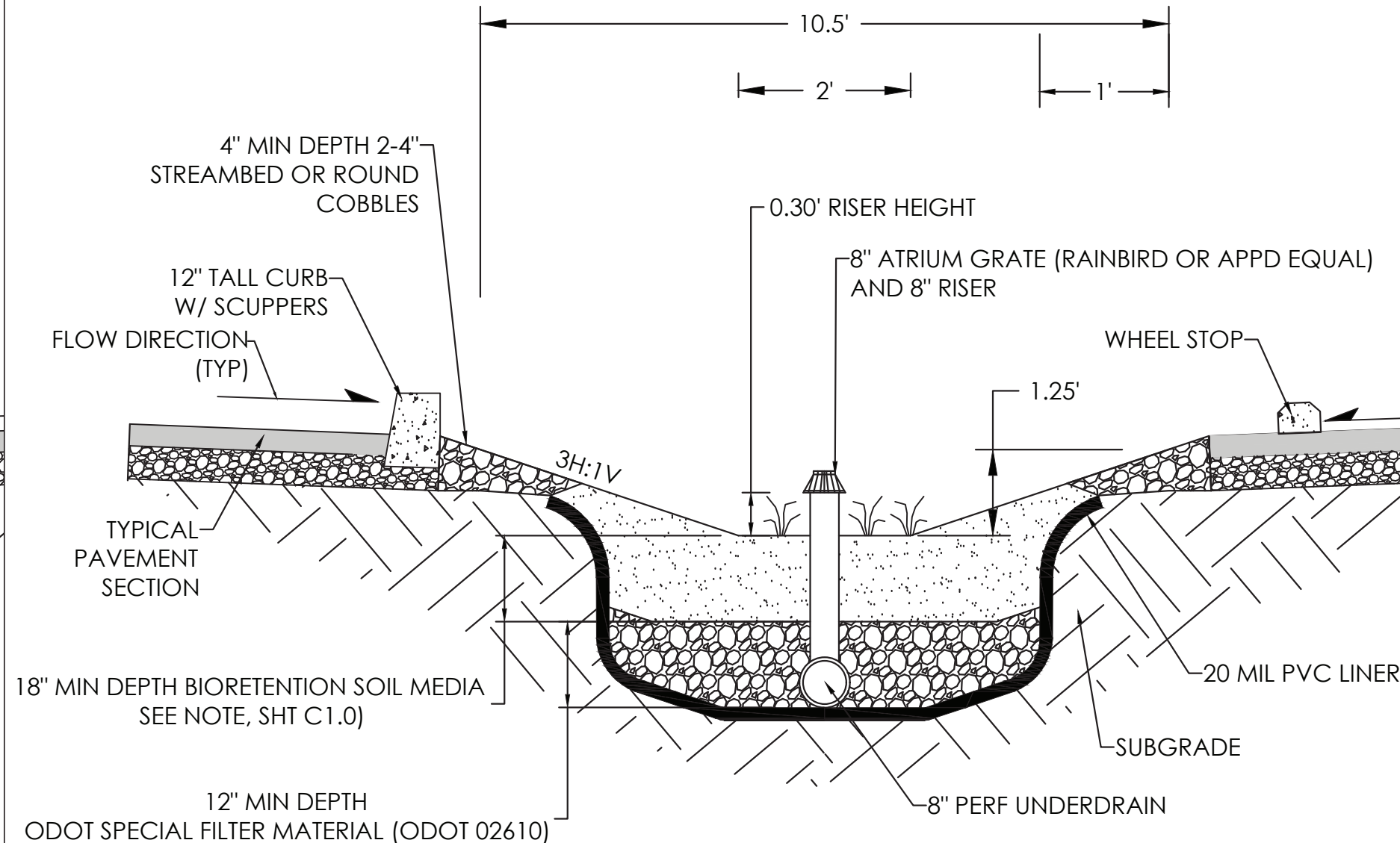


1. Grating and frame must be galvanized steel medium duty.
2. 8" dia. outlet pipe with upturned elbow.
3. Secure outlet pipe with s/s band embedded 2" in wall.

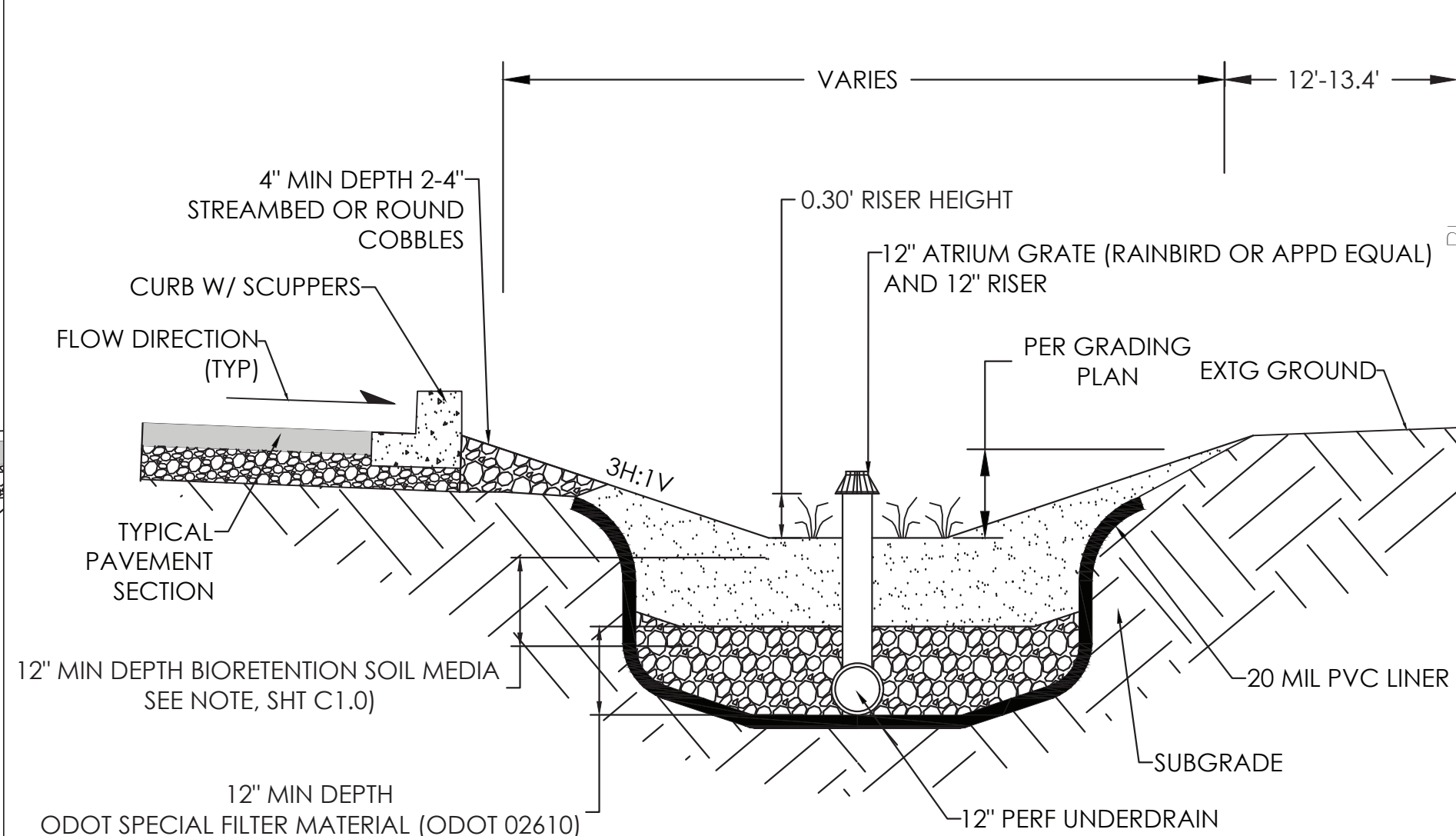
C **FACILITY OVERFLOW CONFIGURATION F**
SCALE: NTS SOURCE: BES DTL SW-252



D **STORMWATER SWALE I**
SCALE: NTS



E **STORMWATER SWALE II**
SCALE: NTS



E **STORMWATER BASIN**
SCALE: NTS



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www.maulfooster.com



REGISTERED PROFESSIONAL ENGINEER
70867PE
OREGON
L. RAHIM
EXPIRES: 6/30/2019
This digital seal certifies the signatory and document content.

BRIDGE POINT I-5
BRIDGE POINT I-5, LLC
PORTLAND OREGON

NO.	DATE	DESCRIPTION
1	06/18/2019	PERMIT SET
A		ISSUE

PROJECT: 1648.02.01
DESIGNED: L. RAHIM
DRAWN: L. RAHIM
CHECKED: C. GOKCORA
SCALE

DRAWING NOT TO SCALE

SHEET TITLE

STORM DRAINAGE DETAILS III

SHEET

C6.2

APPENDIX A

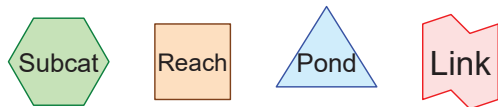
GEOTECHNICAL REPORT



APPENDIX B

HYDROCAD REPORT





Routing Diagram for Bridge Point I-5 Hydrological calcs

Prepared by Microsoft, Printed 6/21/2019

HydroCAD® 10.00 s/n 01682 © 2012 HydroCAD Software Solutions LLC

Bridge Point I-5 Hydrological calcs

Prepared by Microsoft

Printed 6/21/2019

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Page 2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.912	84	50-75% Grass cover, Fair, HSG D (34S, 36S, 37S, 39S, 47S, 48S)
4.890	98	Paved parking, HSG C (32S, 47S)
10.138	98	Paved parking, HSG D (34S, 36S, 37S, 39S)
15.497	98	Unconnected roofs, HSG D (42S)
0.430	98	Water Surface, HSG D (48S)
31.867	98	TOTAL AREA

Bridge Point I-5 Hydrological calcs

Prepared by Microsoft

Printed 6/21/2019

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Page 3

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
4.890	HSG C	32S, 47S
26.977	HSG D	34S, 36S, 37S, 39S, 42S, 47S, 48S
0.000	Other	
31.867		TOTAL AREA

Bridge Point I-5 Hydrological calcs

Prepared by Microsoft

Printed 6/21/2019

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Page 4

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	48R	28.75	28.50	50.0	0.0050	0.013	30.0	0.0	0.0
2	31P	48.35	48.15	40.0	0.0050	0.013	18.0	0.0	0.0
3	34P	45.35	45.10	50.0	0.0050	0.011	12.0	0.0	0.0
4	34P	45.35	45.10	50.0	0.0050	0.013	18.0	0.0	0.0
5	38P	50.30	50.05	50.0	0.0050	0.013	12.0	0.0	0.0
6	39P	30.00	29.75	50.0	0.0050	0.012	30.0	0.0	0.0
7	40P	42.25	34.00	1,000.0	0.0083	0.013	24.0	0.0	0.0
8	43P	42.50	42.25	50.0	0.0050	0.013	12.0	0.0	0.0
9	47P	30.10	30.00	20.0	0.0050	0.013	8.0	0.0	0.0
10	47P	30.10	30.00	20.0	0.0050	0.013	24.0	0.0	0.0

Bridge Point I-5 Hydrological calcs

Prepared by Microsoft

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Bridge Point I-5 hydrological calcs

Type IA 24-hr 0.83 in storm Rainfall=0.83"

Printed 6/21/2019

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Summary for Subcatchment 32S: Basin 5 Area - West

Runoff = 0.41 cfs @ 7.95 hrs, Volume= 0.132 af, Depth> 0.63"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

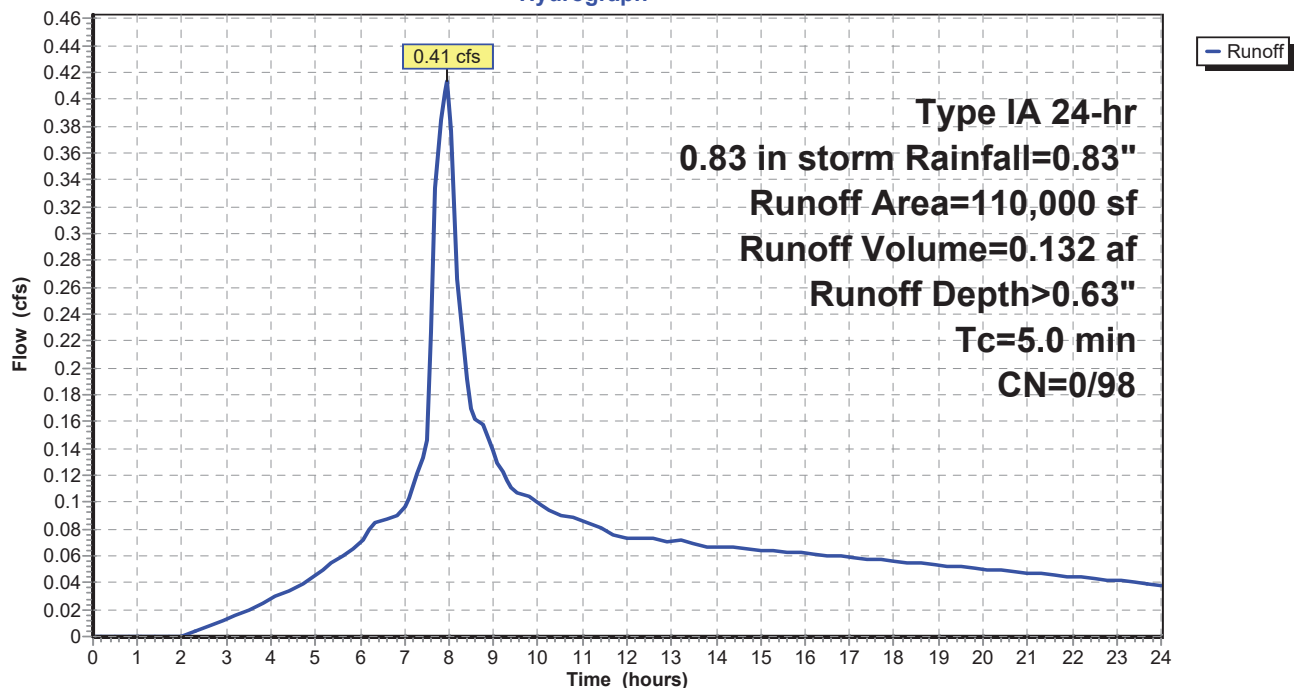
Type IA 24-hr 0.83 in storm Rainfall=0.83"

Area (sf)	CN	Description
110,000	98	Paved parking, HSG C
110,000	98	100.00% Impervious Area

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

Subcatchment 32S: Basin 5 Area - West

Hydrograph



Bridge Point I-5 Hydrological calcs

Prepared by Microsoft

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 0.83 in storm Rainfall=0.83"

Printed 6/21/2019

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Summary for Subcatchment 34S: Basin 1

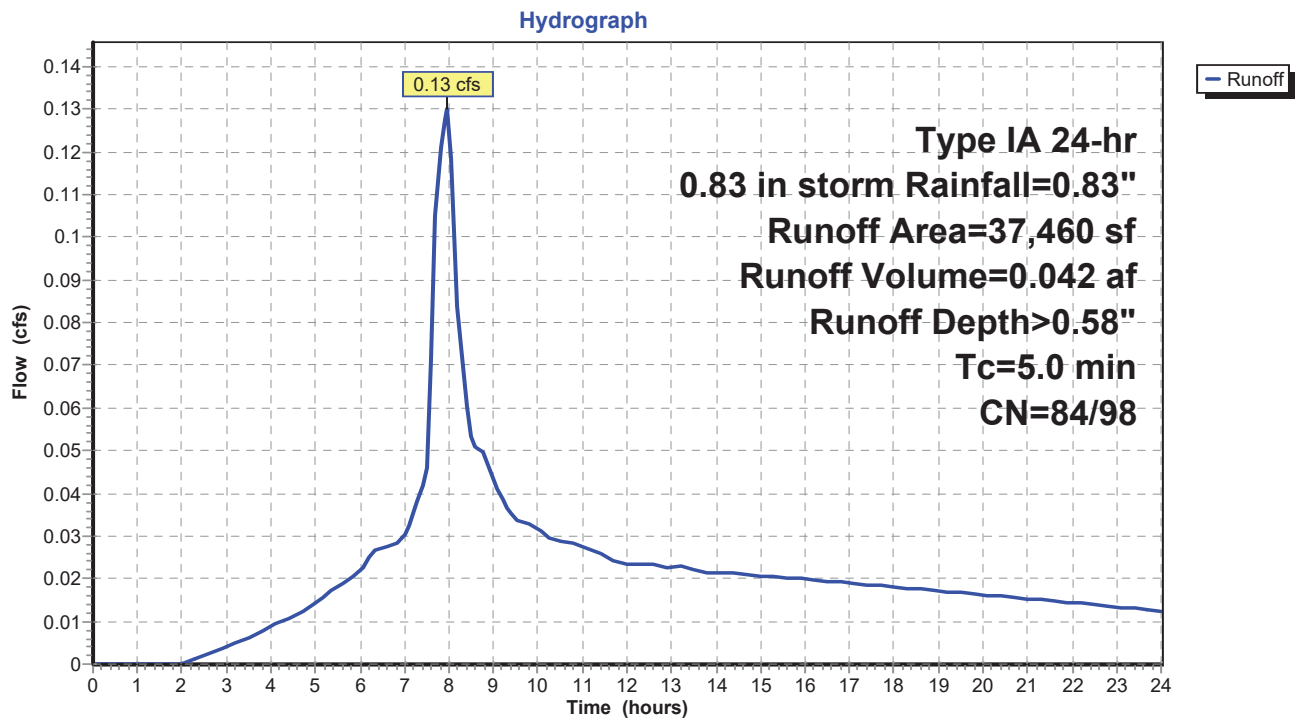
Runoff = 0.13 cfs @ 7.95 hrs, Volume= 0.042 af, Depth> 0.58"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 0.83 in storm Rainfall=0.83"

Area (sf)	CN	Description
34,620	98	Paved parking, HSG D
2,840	84	50-75% Grass cover, Fair, HSG D
37,460	97	Weighted Average
2,840	84	7.58% Pervious Area
34,620	98	92.42% Impervious Area

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

Subcatchment 34S: Basin 1



Bridge Point I-5 Hydrological calcs

Prepared by Microsoft

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 0.83 in storm Rainfall=0.83"

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Summary for Subcatchment 36S: Basin 4

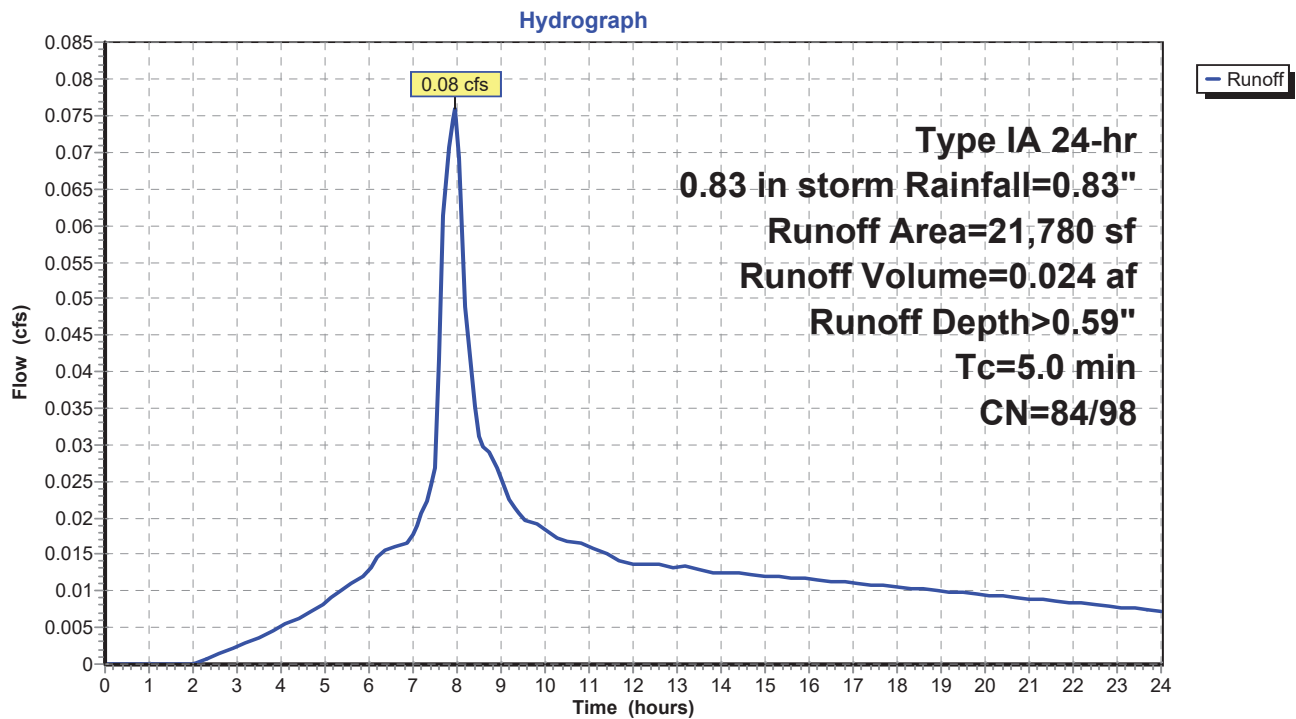
Runoff = 0.08 cfs @ 7.95 hrs, Volume= 0.024 af, Depth> 0.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 0.83 in storm Rainfall=0.83"

Area (sf)	CN	Description
20,220	98	Paved parking, HSG D
1,560	84	50-75% Grass cover, Fair, HSG D
21,780	97	Weighted Average
1,560	84	7.16% Pervious Area
20,220	98	92.84% Impervious Area

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

Subcatchment 36S: Basin 4



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs

Type IA 24-hr 0.83 in storm Rainfall=0.83"

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Page 8

Summary for Subcatchment 37S: Basin 2

Runoff = 0.24 cfs @ 7.95 hrs, Volume= 0.079 af, Depth> 0.59"

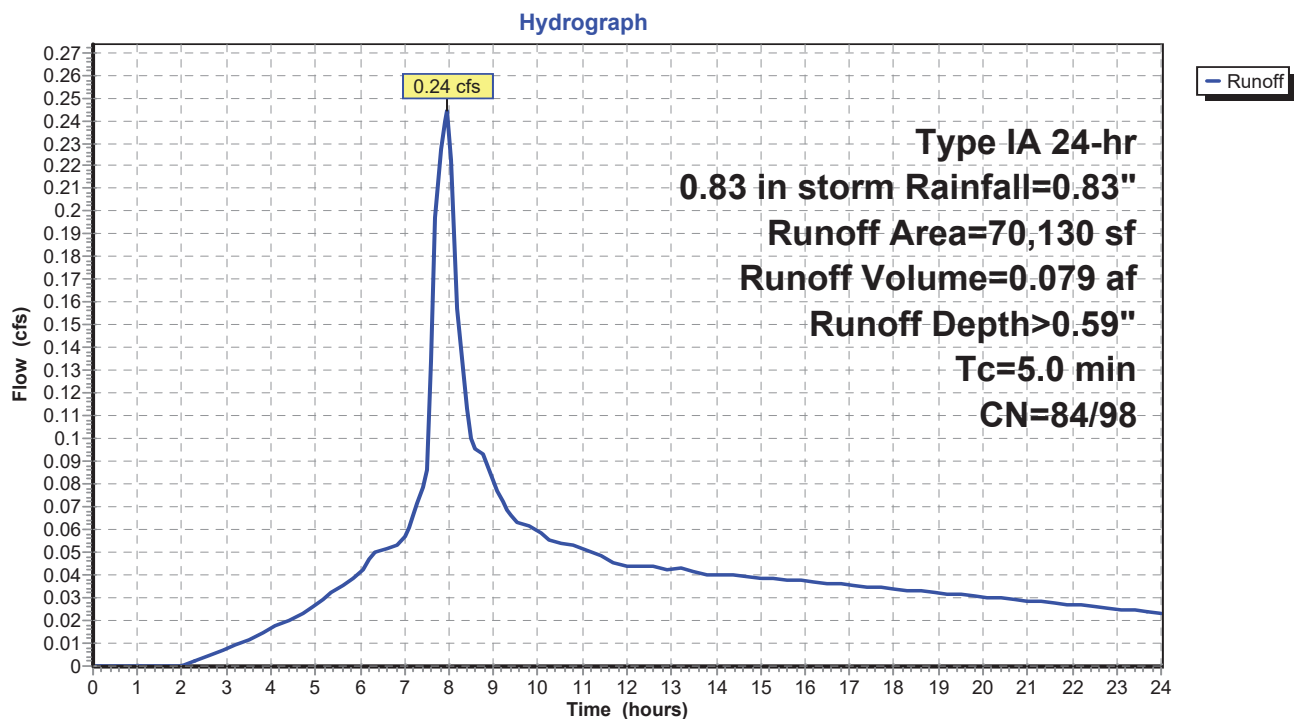
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Type IA 24-hr 0.83 in storm Rainfall=0.83"

Area (sf)	CN	Description
64,990	98	Paved parking, HSG D
5,140	84	50-75% Grass cover, Fair, HSG D
70,130	97	Weighted Average
5,140	84	7.33% Pervious Area
64,990	98	92.67% Impervious Area

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

Subcatchment 37S: Basin 2



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs

Type IA 24-hr 0.83 in storm Rainfall=0.83"

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Summary for Subcatchment 39S: Basin 7

Runoff = 1.21 cfs @ 7.95 hrs, Volume= 0.386 af, Depth> 0.62"

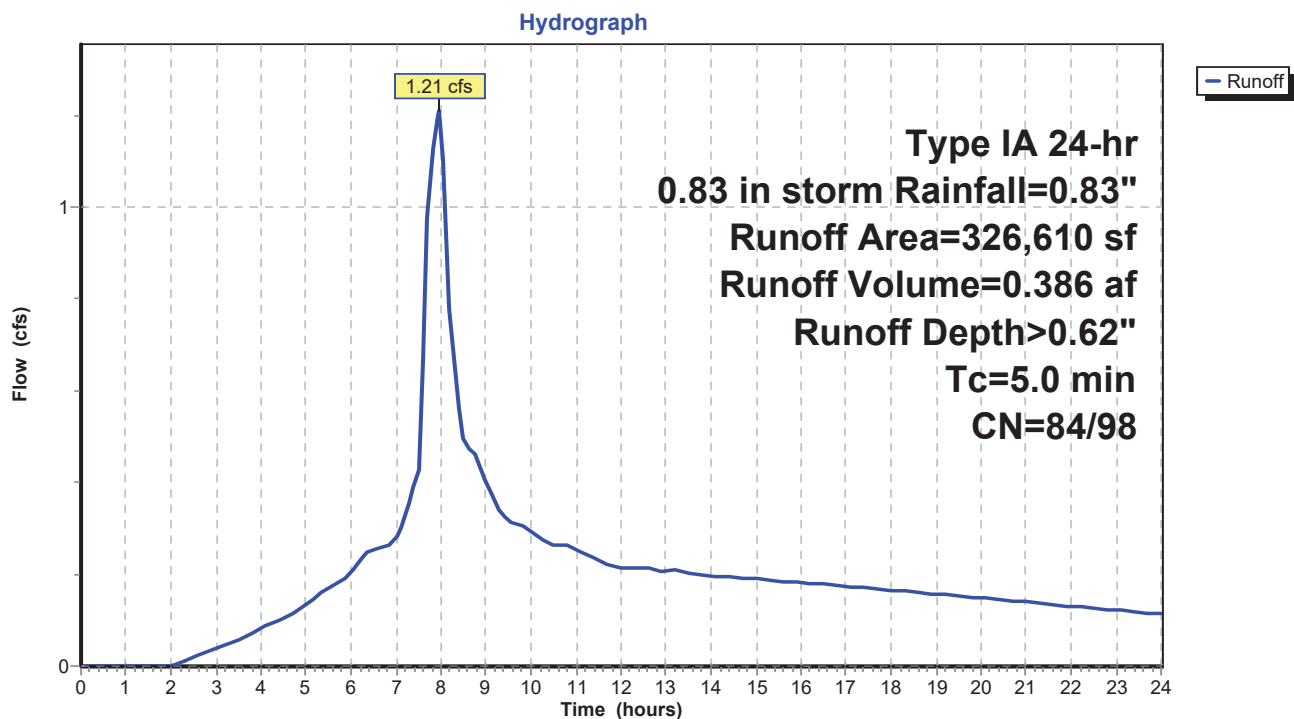
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Type IA 24-hr 0.83 in storm Rainfall=0.83"

Area (sf)	CN	Description
321,790	98	Paved parking, HSG D
4,820	84	50-75% Grass cover, Fair, HSG D
326,610	98	Weighted Average
4,820	84	1.48% Pervious Area
321,790	98	98.52% Impervious Area

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

Subcatchment 39S: Basin 7



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs

Type IA 24-hr 0.83 in storm Rainfall=0.83"

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Summary for Subcatchment 42S: Roof areas (Building A + Building B)

Runoff = 2.54 cfs @ 7.95 hrs, Volume= 0.808 af, Depth> 0.63"

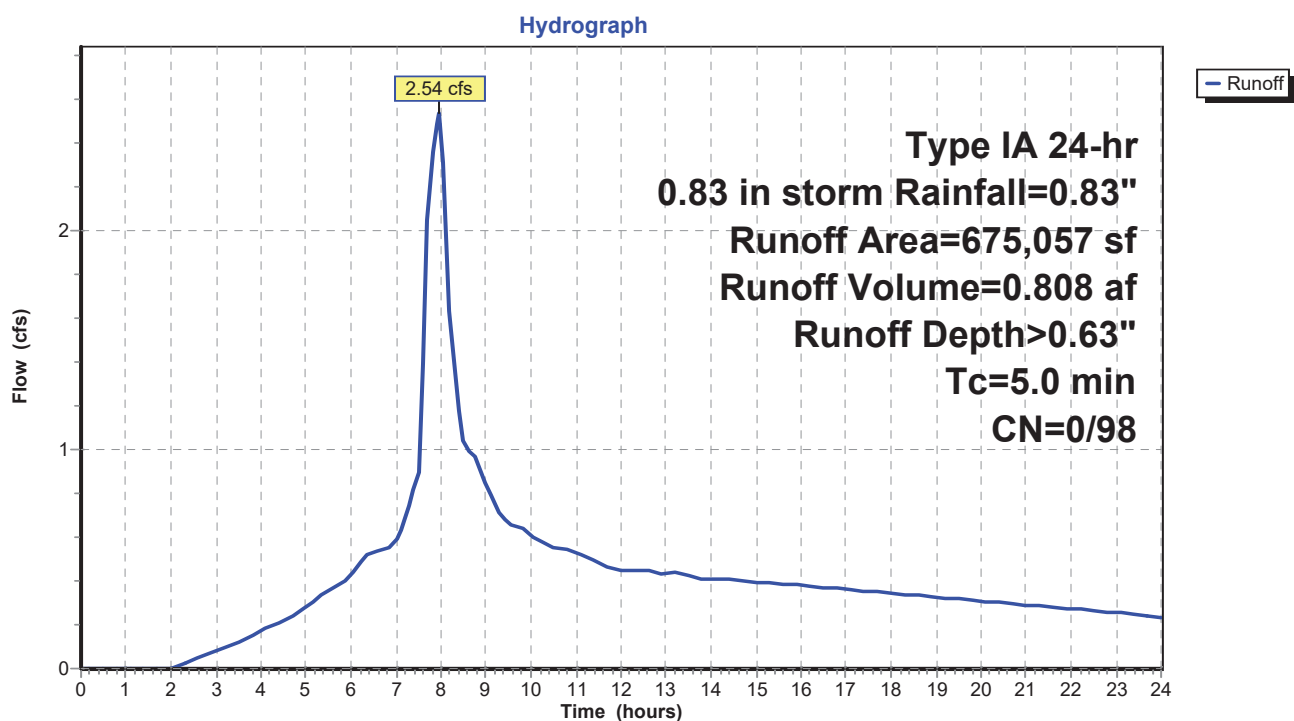
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Type IA 24-hr 0.83 in storm Rainfall=0.83"

Area (sf)	CN	Description
439,285	98	Unconnected roofs, HSG D
235,772	98	Unconnected roofs, HSG D
675,057	98	Weighted Average
675,057	98	100.00% Impervious Area

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

Subcatchment 42S: Roof areas (Building A + Building B)



Bridge Point I-5 Hydrological calcs

Prepared by Microsoft

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 0.83 in storm Rainfall=0.83"

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Summary for Subcatchment 47S: Basin 5 Area - East

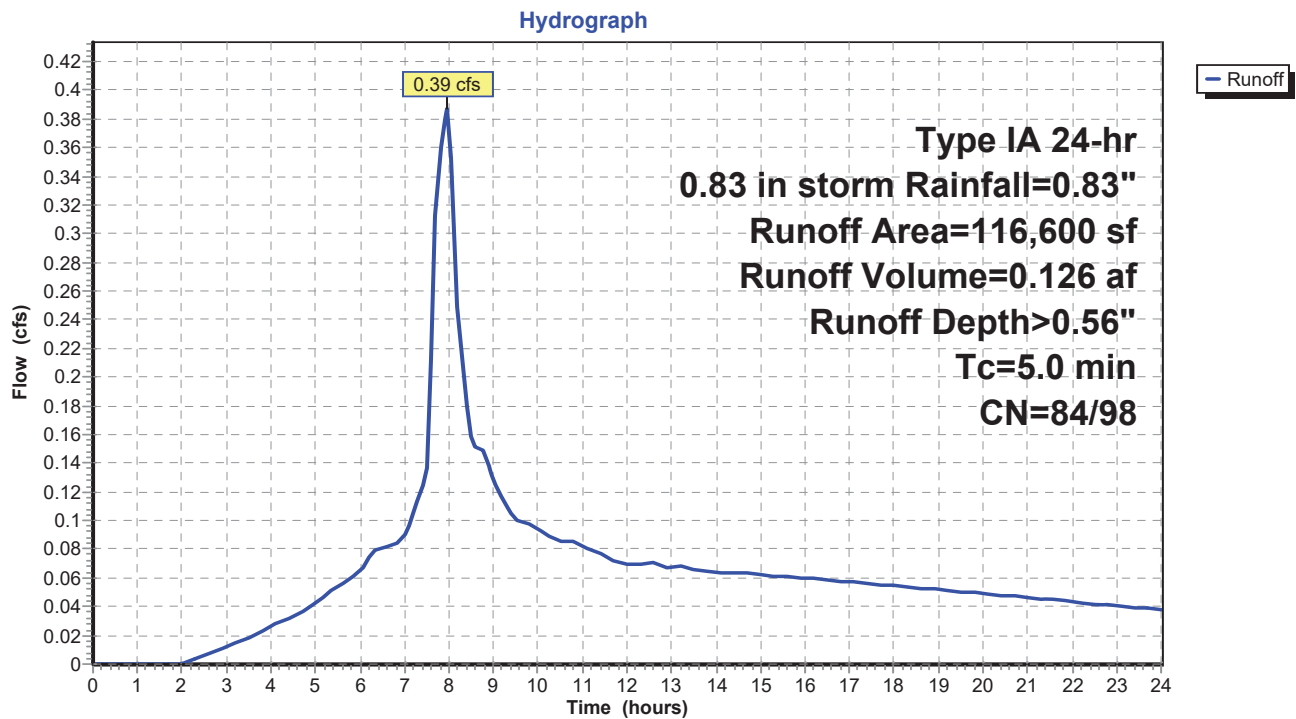
Runoff = 0.39 cfs @ 7.95 hrs, Volume= 0.126 af, Depth> 0.56"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 0.83 in storm Rainfall=0.83"

Area (sf)	CN	Description
102,990	98	Paved parking, HSG C
13,610	84	50-75% Grass cover, Fair, HSG D
116,600	96	Weighted Average
13,610	84	11.67% Pervious Area
102,990	98	88.33% Impervious Area

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

Subcatchment 47S: Basin 5 Area - East



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs

Type IA 24-hr 0.83 in storm Rainfall=0.83"

Printed 6/21/2019

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Summary for Subcatchment 48S: Stormwater Basin

Runoff = 0.07 cfs @ 7.95 hrs, Volume= 0.024 af, Depth> 0.42"

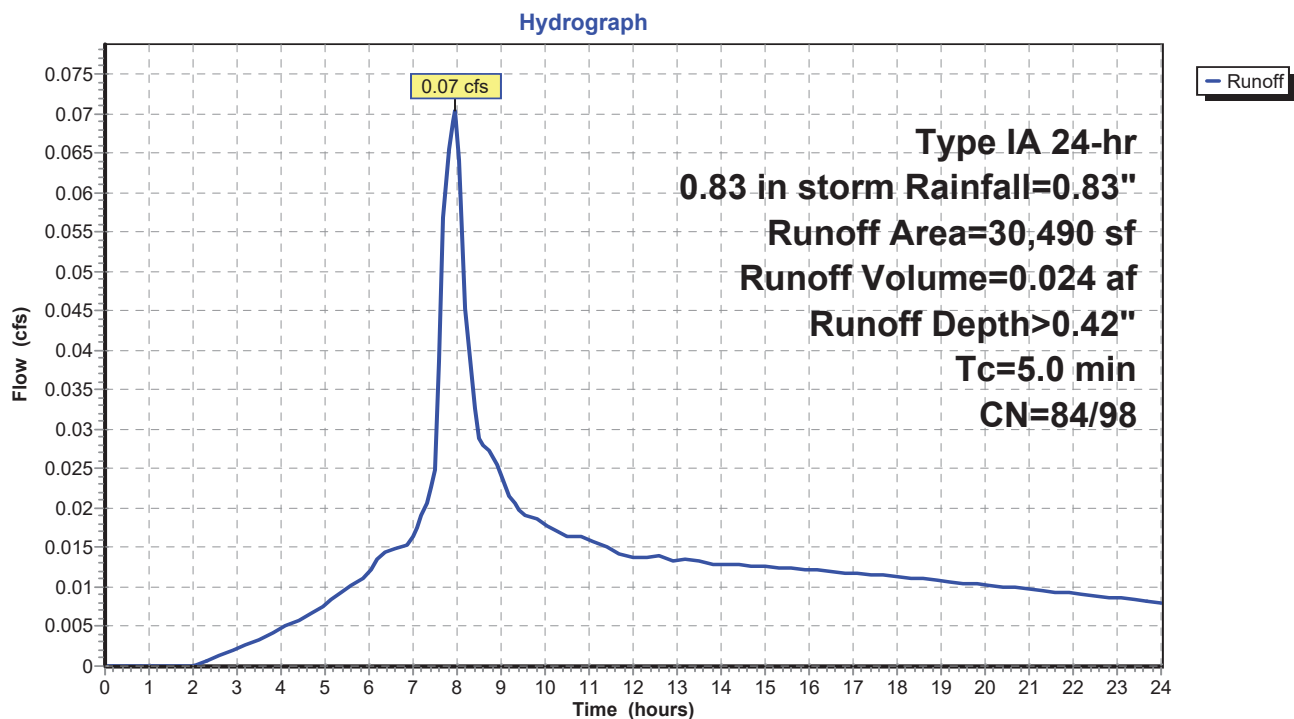
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Type IA 24-hr 0.83 in storm Rainfall=0.83"

Area (sf)	CN	Description
18,740	98	Water Surface, HSG D
11,750	84	50-75% Grass cover, Fair, HSG D
30,490	93	Weighted Average
11,750	84	38.54% Pervious Area
18,740	98	61.46% Impervious Area

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

Subcatchment 48S: Stormwater Basin



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs

Type IA 24-hr 0.83 in storm Rainfall=0.83"

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Summary for Reach 48R: Existing Outfall Pipe

Inflow Area = 31.867 ac, 97.14% Impervious, Inflow Depth > 0.58" for 0.83 in storm event
Inflow = 3.89 cfs @ 7.95 hrs, Volume= 1.552 af
Outflow = 3.88 cfs @ 7.95 hrs, Volume= 1.552 af, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Max. Velocity= 4.10 fps, Min. Travel Time= 0.2 min

Avg. Velocity = 2.51 fps, Avg. Travel Time= 0.3 min

Peak Storage= 47 cf @ 7.95 hrs

Average Depth at Peak Storage= 0.62'

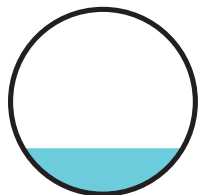
Bank-Full Depth= 2.50' Flow Area= 4.9 sf, Capacity= 29.00 cfs

30.0" Round Pipe

n= 0.013 Concrete pipe, bends & connections

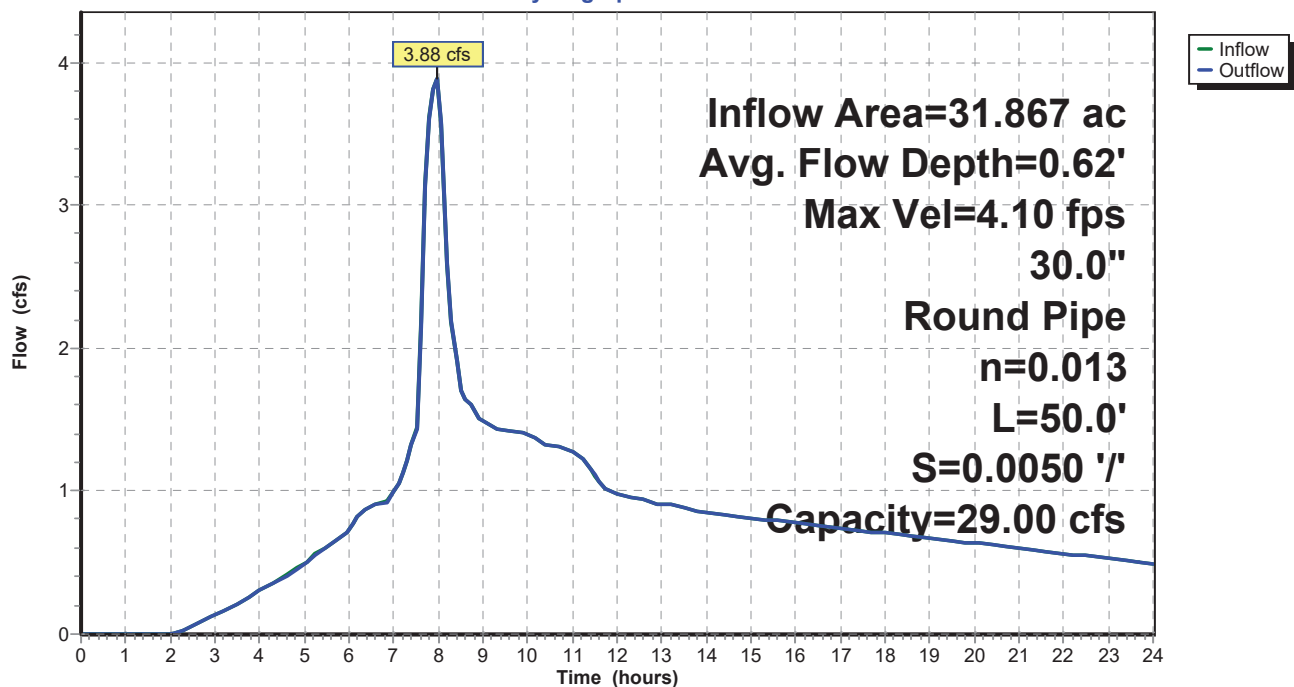
Length= 50.0' Slope= 0.0050 '/'

Inlet Invert= 28.75', Outlet Invert= 28.50'



Reach 48R: Existing Outfall Pipe

Hydrograph



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 0.83 in storm Rainfall=0.83"

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Summary for Reach 49R: swale cross-section

Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min

Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs

Average Depth at Peak Storage= 0.00'

Bank-Full Depth= 1.25' Flow Area= 7.2 sf, Capacity= 3.09 cfs

2.00' x 1.25' deep channel, n= 0.025 Earth, clean & winding

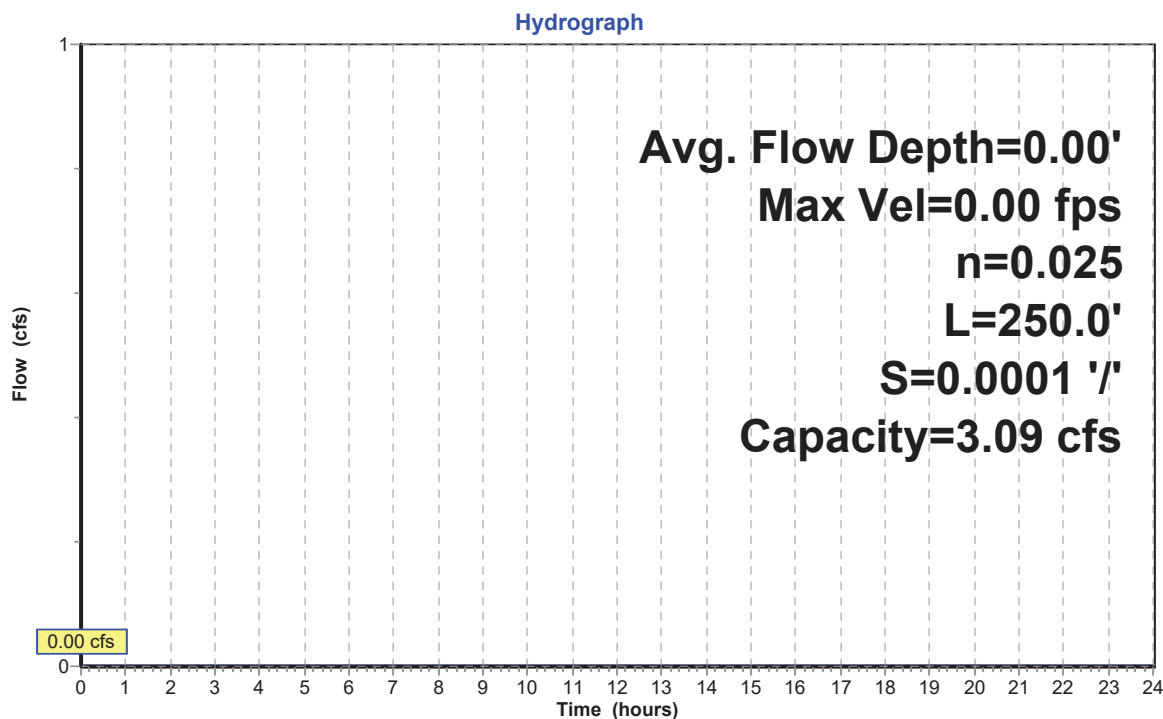
Side Slope Z-value= 3.0 '/' Top Width= 9.50'

Length= 250.0' Slope= 0.0001 '/'

Inlet Invert= 52.00', Outlet Invert= 51.98'



Reach 49R: swale cross-section



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs
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Summary for Pond 31P: swale 2

Inflow Area = 5.202 ac, 93.99% Impervious, Inflow Depth > 0.59" for 0.83 in storm event
Inflow = 0.80 cfs @ 7.95 hrs, Volume= 0.257 af
Outflow = 0.73 cfs @ 8.09 hrs, Volume= 0.256 af, Atten= 9%, Lag= 8.1 min
Primary = 0.14 cfs @ 8.08 hrs, Volume= 0.160 af
Secondary = 0.15 cfs @ 8.09 hrs, Volume= 0.002 af
Tertiary = 0.45 cfs @ 8.08 hrs, Volume= 0.094 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Peak Elev= 48.69' @ 8.08 hrs Surf.Area= 2,970 sf Storage= 793 cf

Plug-Flow detention time= 21.5 min calculated for 0.256 af (100% of inflow)
Center-of-Mass det. time= 19.0 min (746.4 - 727.4)

Volume	Invert	Avail.Storage	Storage Description
#1	48.35'	5,590 cf	Custom Stage Data (Conic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
48.35	1,690	0	0	1,690
49.60	8,040	5,590	5,590	8,047

Device	Routing	Invert	Outlet Devices
#1	Primary	48.35'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	48.68'	8.0" Horiz. Orifice/Grate X 12.00 C= 0.600 Limited to weir flow at low heads
#3	Tertiary	48.35'	18.0" Round Culvert L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 48.35' / 48.15' S= 0.0050 ' / ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=0.14 cfs @ 8.08 hrs HW=48.69' TW=45.85' (Dynamic Tailwater)

↑ **1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Secondary OutFlow Max=0.14 cfs @ 8.09 hrs HW=48.69' TW=45.85' (Dynamic Tailwater)

↑ **2=Orifice/Grate** (Weir Controls 0.14 cfs @ 0.39 fps)

Tertiary OutFlow Max=0.44 cfs @ 8.08 hrs HW=48.69' TW=45.07' (Dynamic Tailwater)

↑ **3=Culvert** (Barrel Controls 0.44 cfs @ 2.20 fps)

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Bridge Point I-5 hydrological calcs

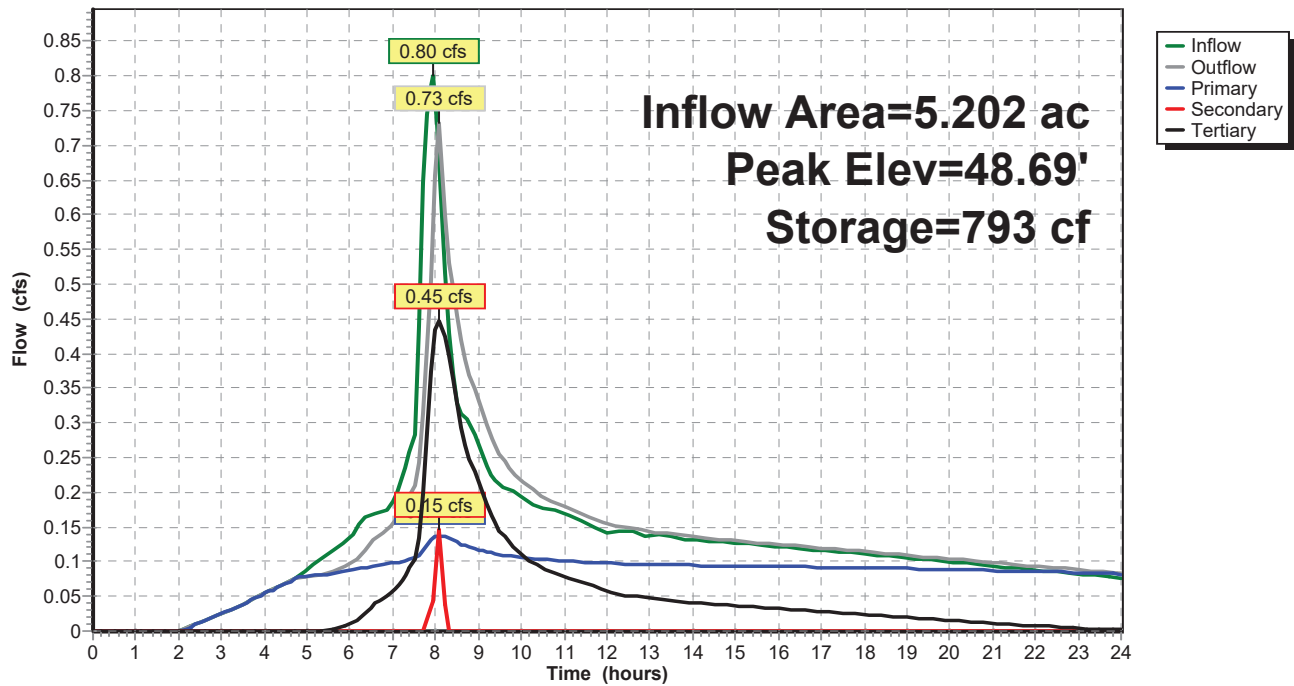
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Pond 31P: swale 2

Hydrograph



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Summary for Pond 34P: drainage layer

Inflow Area = 5.202 ac, 93.99% Impervious, Inflow Depth > 0.37" for 0.83 in storm event
Inflow = 0.28 cfs @ 8.09 hrs, Volume= 0.162 af
Outflow = 0.13 cfs @ 8.51 hrs, Volume= 0.159 af, Atten= 55%, Lag= 25.6 min
Primary = 0.13 cfs @ 8.51 hrs, Volume= 0.159 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Peak Elev= 45.95' @ 8.51 hrs Surf.Area= 1,690 sf Storage= 337 cf

Plug-Flow detention time= 33.0 min calculated for 0.159 af (98% of inflow)
Center-of-Mass det. time= 20.1 min (827.6 - 807.6)

Volume	Invert	Avail.Storage	Storage Description
#1	45.35'	837 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 2,535 cf Overall x 33.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
45.35	1,690	0	0
46.85	1,690	2,535	2,535

Device	Routing	Invert	Outlet Devices
#1	Primary	45.35'	12.0" Round Culvert L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 45.35' / 45.10' S= 0.0050 ' / ' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 1	45.35'	2.5" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Secondary	45.35'	18.0" Round Culvert L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 45.35' / 45.10' S= 0.0050 ' / ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#4	Device 3	46.84'	18.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.13 cfs @ 8.51 hrs HW=45.95' TW=42.70' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 0.13 cfs of 0.99 cfs potential flow)
↑ **2=Orifice/Grate** (Orifice Controls 0.13 cfs @ 3.74 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=45.35' TW=45.00' (Dynamic Tailwater)

↑ **3=Culvert** (Controls 0.00 cfs)
↑ **4=Orifice/Grate** (Controls 0.00 cfs)

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Bridge Point I-5 hydrological calcs

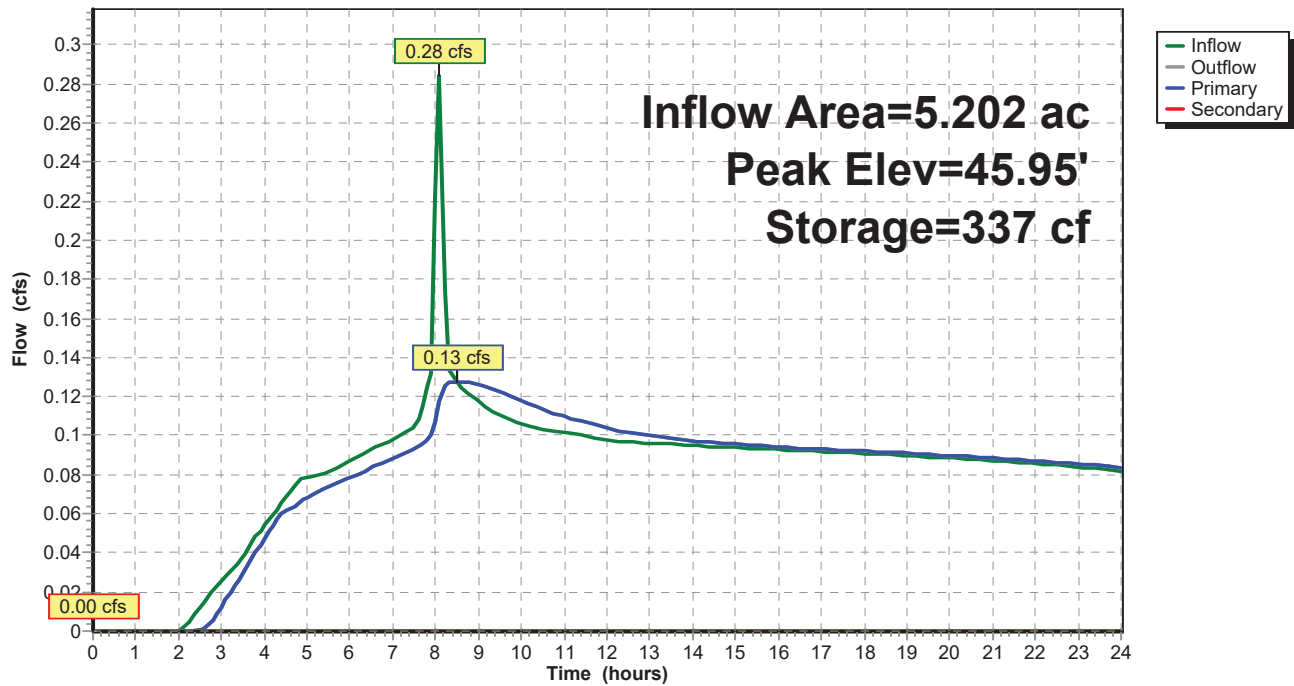
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Pond 34P: drainage layer

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Summary for Pond 36P: Stormwater Basin

Inflow Area = 2.810 ac, 84.93% Impervious, Inflow Depth > 0.95" for 0.83 in storm event
Inflow = 0.82 cfs @ 8.01 hrs, Volume= 0.222 af
Outflow = 0.35 cfs @ 8.98 hrs, Volume= 0.222 af, Atten= 57%, Lag= 58.1 min
Primary = 0.35 cfs @ 8.98 hrs, Volume= 0.222 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Peak Elev= 45.14' @ 8.98 hrs Surf.Area= 7,572 sf Storage= 1,068 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)

Center-of-Mass det. time= 15.7 min (708.8 - 693.1)

Volume	Invert	Avail.Storage	Storage Description
#1	45.00'	60,466 cf	Custom Stage Data (Conic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
45.00	7,340	0	0	7,340
50.00	17,580	60,466	60,466	17,761

Device	Routing	Invert	Outlet Devices
#1	Primary	45.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	48.00'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.35 cfs @ 8.98 hrs HW=45.14' TW=42.73' (Dynamic Tailwater)

↑**1=Exfiltration** (Exfiltration Controls 0.35 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=45.00' TW=41.50' (Dynamic Tailwater)

↑**2=Orifice/Grate** (Controls 0.00 cfs)

Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs

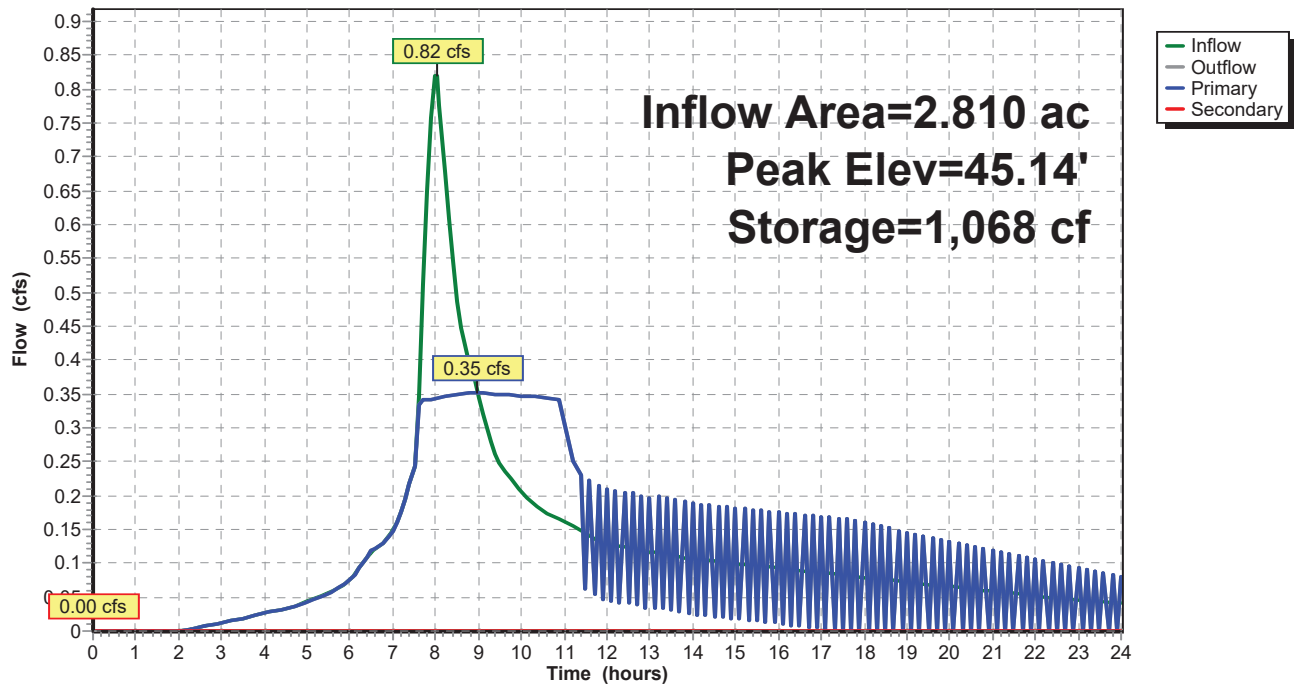
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Pond 36P: Stormwater Basin

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Summary for Pond 37P: swale 1

Inflow Area = 0.860 ac, 92.42% Impervious, Inflow Depth > 0.58" for 0.83 in storm event
Inflow = 0.13 cfs @ 7.95 hrs, Volume= 0.042 af
Outflow = 0.05 cfs @ 8.92 hrs, Volume= 0.042 af, Atten= 65%, Lag= 58.0 min
Primary = 0.05 cfs @ 8.92 hrs, Volume= 0.042 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Peak Elev= 53.11' @ 8.92 hrs Surf.Area= 986 sf Storage= 231 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)

Center-of-Mass det. time= 32.4 min (760.5 - 728.1)

Volume	Invert	Avail.Storage	Storage Description
#1	52.80'	1,396 cf	Custom Stage Data (Conic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
52.80	530	0	0	530
53.80	2,505	1,396	1,396	2,509

Device	Routing	Invert	Outlet Devices
#1	Primary	52.80'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	53.13'	8.0" Horiz. Orifice/Grate X 2.00 C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.05 cfs @ 8.92 hrs HW=53.11' TW=50.43' (Dynamic Tailwater)

↑**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=52.80' TW=50.30' (Dynamic Tailwater)

↑**2=Orifice/Grate** (Controls 0.00 cfs)

Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs

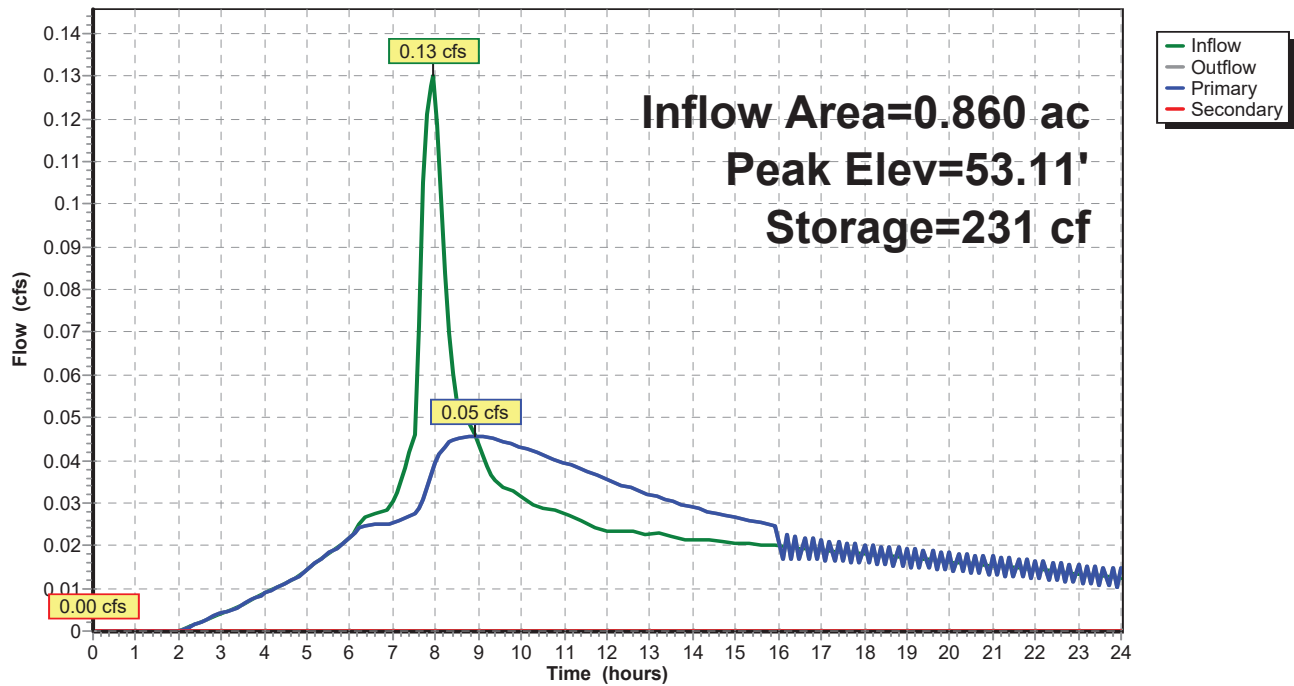
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Pond 37P: swale 1

Hydrograph



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Summary for Pond 38P: drainage layer

Inflow Area = 0.860 ac, 92.42% Impervious, Inflow Depth > 0.58" for 0.83 in storm event
Inflow = 0.05 cfs @ 8.92 hrs, Volume= 0.042 af
Outflow = 0.05 cfs @ 8.98 hrs, Volume= 0.042 af, Atten= 0%, Lag= 3.9 min
Primary = 0.05 cfs @ 8.98 hrs, Volume= 0.042 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Peak Elev= 50.43' @ 8.98 hrs Surf.Area= 530 sf Storage= 22 cf

Plug-Flow detention time= 10.9 min calculated for 0.042 af (99% of inflow)

Center-of-Mass det. time= 6.4 min (766.9 - 760.5)

Volume	Invert	Avail.Storage	Storage Description
#1	50.30'	175 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 530 cf Overall x 33.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
50.30	530	0	0
51.30	530	530	530

Device	Routing	Invert	Outlet Devices
#1	Primary	50.30'	12.0" Round Culvert L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 50.30' / 50.05' S= 0.0050 ' S= 0.0050 ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.05 cfs @ 8.98 hrs HW=50.43' TW=42.68' (Dynamic Tailwater)

↑**1=Culvert** (Barrel Controls 0.05 cfs @ 1.21 fps)

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Bridge Point I-5 hydrological calcs

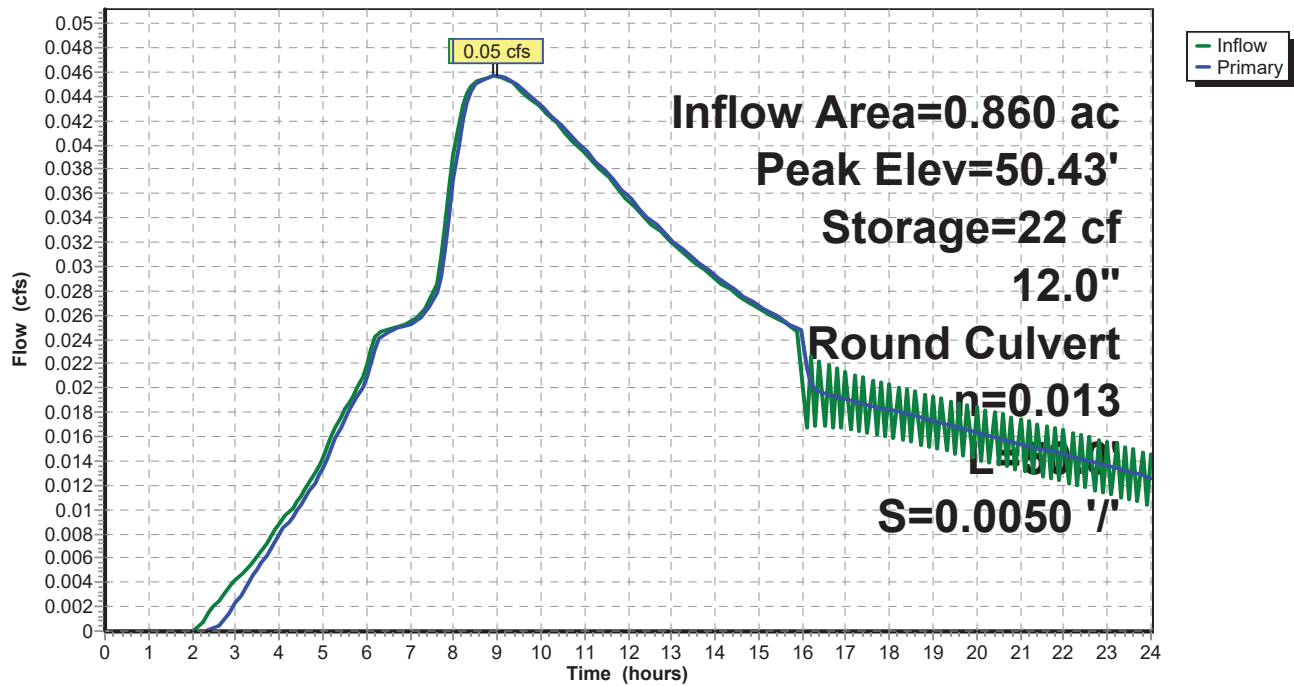
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Pond 38P: drainage layer

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Summary for Pond 39P: MH upstream of Private Outfall

Inflow Area = 31.867 ac, 97.14% Impervious, Inflow Depth > 0.58" for 0.83 in storm event
Inflow = 3.89 cfs @ 7.95 hrs, Volume= 1.552 af
Outflow = 3.89 cfs @ 7.95 hrs, Volume= 1.552 af, Atten= 0%, Lag= 0.0 min
Primary = 3.89 cfs @ 7.95 hrs, Volume= 1.552 af

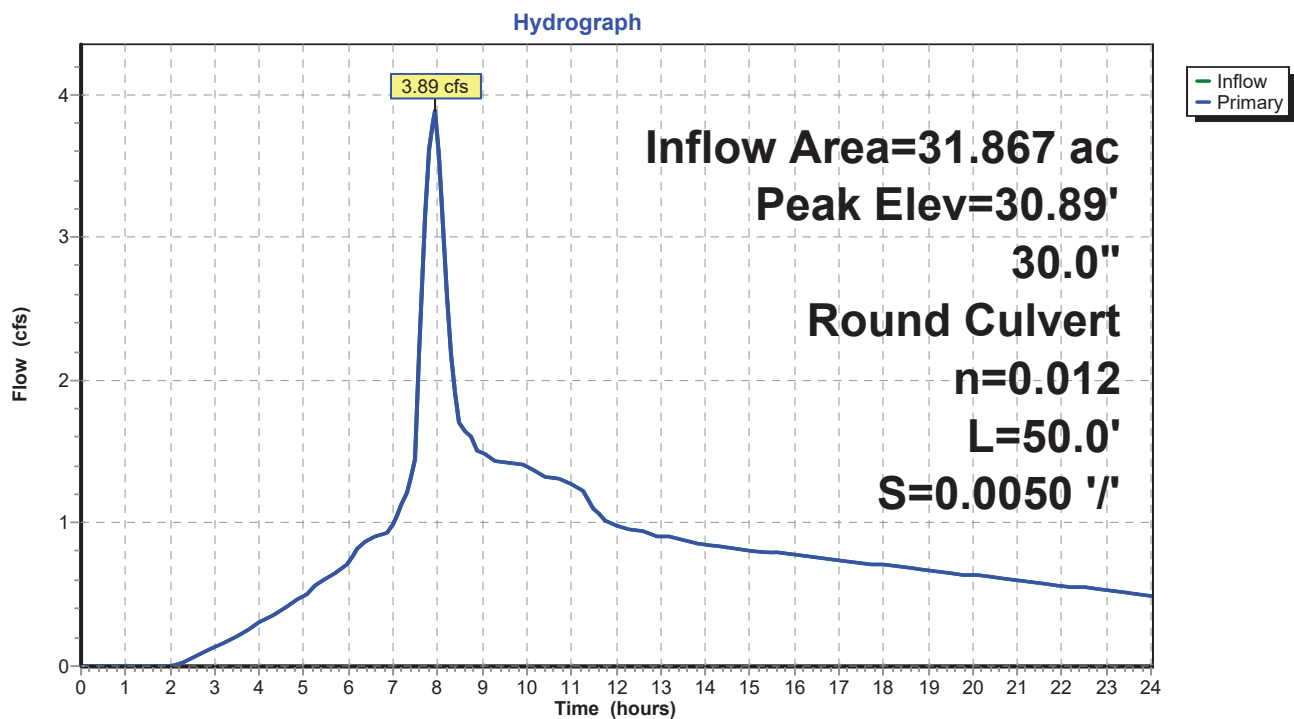
Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Peak Elev= 30.89' @ 7.95 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	30.00'	30.0" Round RCP_Round 30" L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 30.00' / 29.75' S= 0.0050 '/ Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 4.91 sf

Primary OutFlow Max=3.82 cfs @ 7.95 hrs HW=30.88' TW=29.36' (Dynamic Tailwater)
↑1=RCP_Round 30" (Barrel Controls 3.82 cfs @ 3.67 fps)

Pond 39P: MH upstream of Private Outfall



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Summary for Pond 40P: (new Pond)

Inflow Area = 24.369 ac, 96.71% Impervious, Inflow Depth > 0.57" for 0.83 in storm event
Inflow = 2.68 cfs @ 7.95 hrs, Volume= 1.166 af
Outflow = 2.68 cfs @ 7.95 hrs, Volume= 1.166 af, Atten= 0%, Lag= 0.0 min
Primary = 2.68 cfs @ 7.95 hrs, Volume= 1.166 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Peak Elev= 42.93' @ 7.95 hrs

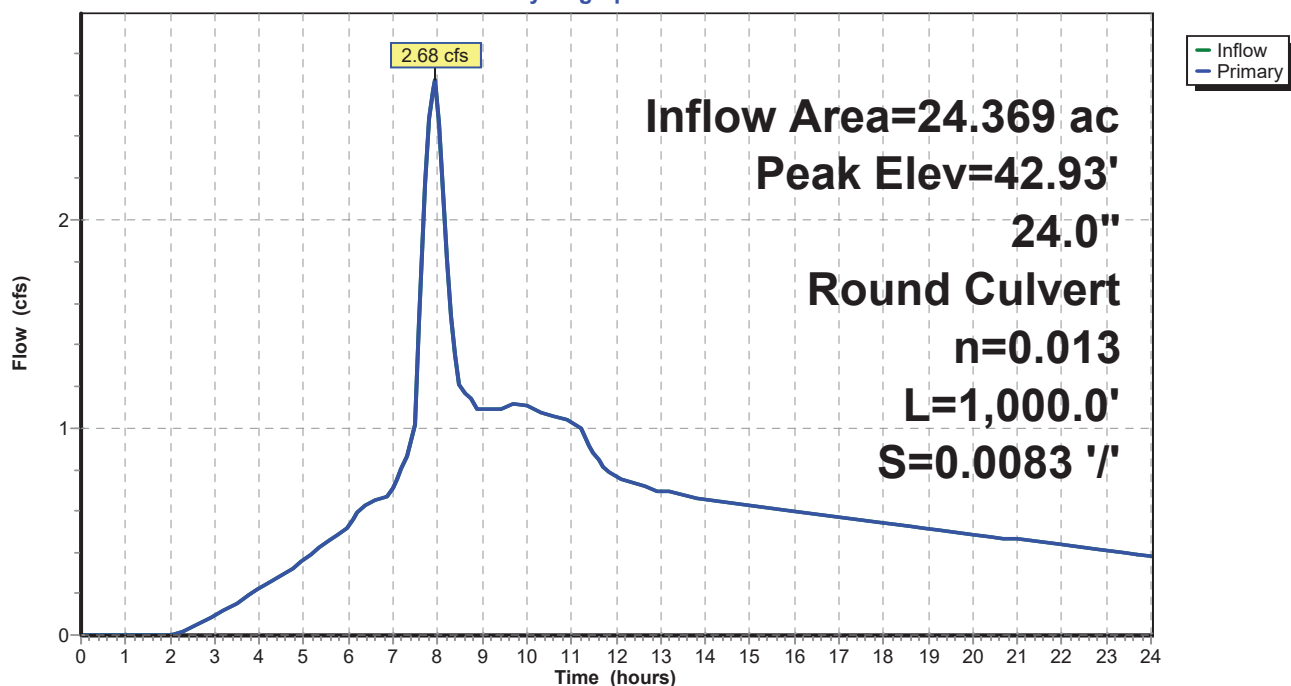
Device	Routing	Invert	Outlet Devices
#1	Primary	42.25'	24.0" Round Culvert L= 1,000.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 42.25' / 34.00' S= 0.0083 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=2.63 cfs @ 7.95 hrs HW=42.93' TW=30.88' (Dynamic Tailwater)

↑ **1=Culvert** (Inlet Controls 2.63 cfs @ 2.80 fps)

Pond 40P: (new Pond)

Hydrograph



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Summary for Pond 43P: drainage layer

Inflow Area = 2.810 ac, 84.93% Impervious, Inflow Depth > 0.95" for 0.83 in storm event
Inflow = 0.35 cfs @ 8.98 hrs, Volume= 0.222 af
Outflow = 0.35 cfs @ 10.57 hrs, Volume= 0.158 af, Atten= 1%, Lag= 95.5 min
Primary = 0.35 cfs @ 10.57 hrs, Volume= 0.158 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Peak Elev= 42.90' @ 10.35 hrs Surf.Area= 7,340 sf Storage= 3,379 cf

Plug-Flow detention time= 284.9 min calculated for 0.157 af (71% of inflow)

Center-of-Mass det. time= 135.7 min (844.5 - 708.8)

Volume	Invert	Avail.Storage	Storage Description
#1	41.50'	4,844 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 14,680 cf Overall x 33.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
41.50	7,340	0	0
43.50	7,340	14,680	14,680

Device	Routing	Invert	Outlet Devices
#1	Primary	42.50'	12.0" Round Culvert L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 42.50' / 42.25' S= 0.0050 ' S= 0.0050 ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.35 cfs @ 10.57 hrs HW=42.89' TW=42.67' (Dynamic Tailwater)

↑**1=Culvert** (Outlet Controls 0.35 cfs @ 1.79 fps)

Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs

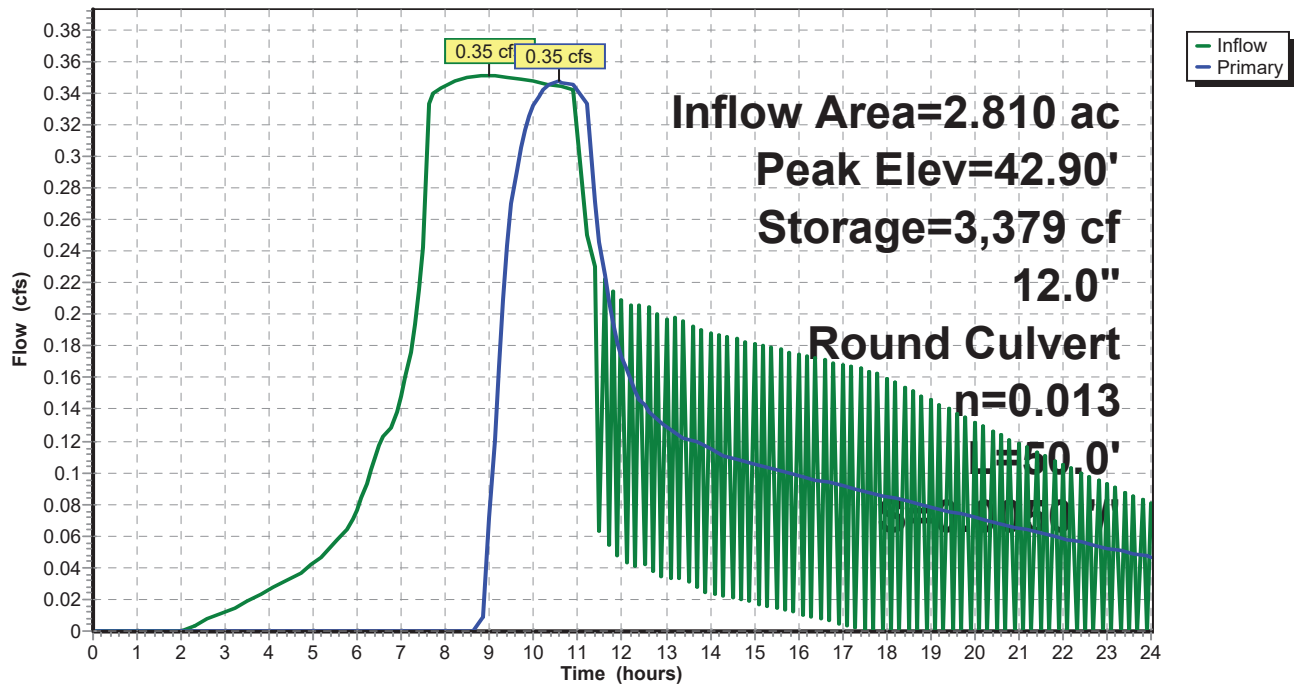
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Pond 43P: drainage layer

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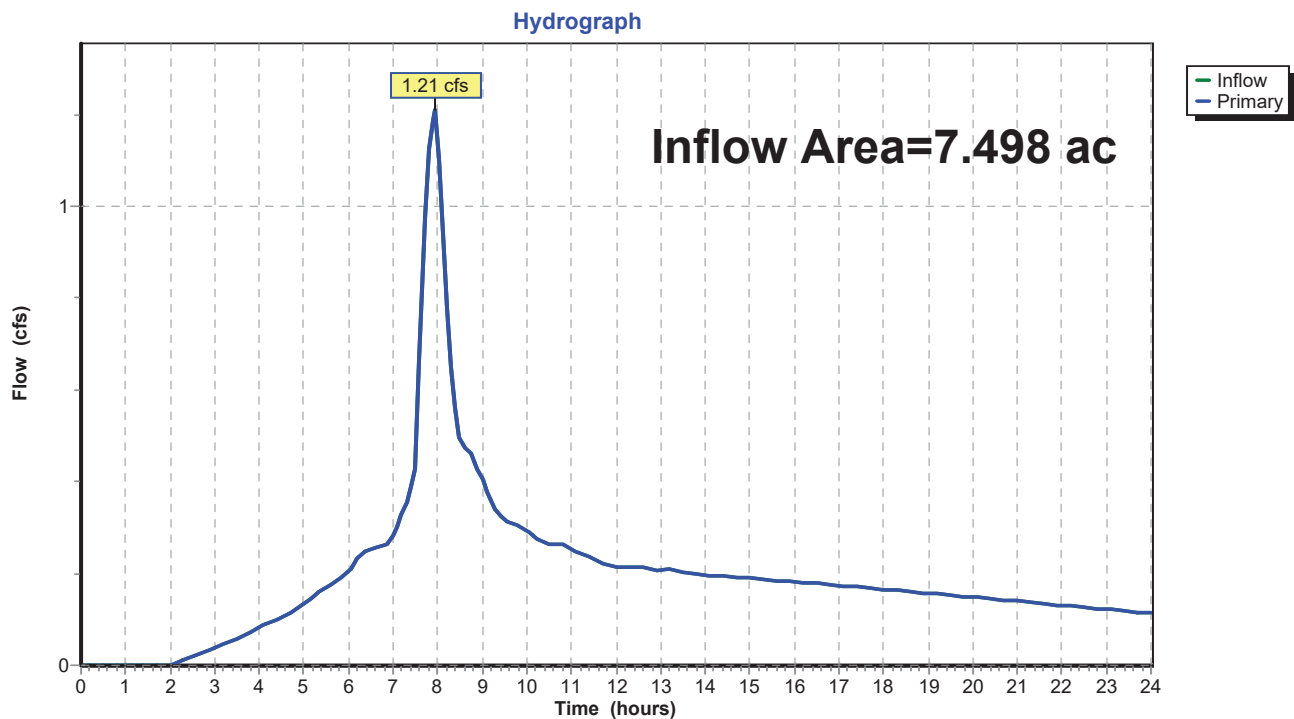
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Summary for Pond 45P: stormfilter vault

Inflow Area = 7.498 ac, 98.52% Impervious, Inflow Depth > 0.62" for 0.83 in storm event
Inflow = 1.21 cfs @ 7.95 hrs, Volume= 0.386 af
Primary = 1.21 cfs @ 7.95 hrs, Volume= 0.386 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Pond 45P: stormfilter vault



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Summary for Pond 47P: flow diversion MH 1

Inflow Area = 7.498 ac, 98.52% Impervious, Inflow Depth > 0.62" for 0.83 in storm event
Inflow = 1.21 cfs @ 7.95 hrs, Volume= 0.386 af
Outflow = 1.21 cfs @ 7.95 hrs, Volume= 0.386 af, Atten= 0%, Lag= 0.0 min
Primary = 1.21 cfs @ 7.95 hrs, Volume= 0.386 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Peak Elev= 34.08' @ 7.95 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	30.10'	8.0" Round Culvert L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 30.10' / 30.00' S= 0.0050 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Device 1	30.10'	4.8" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Secondary	30.10'	24.0" Round Culvert L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 30.10' / 30.00' S= 0.0050 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#4	Device 3	34.60'	24.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.19 cfs @ 7.95 hrs HW=33.95' TW=0.00' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 1.19 cfs of 2.49 cfs potential flow)

↑ **2=Orifice/Grate** (Orifice Controls 1.19 cfs @ 9.45 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=30.10' TW=30.00' (Dynamic Tailwater)

↑ **3=Culvert** (Controls 0.00 cfs)

↑ **4=Orifice/Grate** (Controls 0.00 cfs)

Bridge Point I-5 Hydrological calcs

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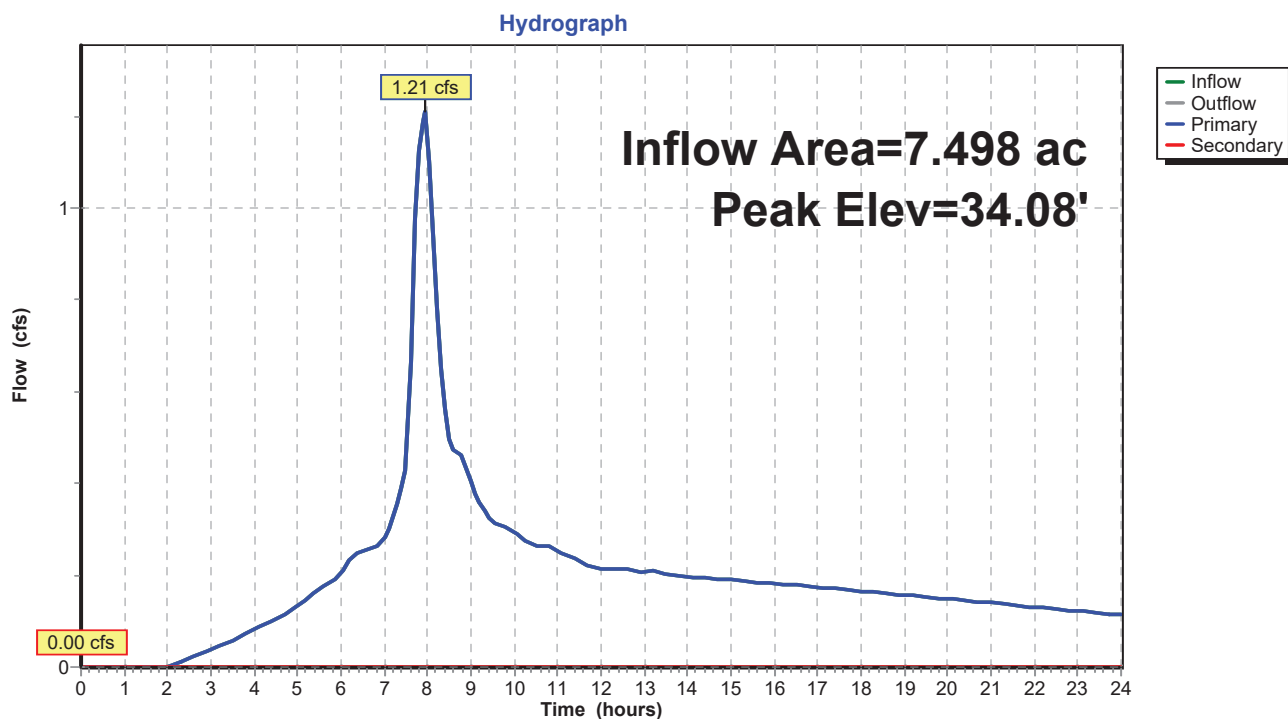
Bridge Point I-5 hydrological calcs

Type IA 24-hr 0.83 in storm Rainfall=0.83"

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Pond 47P: flow diversion MH 1



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Bridge Point I-5 hydrological calcs

Type IA 24-hr 25-yr Rainfall=3.90"

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Summary for Subcatchment 32S: Basin 5 Area - West

Runoff = 2.31 cfs @ 7.92 hrs, Volume= 0.770 af, Depth> 3.66"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

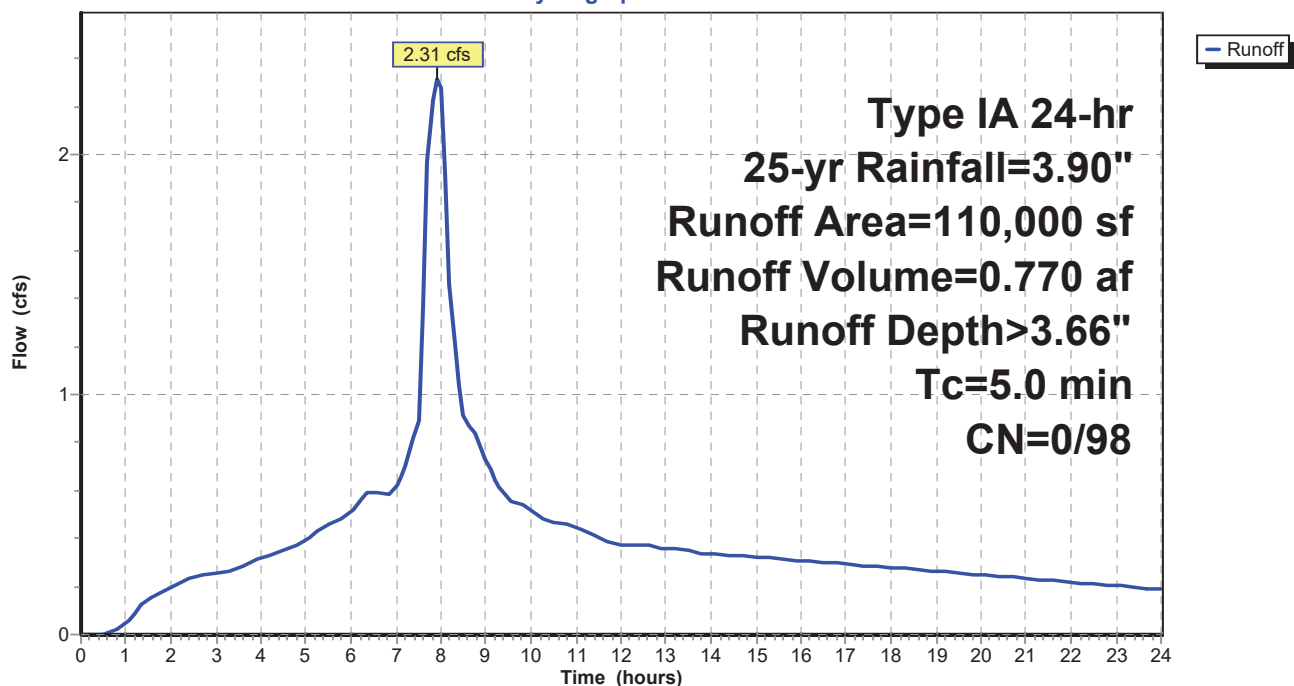
Type IA 24-hr 25-yr Rainfall=3.90"

Area (sf)	CN	Description
110,000	98	Paved parking, HSG C
110,000	98	100.00% Impervious Area

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

Subcatchment 32S: Basin 5 Area - West

Hydrograph



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs

Type IA 24-hr 25-yr Rainfall=3.90"

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Summary for Subcatchment 34S: Basin 1

Runoff = 0.76 cfs @ 7.92 hrs, Volume= 0.255 af, Depth> 3.55"

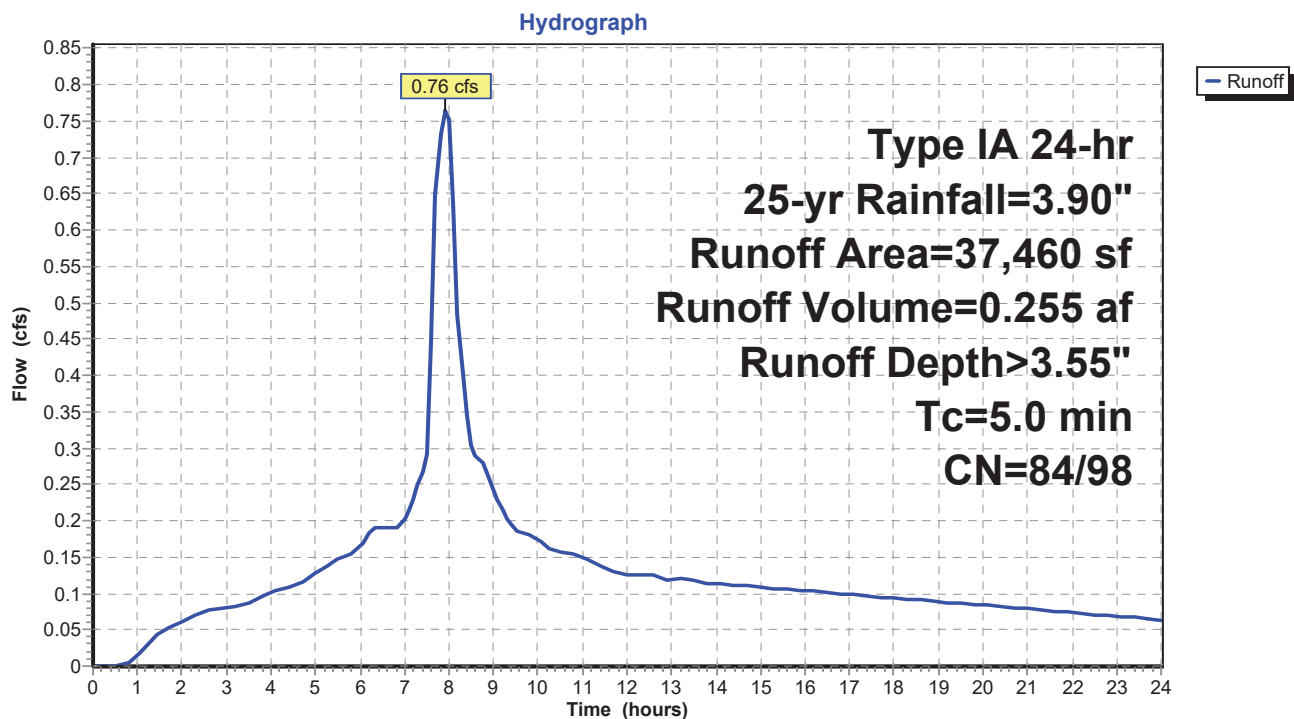
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Type IA 24-hr 25-yr Rainfall=3.90"

Area (sf)	CN	Description
34,620	98	Paved parking, HSG D
2,840	84	50-75% Grass cover, Fair, HSG D
37,460	97	Weighted Average
2,840	84	7.58% Pervious Area
34,620	98	92.42% Impervious Area

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

Subcatchment 34S: Basin 1



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Type IA 24-hr 25-yr Rainfall=3.90"

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Summary for Subcatchment 36S: Basin 4

Runoff = 0.45 cfs @ 7.92 hrs, Volume= 0.148 af, Depth> 3.56"

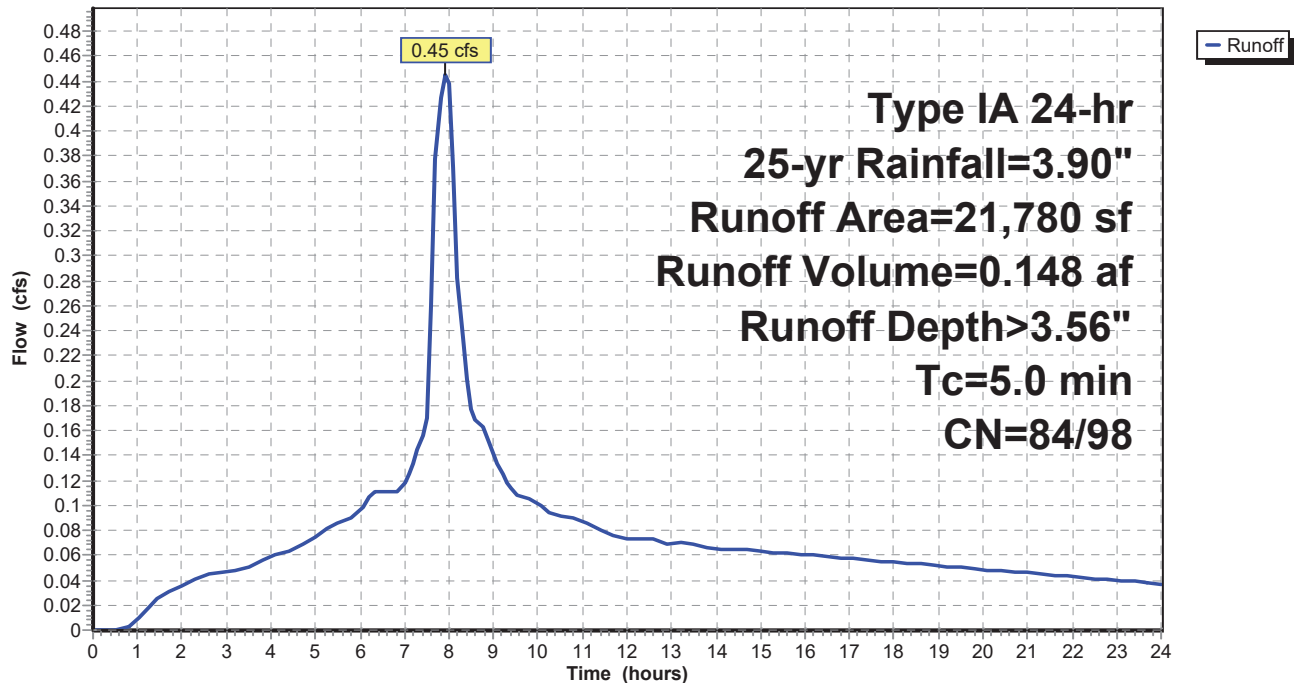
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 25-yr Rainfall=3.90"

Area (sf)	CN	Description
20,220	98	Paved parking, HSG D
1,560	84	50-75% Grass cover, Fair, HSG D
21,780	97	Weighted Average
1,560	84	7.16% Pervious Area
20,220	98	92.84% Impervious Area

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

Subcatchment 36S: Basin 4

Hydrograph



Bridge Point I-5 Hydrological calcs

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Type IA 24-hr 25-yr Rainfall=3.90"

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Summary for Subcatchment 37S: Basin 2

Runoff = 1.43 cfs @ 7.92 hrs, Volume= 0.477 af, Depth> 3.56"

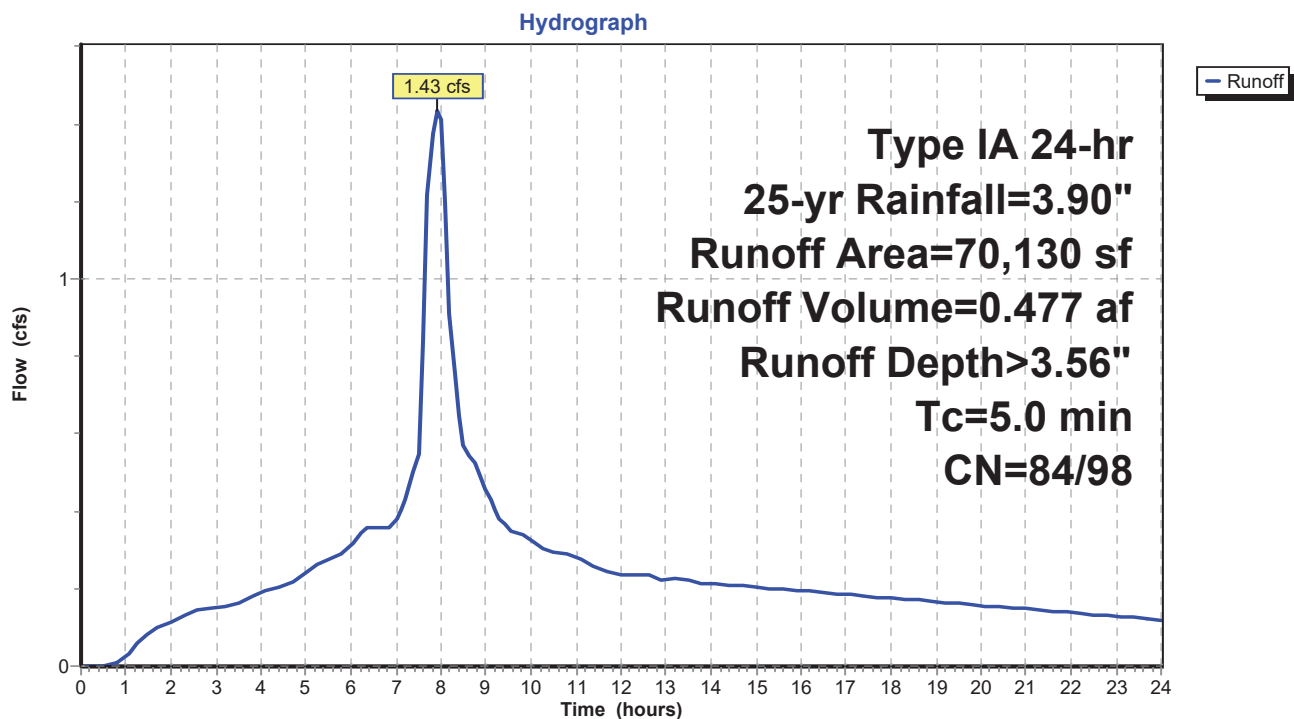
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Type IA 24-hr 25-yr Rainfall=3.90"

Area (sf)	CN	Description
64,990	98	Paved parking, HSG D
5,140	84	50-75% Grass cover, Fair, HSG D
70,130	97	Weighted Average
5,140	84	7.33% Pervious Area
64,990	98	92.67% Impervious Area

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

Subcatchment 37S: Basin 2



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Type IA 24-hr 25-yr Rainfall=3.90"

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Summary for Subcatchment 39S: Basin 7

Runoff = 6.83 cfs @ 7.92 hrs, Volume= 2.274 af, Depth> 3.64"

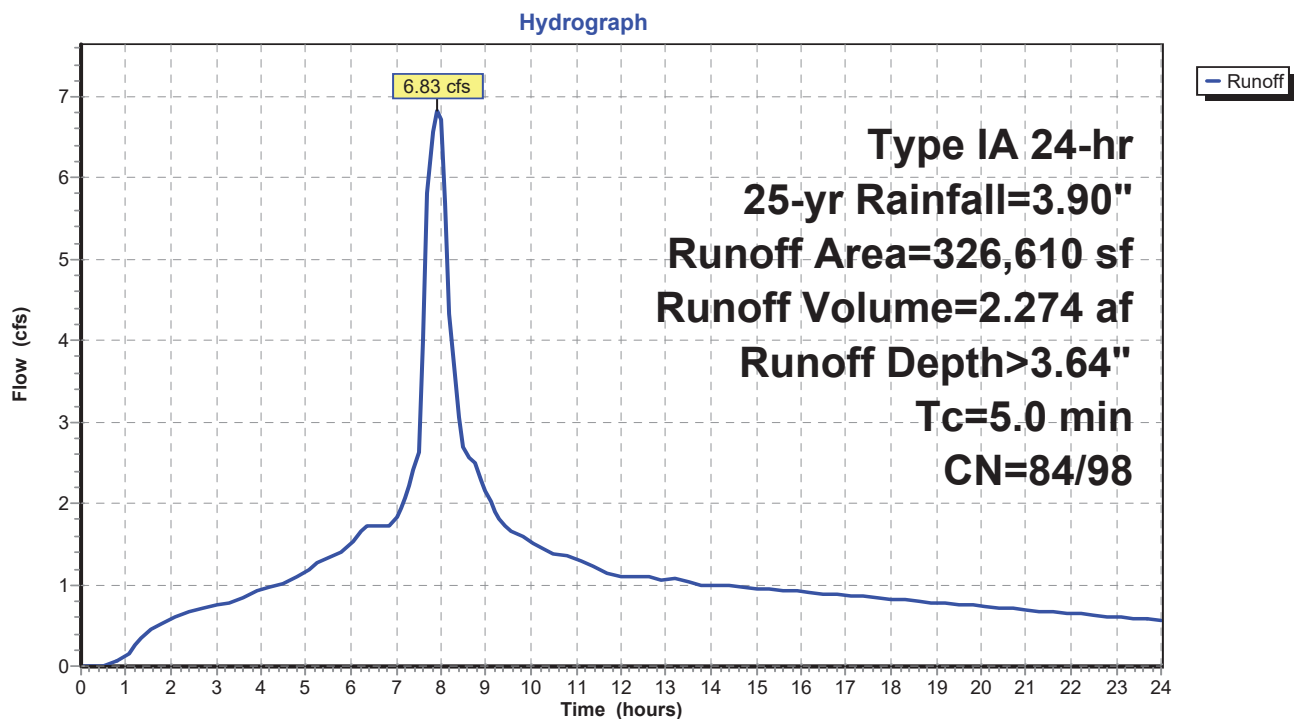
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Type IA 24-hr 25-yr Rainfall=3.90"

Area (sf)	CN	Description
321,790	98	Paved parking, HSG D
4,820	84	50-75% Grass cover, Fair, HSG D
326,610	98	Weighted Average
4,820	84	1.48% Pervious Area
321,790	98	98.52% Impervious Area

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

Subcatchment 39S: Basin 7



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Type IA 24-hr 25-yr Rainfall=3.90"

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Summary for Subcatchment 42S: Roof areas (Building A + Building B)

Runoff = 14.20 cfs @ 7.92 hrs, Volume= 4.726 af, Depth> 3.66"

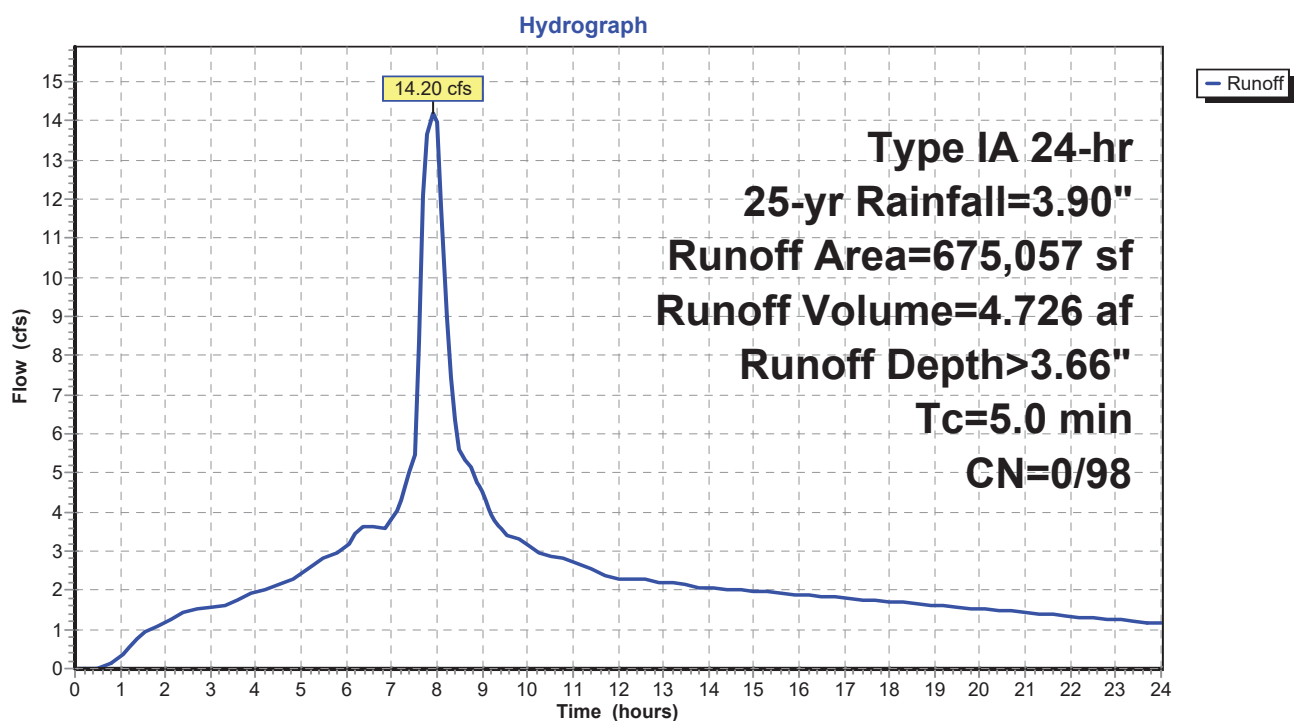
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Type IA 24-hr 25-yr Rainfall=3.90"

Area (sf)	CN	Description
439,285	98	Unconnected roofs, HSG D
235,772	98	Unconnected roofs, HSG D
675,057	98	Weighted Average
675,057	98	100.00% Impervious Area

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

Subcatchment 42S: Roof areas (Building A + Building B)



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 25-yr Rainfall=3.90"

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Summary for Subcatchment 47S: Basin 5 Area - East

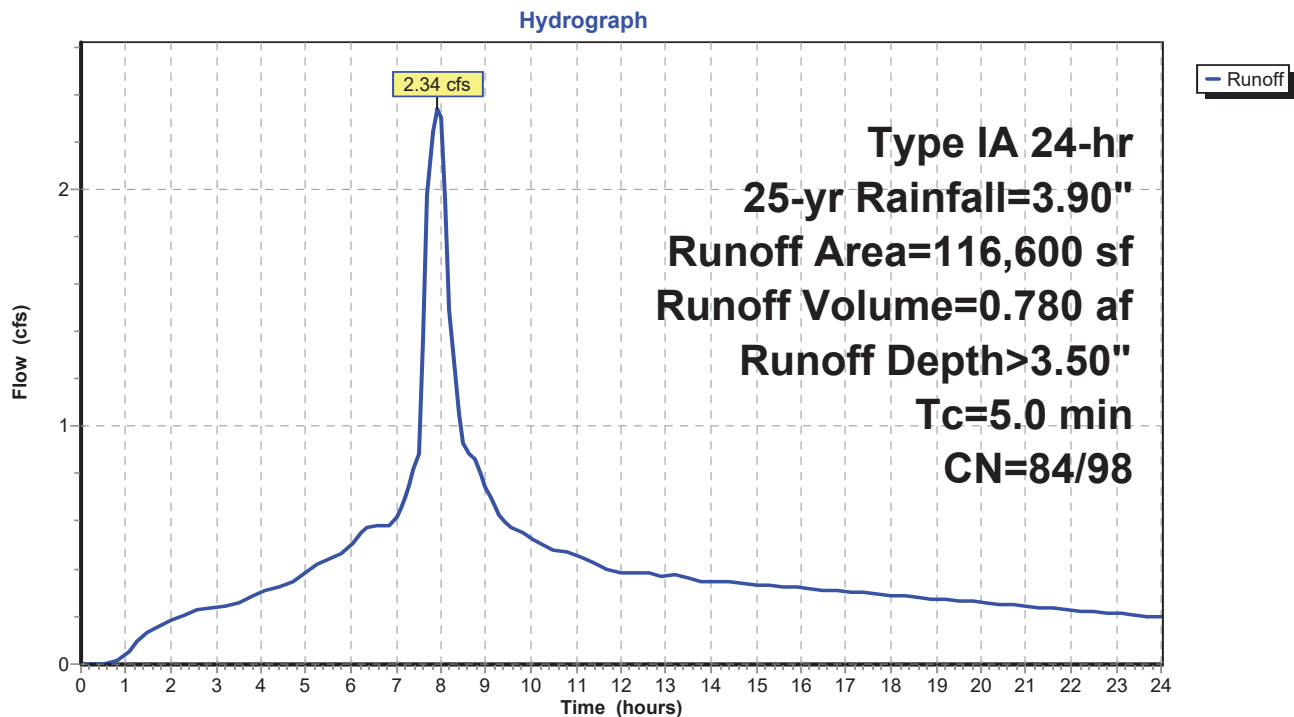
Runoff = 2.34 cfs @ 7.93 hrs, Volume= 0.780 af, Depth> 3.50"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 25-yr Rainfall=3.90"

Area (sf)	CN	Description
102,990	98	Paved parking, HSG C
13,610	84	50-75% Grass cover, Fair, HSG D
116,600	96	Weighted Average
13,610	84	11.67% Pervious Area
102,990	98	88.33% Impervious Area

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

Subcatchment 47S: Basin 5 Area - East



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 25-yr Rainfall=3.90"

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Summary for Subcatchment 48S: Stormwater Basin

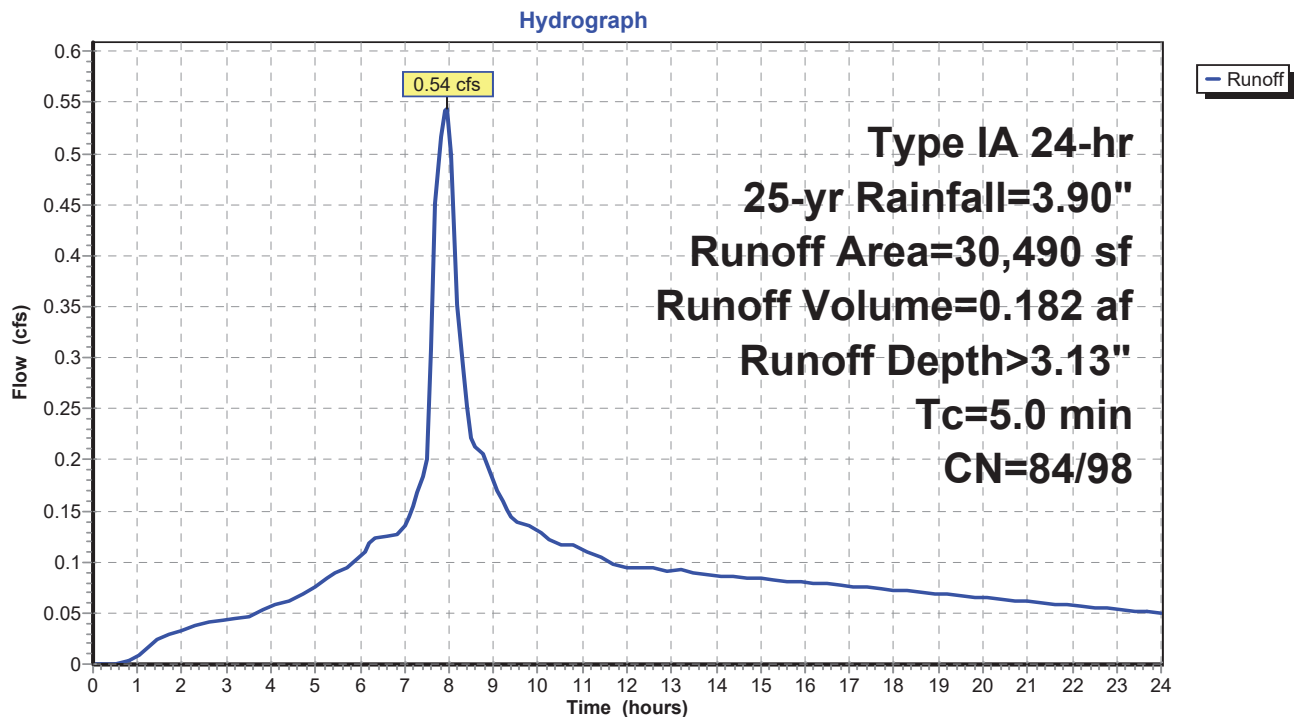
Runoff = 0.54 cfs @ 7.94 hrs, Volume= 0.182 af, Depth> 3.13"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 25-yr Rainfall=3.90"

Area (sf)	CN	Description
18,740	98	Water Surface, HSG D
11,750	84	50-75% Grass cover, Fair, HSG D
30,490	93	Weighted Average
11,750	84	38.54% Pervious Area
18,740	98	61.46% Impervious Area

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

Subcatchment 48S: Stormwater Basin



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Bridge Point I-5 hydrological calcs
Type IA 24-hr 25-yr Rainfall=3.90"

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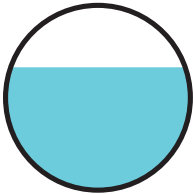
Summary for Reach 48R: Existing Outfall Pipe

Inflow Area = 31.867 ac, 97.14% Impervious, Inflow Depth > 3.32" for 25-yr event
Inflow = 22.62 cfs @ 7.93 hrs, Volume= 8.819 af
Outflow = 22.62 cfs @ 7.93 hrs, Volume= 8.818 af, Atten= 0%, Lag= 0.1 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Max. Velocity= 6.53 fps, Min. Travel Time= 0.1 min
Avg. Velocity= 4.13 fps, Avg. Travel Time= 0.2 min

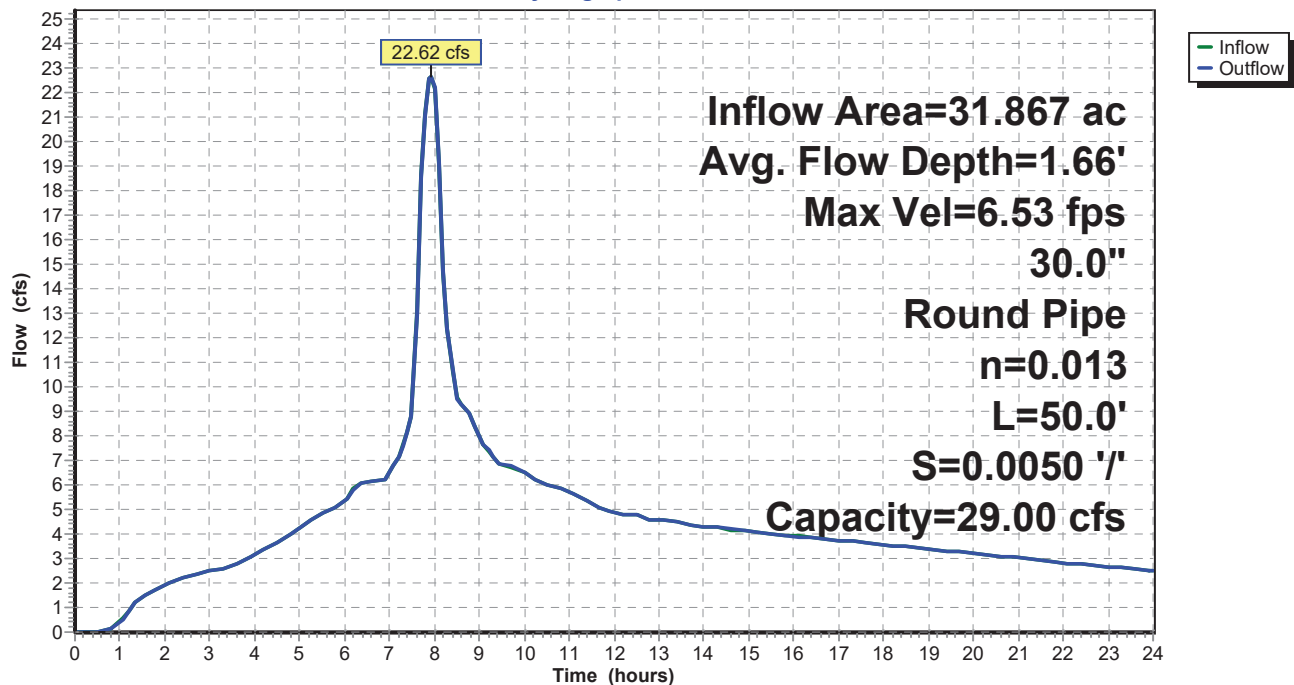
Peak Storage= 173 cf @ 7.93 hrs
Average Depth at Peak Storage= 1.66'
Bank-Full Depth= 2.50' Flow Area= 4.9 sf, Capacity= 29.00 cfs

30.0" Round Pipe
n= 0.013 Concrete pipe, bends & connections
Length= 50.0' Slope= 0.0050 '/
Inlet Invert= 28.75', Outlet Invert= 28.50'



Reach 48R: Existing Outfall Pipe

Hydrograph



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Type IA 24-hr 25-yr Rainfall=3.90"

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Summary for Reach 49R: swale cross-section

Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min

Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs

Average Depth at Peak Storage= 0.00'

Bank-Full Depth= 1.25' Flow Area= 7.2 sf, Capacity= 3.09 cfs

2.00' x 1.25' deep channel, n= 0.025 Earth, clean & winding

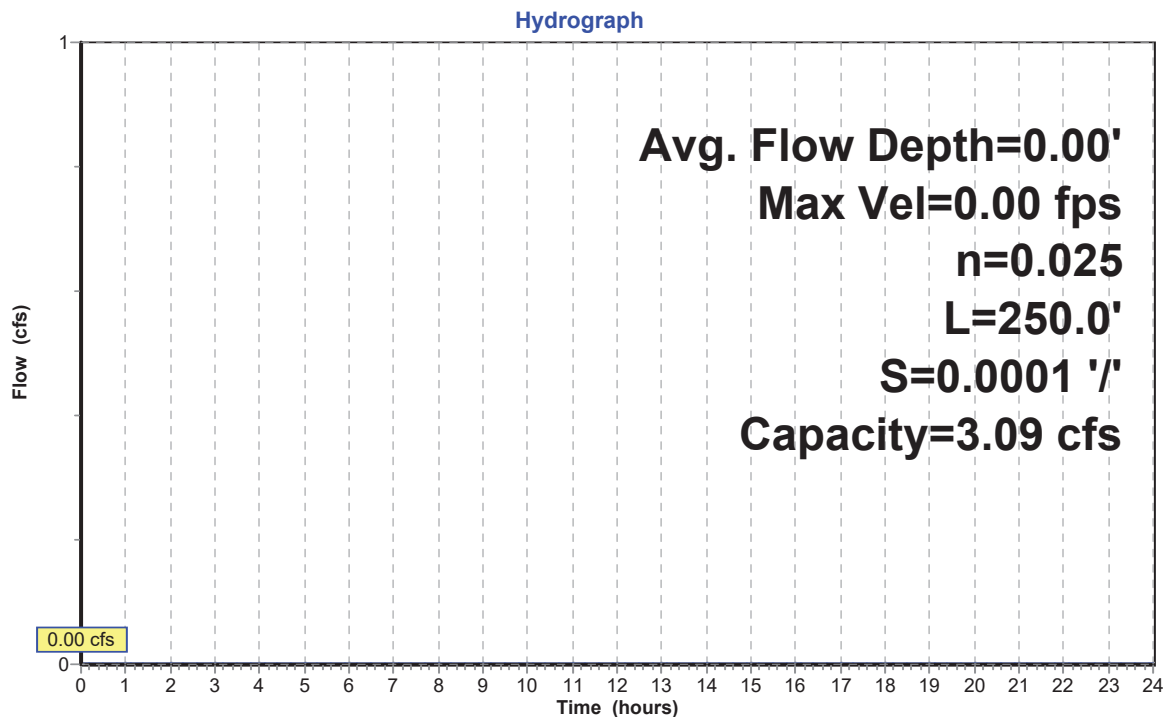
Side Slope Z-value= 3.0 '/' Top Width= 9.50'

Length= 250.0' Slope= 0.0001 '/'

Inlet Invert= 52.00', Outlet Invert= 51.98'



Reach 49R: swale cross-section



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Type IA 24-hr 25-yr Rainfall=3.90"

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Summary for Pond 31P: swale 2

Inflow Area = 5.202 ac, 93.99% Impervious, Inflow Depth > 3.58" for 25-yr event
Inflow = 4.65 cfs @ 7.92 hrs, Volume= 1.550 af
Outflow = 4.68 cfs @ 7.95 hrs, Volume= 1.537 af, Atten= 0%, Lag= 1.6 min
Primary = 0.16 cfs @ 7.95 hrs, Volume= 0.257 af
Secondary = 3.75 cfs @ 7.95 hrs, Volume= 0.496 af
Tertiary = 0.77 cfs @ 7.95 hrs, Volume= 0.785 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Peak Elev= 48.81' @ 7.95 hrs Surf.Area= 3,468 sf Storage= 1,156 cf

Plug-Flow detention time= 15.2 min calculated for 1.531 af (99% of inflow)
Center-of-Mass det. time= 8.7 min (674.6 - 665.9)

Volume	Invert	Avail.Storage	Storage Description	
#1	48.35'	5,590 cf	Custom Stage Data (Conic) Listed below (Recalc)	
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
48.35	1,690	0	0	1,690
49.60	8,040	5,590	5,590	8,047

Device	Routing	Invert	Outlet Devices
#1	Primary	48.35'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	48.68'	8.0" Horiz. Orifice/Grate X 12.00 C= 0.600 Limited to weir flow at low heads
#3	Tertiary	48.35'	18.0" Round Culvert L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 48.35' / 48.15' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=0.16 cfs @ 7.95 hrs HW=48.81' TW=47.30' (Dynamic Tailwater)

↑**1=Exfiltration** (Exfiltration Controls 0.16 cfs)

Secondary OutFlow Max=3.68 cfs @ 7.95 hrs HW=48.81' TW=47.30' (Dynamic Tailwater)

↑**2=Orifice/Grate** (Weir Controls 3.68 cfs @ 1.16 fps)

Tertiary OutFlow Max=0.77 cfs @ 7.95 hrs HW=48.81' TW=47.18' (Dynamic Tailwater)

↑**3=Culvert** (Barrel Controls 0.77 cfs @ 2.53 fps)

Bridge Point I-5 Hydrological calcs

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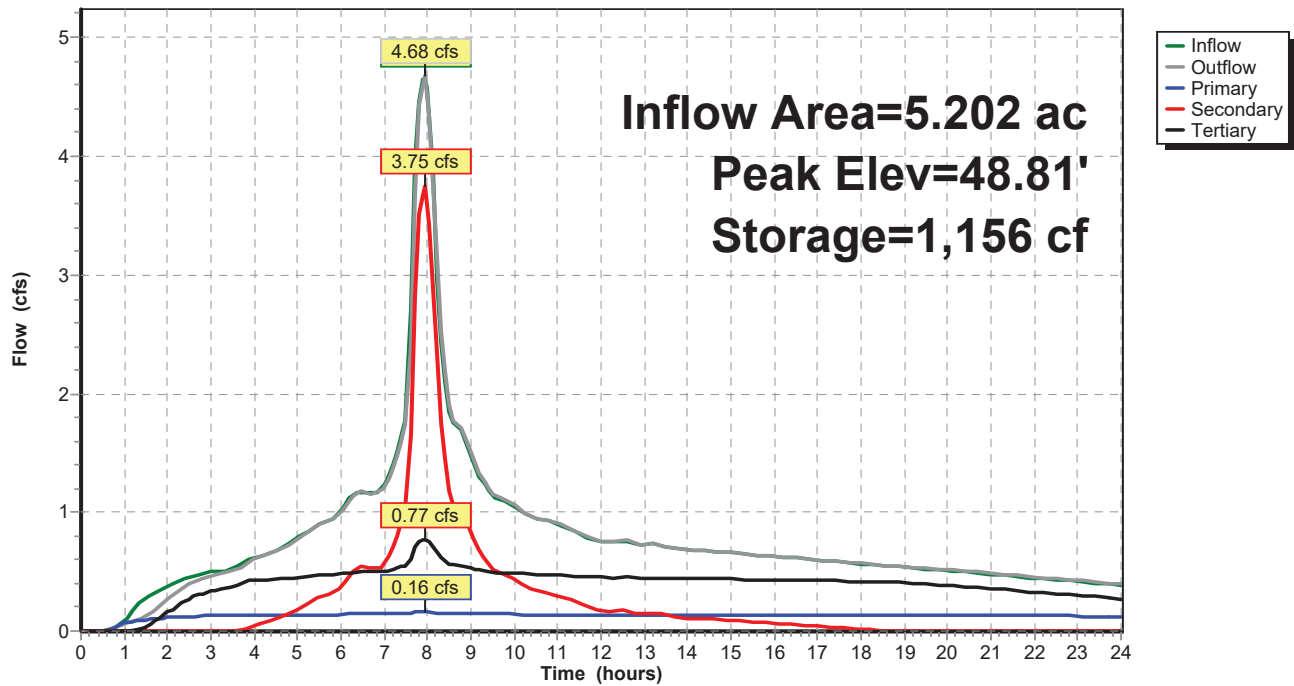
Bridge Point I-5 hydrological calcs
Type IA 24-hr 25-yr Rainfall=3.90"

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Pond 31P: swale 2

Hydrograph



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Bridge Point I-5 hydrological calcs

Type IA 24-hr 25-yr Rainfall=3.90"

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Summary for Pond 34P: drainage layer

Inflow Area = 5.202 ac, 93.99% Impervious, Inflow Depth > 1.74" for 25-yr event
Inflow = 3.91 cfs @ 7.95 hrs, Volume= 0.752 af
Outflow = 4.01 cfs @ 7.98 hrs, Volume= 0.744 af, Atten= 0%, Lag= 1.5 min
Primary = 0.28 cfs @ 10.01 hrs, Volume= 0.357 af
Secondary = 3.78 cfs @ 7.98 hrs, Volume= 0.388 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Peak Elev= 48.17' @ 10.01 hrs Surf.Area= 1,690 sf Storage= 837 cf

Plug-Flow detention time= 26.6 min calculated for 0.741 af (99% of inflow)

Center-of-Mass det. time= 18.1 min (617.3 - 599.2)

Volume	Invert	Avail.Storage	Storage Description
#1	45.35'	837 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 2,535 cf Overall x 33.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
45.35	1,690	0	0
46.85	1,690	2,535	2,535

Device	Routing	Invert	Outlet Devices
#1	Primary	45.35'	12.0" Round Culvert L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 45.35' / 45.10' S= 0.0050 ' S= 0.0050 ' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 1	45.35'	2.5" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Secondary	45.35'	18.0" Round Culvert L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 45.35' / 45.10' S= 0.0050 ' S= 0.0050 ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#4	Device 3	46.84'	18.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.28 cfs @ 10.01 hrs HW=48.17' TW=43.21' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 0.28 cfs of 4.55 cfs potential flow)

↑ **2=Orifice/Grate** (Orifice Controls 0.28 cfs @ 8.09 fps)

Secondary OutFlow Max=2.31 cfs @ 7.98 hrs HW=47.34' TW=47.23' (Dynamic Tailwater)

↑ **3=Culvert** (Inlet Controls 2.31 cfs @ 1.31 fps)

↑ **4=Orifice/Grate** (Passes 2.31 cfs of 2.92 cfs potential flow)

Bridge Point I-5 Hydrological calcs

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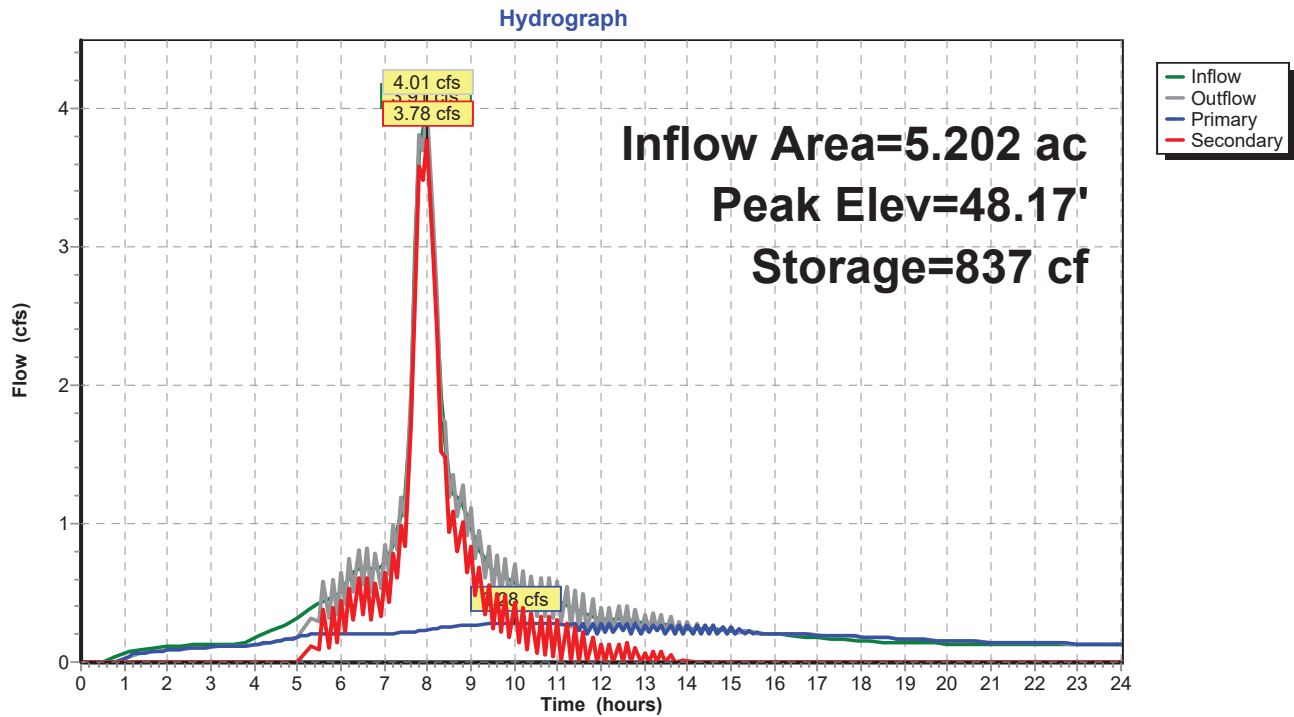
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Type IA 24-hr 25-yr Rainfall=3.90"

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Pond 34P: drainage layer



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Bridge Point I-5 hydrological calcs

Type IA 24-hr 25-yr Rainfall=3.90"

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Summary for Pond 36P: Stormwater Basin

Inflow Area = 2.810 ac, 84.93% Impervious, Inflow Depth > 8.46" for 25-yr event
Inflow = 6.99 cfs @ 7.97 hrs, Volume= 1.981 af
Outflow = 1.34 cfs @ 9.99 hrs, Volume= 1.301 af, Atten= 81%, Lag= 121.2 min
Primary = 0.62 cfs @ 9.99 hrs, Volume= 1.016 af
Secondary = 0.72 cfs @ 9.99 hrs, Volume= 0.285 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Peak Elev= 48.17' @ 9.99 hrs Surf.Area= 13,322 sf Storage= 32,286 cf

Plug-Flow detention time= 351.0 min calculated for 1.301 af (66% of inflow)

Center-of-Mass det. time= 147.2 min (813.9 - 666.7)

Volume	Invert	Avail.Storage	Storage Description
#1	45.00'	60,466 cf	Custom Stage Data (Conic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
45.00	7,340	0	0	7,340
50.00	17,580	60,466	60,466	17,761

Device	Routing	Invert	Outlet Devices
#1	Primary	45.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	48.00'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.62 cfs @ 9.99 hrs HW=48.17' TW=43.46' (Dynamic Tailwater)

↑**1=Exfiltration** (Exfiltration Controls 0.62 cfs)

Secondary OutFlow Max=0.72 cfs @ 9.99 hrs HW=48.17' TW=43.46' (Dynamic Tailwater)

↑**2=Orifice/Grate** (Weir Controls 0.72 cfs @ 1.35 fps)

Bridge Point I-5 Hydrological calcs

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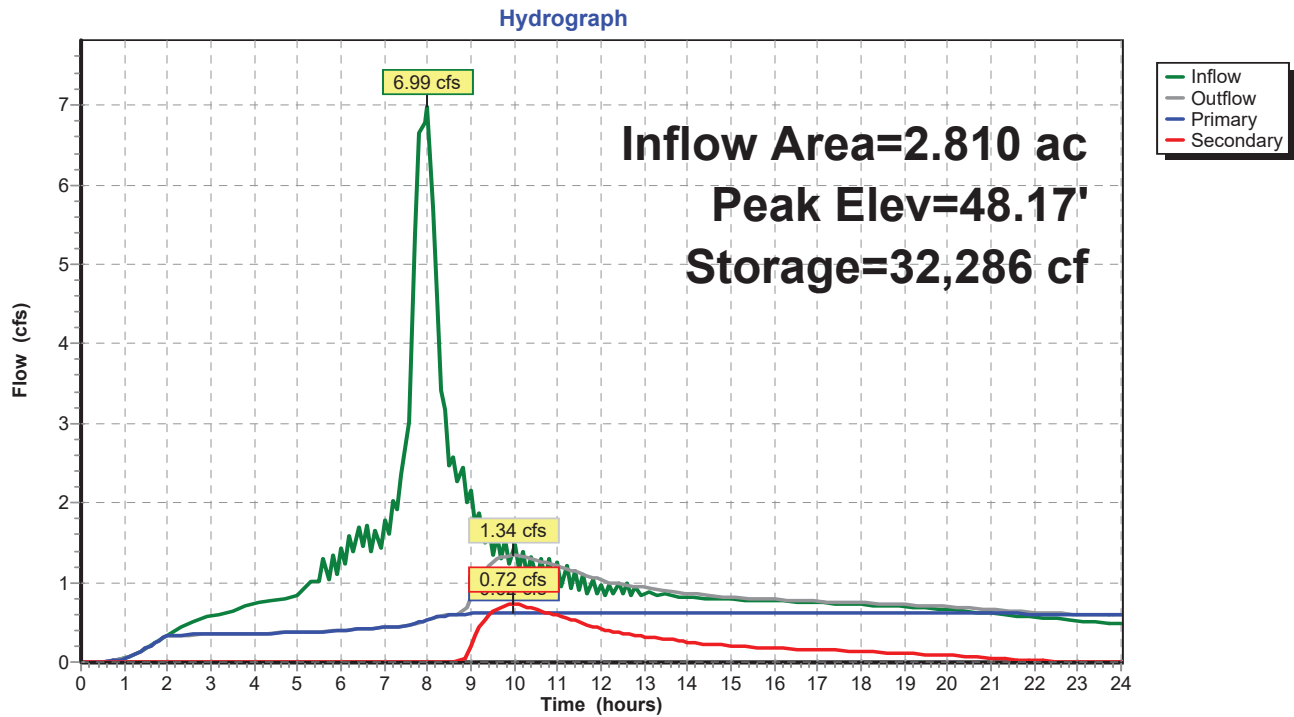
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Pond 36P: Stormwater Basin



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Bridge Point I-5 hydrological calcs

Type IA 24-hr 25-yr Rainfall=3.90"

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Summary for Pond 37P: swale 1

Inflow Area = 0.860 ac, 92.42% Impervious, Inflow Depth > 3.55" for 25-yr event
Inflow = 0.76 cfs @ 7.92 hrs, Volume= 0.255 af
Outflow = 0.76 cfs @ 7.96 hrs, Volume= 0.249 af, Atten= 0%, Lag= 2.2 min
Primary = 0.06 cfs @ 7.96 hrs, Volume= 0.092 af
Secondary = 0.70 cfs @ 7.96 hrs, Volume= 0.157 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Peak Elev= 53.27' @ 7.96 hrs Surf.Area= 1,273 sf Storage= 410 cf

Plug-Flow detention time= 33.0 min calculated for 0.248 af (97% of inflow)

Center-of-Mass det. time= 15.2 min (682.2 - 667.1)

Volume	Invert	Avail.Storage	Storage Description
#1	52.80'	1,396 cf	Custom Stage Data (Conic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
52.80	530	0	0	530
53.80	2,505	1,396	1,396	2,509

Device	Routing	Invert	Outlet Devices
#1	Primary	52.80'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	53.13'	8.0" Horiz. Orifice/Grate X 2.00 C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.06 cfs @ 7.96 hrs HW=53.27' TW=50.84' (Dynamic Tailwater)

↑**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Secondary OutFlow Max=0.70 cfs @ 7.96 hrs HW=53.27' TW=50.84' (Dynamic Tailwater)

↑**2=Orifice/Grate** (Weir Controls 0.70 cfs @ 1.21 fps)

Bridge Point I-5 Hydrological calcs

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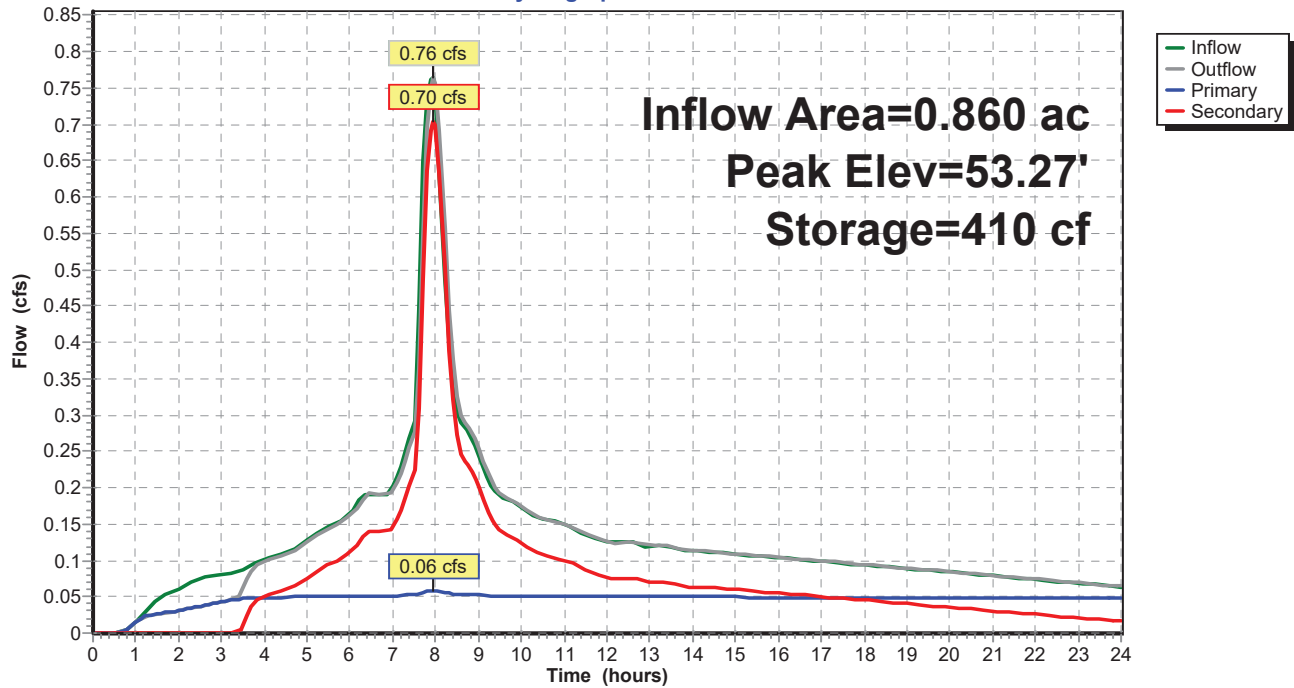
Bridge Point I-5 hydrological calcs
Type IA 24-hr 25-yr Rainfall=3.90"

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Pond 37P: swale 1

Hydrograph



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Bridge Point I-5 hydrological calcs

Type IA 24-hr 25-yr Rainfall=3.90"

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Summary for Pond 38P: drainage layer

Inflow Area = 0.860 ac, 92.42% Impervious, Inflow Depth > 3.47" for 25-yr event
Inflow = 0.76 cfs @ 7.96 hrs, Volume= 0.249 af
Outflow = 0.76 cfs @ 7.97 hrs, Volume= 0.248 af, Atten= 0%, Lag= 0.7 min
Primary = 0.76 cfs @ 7.97 hrs, Volume= 0.248 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Peak Elev= 50.84' @ 7.97 hrs Surf.Area= 530 sf Storage= 94 cf

Plug-Flow detention time= 4.5 min calculated for 0.248 af (100% of inflow)

Center-of-Mass det. time= 2.7 min (684.9 - 682.2)

Volume	Invert	Avail.Storage	Storage Description
#1	50.30'	175 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 530 cf Overall x 33.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
50.30	530	0	0
51.30	530	530	530

Device	Routing	Invert	Outlet Devices
#1	Primary	50.30'	12.0" Round Culvert L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 50.30' / 50.05' S= 0.0050 ' S= 0.0050 ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.75 cfs @ 7.97 hrs HW=50.84' TW=44.30' (Dynamic Tailwater)

↑**1=Culvert** (Barrel Controls 0.75 cfs @ 2.55 fps)

Bridge Point I-5 Hydrological calcs

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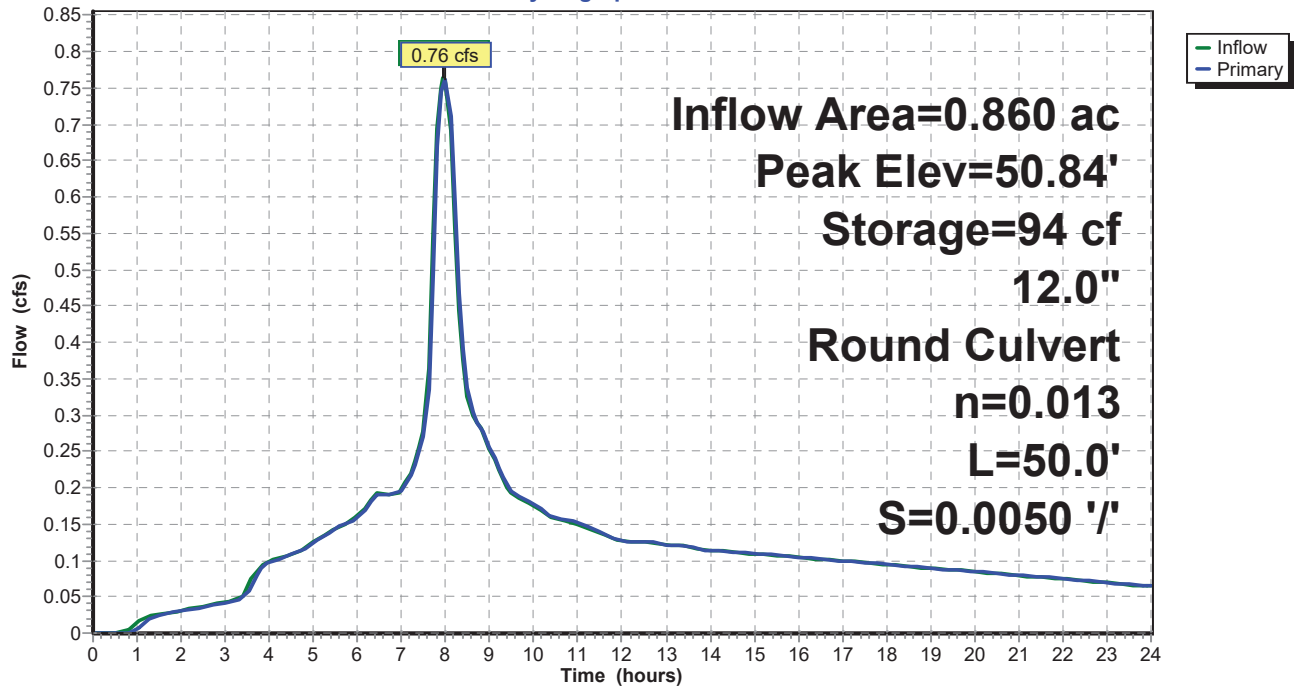
Bridge Point I-5 hydrological calcs
Type IA 24-hr 25-yr Rainfall=3.90"

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Pond 38P: drainage layer

Hydrograph



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 25-yr Rainfall=3.90"

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Summary for Pond 39P: MH upstream of Private Outfall

Inflow Area = 31.867 ac, 97.14% Impervious, Inflow Depth > 3.32" for 25-yr event
Inflow = 22.62 cfs @ 7.93 hrs, Volume= 8.819 af
Outflow = 22.62 cfs @ 7.93 hrs, Volume= 8.819 af, Atten= 0%, Lag= 0.0 min
Primary = 22.62 cfs @ 7.93 hrs, Volume= 8.819 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

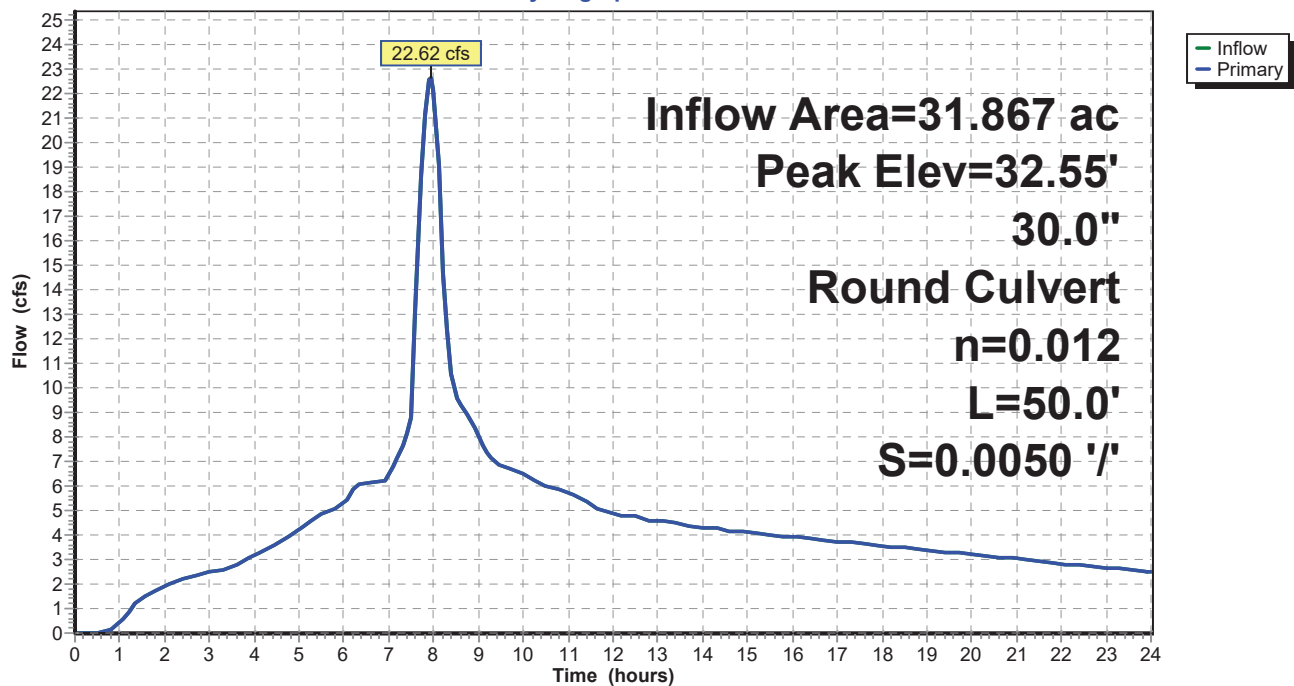
Peak Elev= 32.55' @ 7.93 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	30.00'	30.0" Round RCP_Round 30" L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 30.00' / 29.75' S= 0.0050 '/ Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 4.91 sf

Primary OutFlow Max=22.44 cfs @ 7.93 hrs HW=32.53' TW=30.40' (Dynamic Tailwater)
↑1=RCP_Round 30" (Barrel Controls 22.44 cfs @ 5.61 fps)

Pond 39P: MH upstream of Private Outfall

Hydrograph



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 25-yr Rainfall=3.90"

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Summary for Pond 40P: (new Pond)

Inflow Area = 24.369 ac, 96.71% Impervious, Inflow Depth > 3.22" for 25-yr event
Inflow = 15.80 cfs @ 7.93 hrs, Volume= 6.545 af
Outflow = 15.80 cfs @ 7.93 hrs, Volume= 6.545 af, Atten= 0%, Lag= 0.0 min
Primary = 15.80 cfs @ 7.93 hrs, Volume= 6.545 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

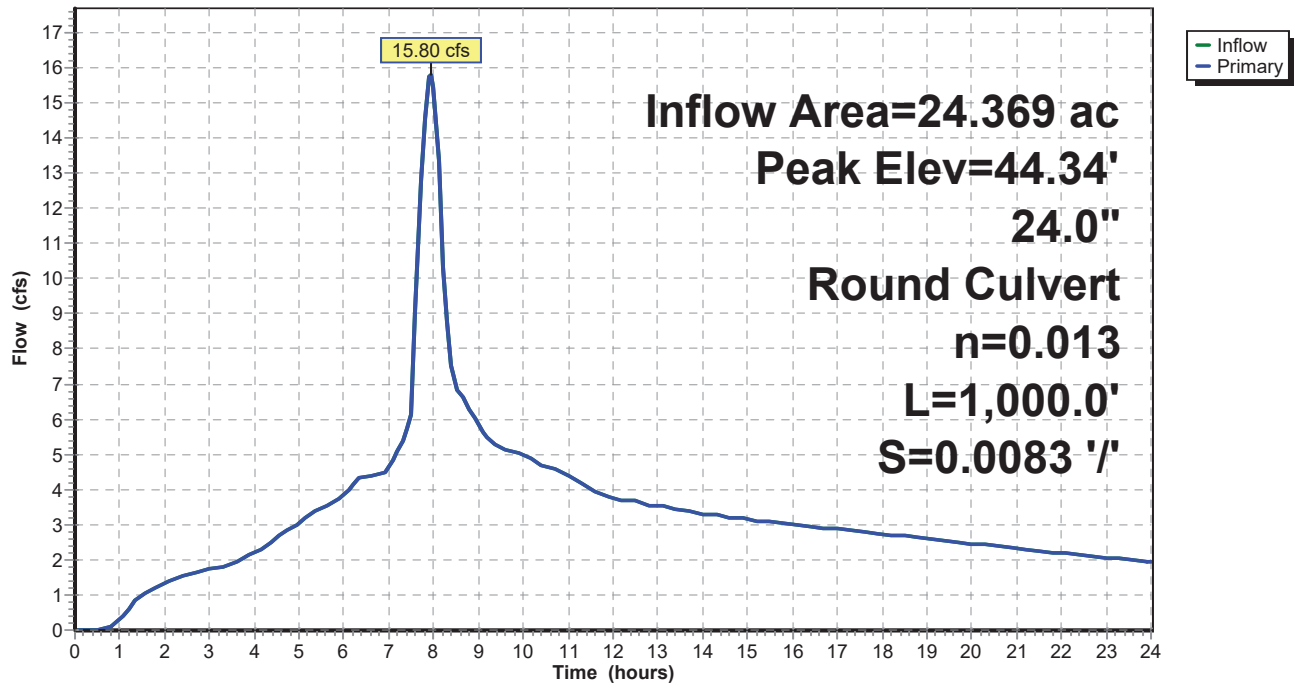
Peak Elev= 44.34' @ 7.93 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	42.25'	24.0" Round Culvert L= 1,000.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 42.25' / 34.00' S= 0.0083 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=15.64 cfs @ 7.93 hrs HW=44.32' TW=32.53' (Dynamic Tailwater)
↑**1=Culvert** (Inlet Controls 15.64 cfs @ 4.98 fps)

Pond 40P: (new Pond)

Hydrograph



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs

Type IA 24-hr 25-yr Rainfall=3.90"

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Summary for Pond 43P: drainage layer

Inflow Area = 2.810 ac, 84.93% Impervious, Inflow Depth > 5.56" for 25-yr event
Inflow = 1.34 cfs @ 9.99 hrs, Volume= 1.301 af
Outflow = 1.37 cfs @ 10.23 hrs, Volume= 1.215 af, Atten= 0%, Lag= 14.3 min
Primary = 1.37 cfs @ 10.23 hrs, Volume= 1.215 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Peak Elev= 44.37' @ 8.04 hrs Surf.Area= 7,340 sf Storage= 4,844 cf

Plug-Flow detention time= 94.5 min calculated for 1.210 af (93% of inflow)

Center-of-Mass det. time= 53.8 min (867.7 - 813.9)

Volume	Invert	Avail.Storage	Storage Description
#1	41.50'	4,844 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 14,680 cf Overall x 33.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
41.50	7,340	0	0
43.50	7,340	14,680	14,680

Device	Routing	Invert	Outlet Devices
#1	Primary	42.50'	12.0" Round Culvert L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 42.50' / 42.25' S= 0.0050 ' S= 0.0050 ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.39 cfs @ 10.23 hrs HW=43.45' TW=43.19' (Dynamic Tailwater)

↑**1=Culvert** (Outlet Controls 1.39 cfs @ 2.31 fps)

Bridge Point I-5 Hydrological calcs

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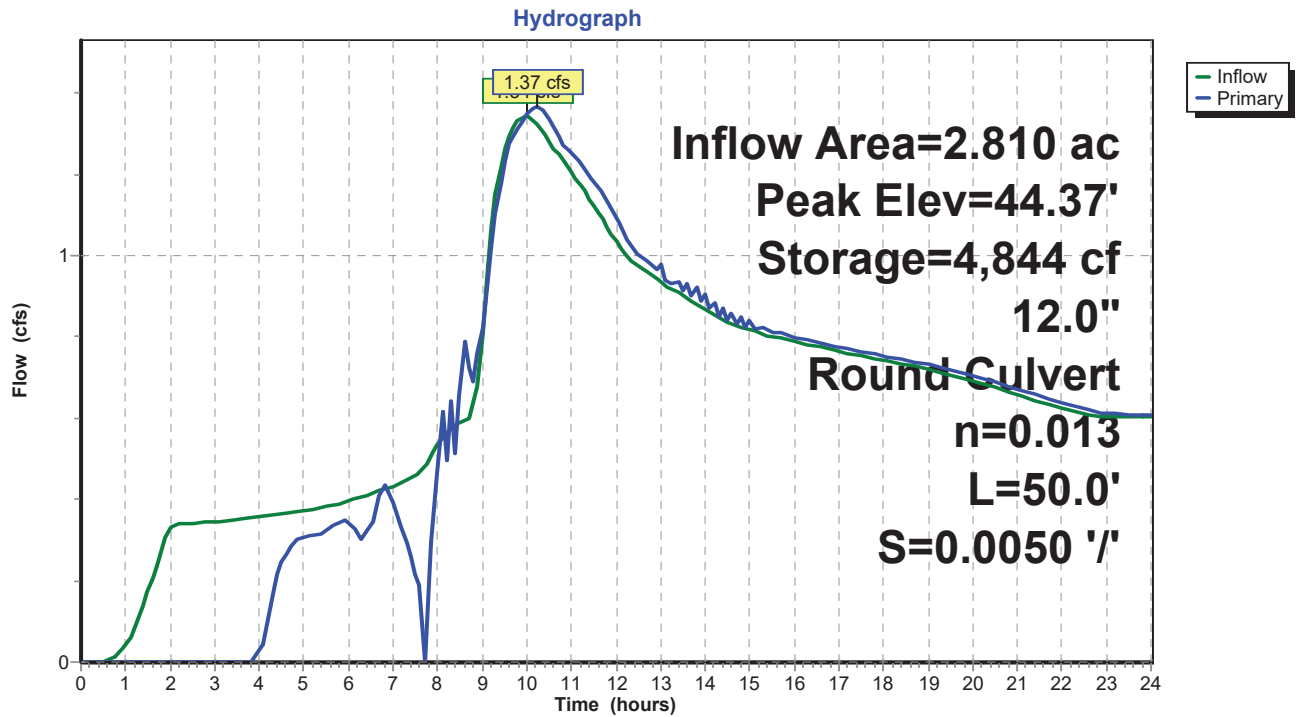
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Bridge Point I-5 hydrological calcs
Type IA 24-hr 25-yr Rainfall=3.90"

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Pond 43P: drainage layer



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 25-yr Rainfall=3.90"

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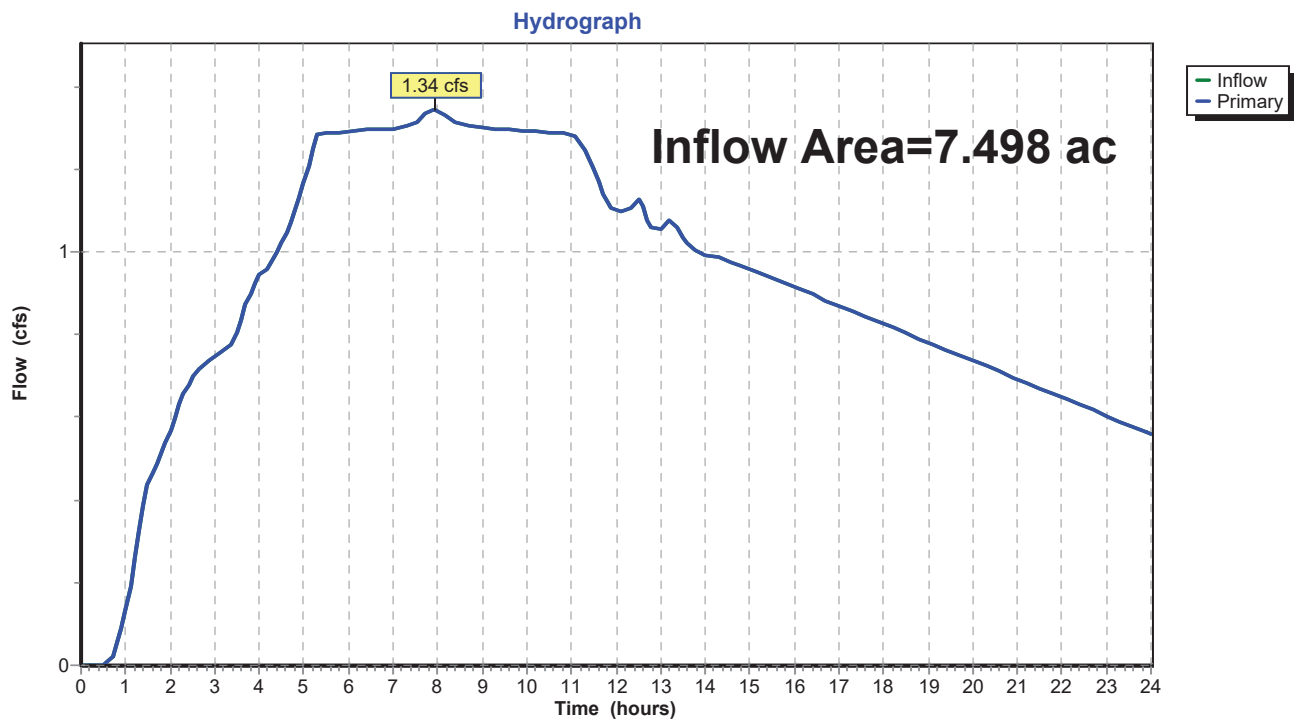
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Summary for Pond 45P: stormfilter vault

Inflow Area = 7.498 ac, 98.52% Impervious, Inflow Depth > 2.89" for 25-yr event
Inflow = 1.34 cfs @ 7.92 hrs, Volume= 1.808 af
Primary = 1.34 cfs @ 7.92 hrs, Volume= 1.808 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Pond 45P: stormfilter vault



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs

Type IA 24-hr 25-yr Rainfall=3.90"

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Summary for Pond 47P: flow diversion MH 1

Inflow Area = 7.498 ac, 98.52% Impervious, Inflow Depth > 3.64" for 25-yr event
Inflow = 6.83 cfs @ 7.92 hrs, Volume= 2.274 af
Outflow = 6.83 cfs @ 7.92 hrs, Volume= 2.274 af, Atten= 0%, Lag= 0.0 min
Primary = 1.34 cfs @ 7.92 hrs, Volume= 1.808 af
Secondary = 5.49 cfs @ 7.92 hrs, Volume= 0.466 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Peak Elev= 35.01' @ 7.92 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	30.10'	8.0" Round Culvert L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 30.10' / 30.00' S= 0.0050 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Device 1	30.10'	4.8" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Secondary	30.10'	24.0" Round Culvert L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 30.10' / 30.00' S= 0.0050 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#4	Device 3	34.60'	24.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.34 cfs @ 7.92 hrs HW=35.01' TW=0.00' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 1.34 cfs of 2.84 cfs potential flow)

↑ **2=Orifice/Grate** (Orifice Controls 1.34 cfs @ 10.67 fps)

Secondary OutFlow Max=5.46 cfs @ 7.92 hrs HW=35.01' TW=32.53' (Dynamic Tailwater)

↑ **3=Culvert** (Passes 5.46 cfs of 18.81 cfs potential flow)

↑ **4=Orifice/Grate** (Weir Controls 5.46 cfs @ 2.10 fps)

Bridge Point I-5 Hydrological calcs

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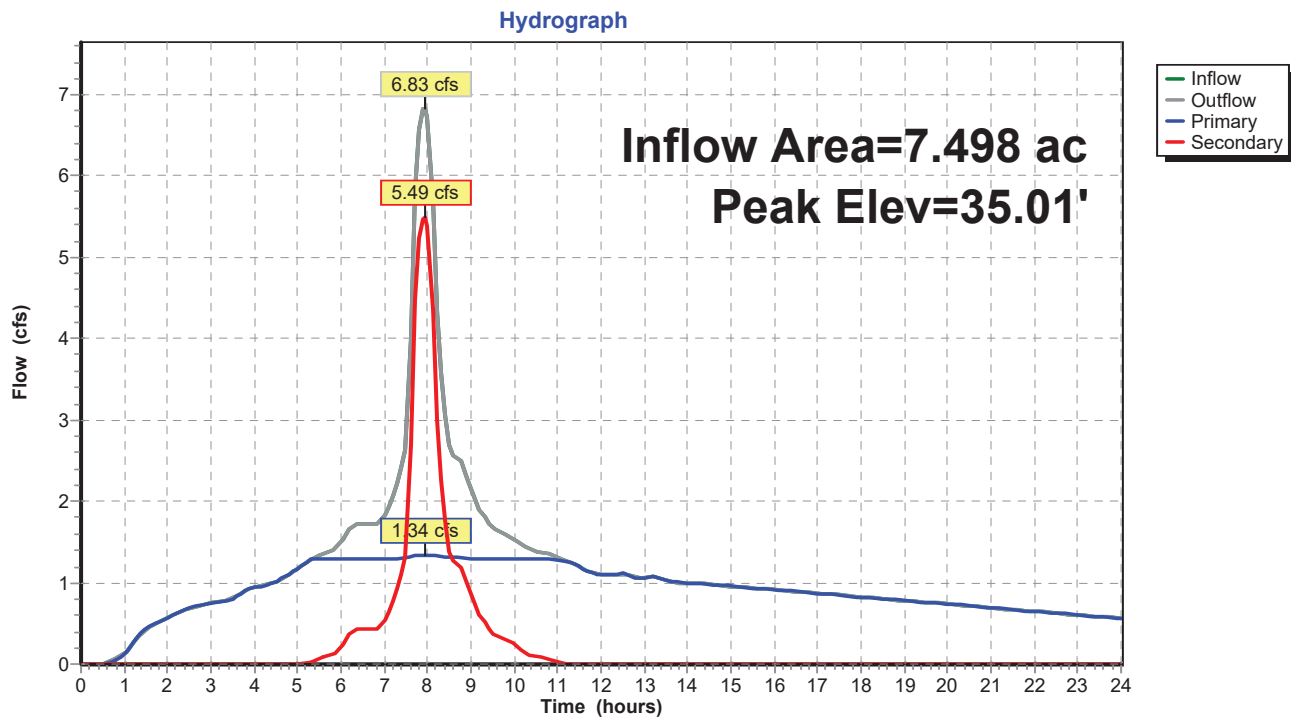
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Bridge Point I-5 hydrological calcs
Type IA 24-hr 25-yr Rainfall=3.90"

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Pond 47P: flow diversion MH 1



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 100-Yr Rainfall=4.40"

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Summary for Subcatchment 32S: Basin 5 Area - West

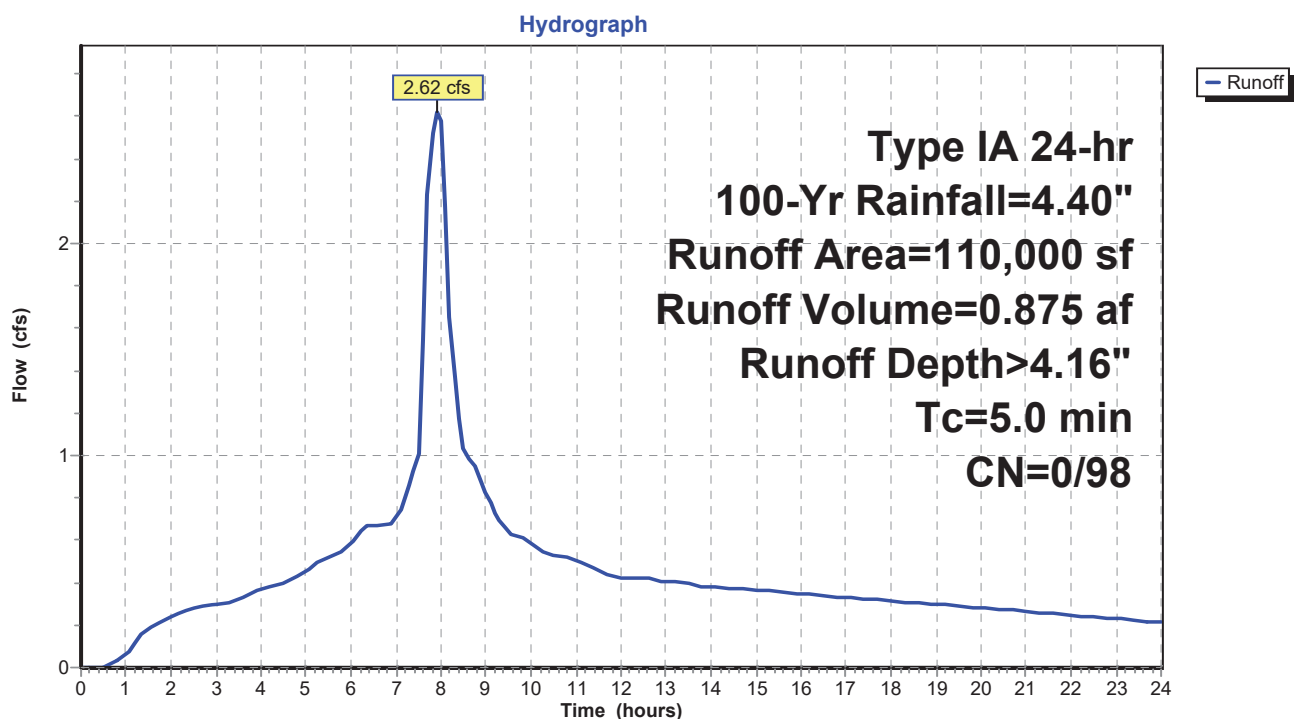
Runoff = 2.62 cfs @ 7.92 hrs, Volume= 0.875 af, Depth> 4.16"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 100-Yr Rainfall=4.40"

Area (sf)	CN	Description
110,000	98	Paved parking, HSG C
110,000	98	100.00% Impervious Area

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

Subcatchment 32S: Basin 5 Area - West



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs

Type IA 24-hr 100-Yr Rainfall=4.40"

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Summary for Subcatchment 34S: Basin 1

Runoff = 0.87 cfs @ 7.92 hrs, Volume= 0.290 af, Depth> 4.05"

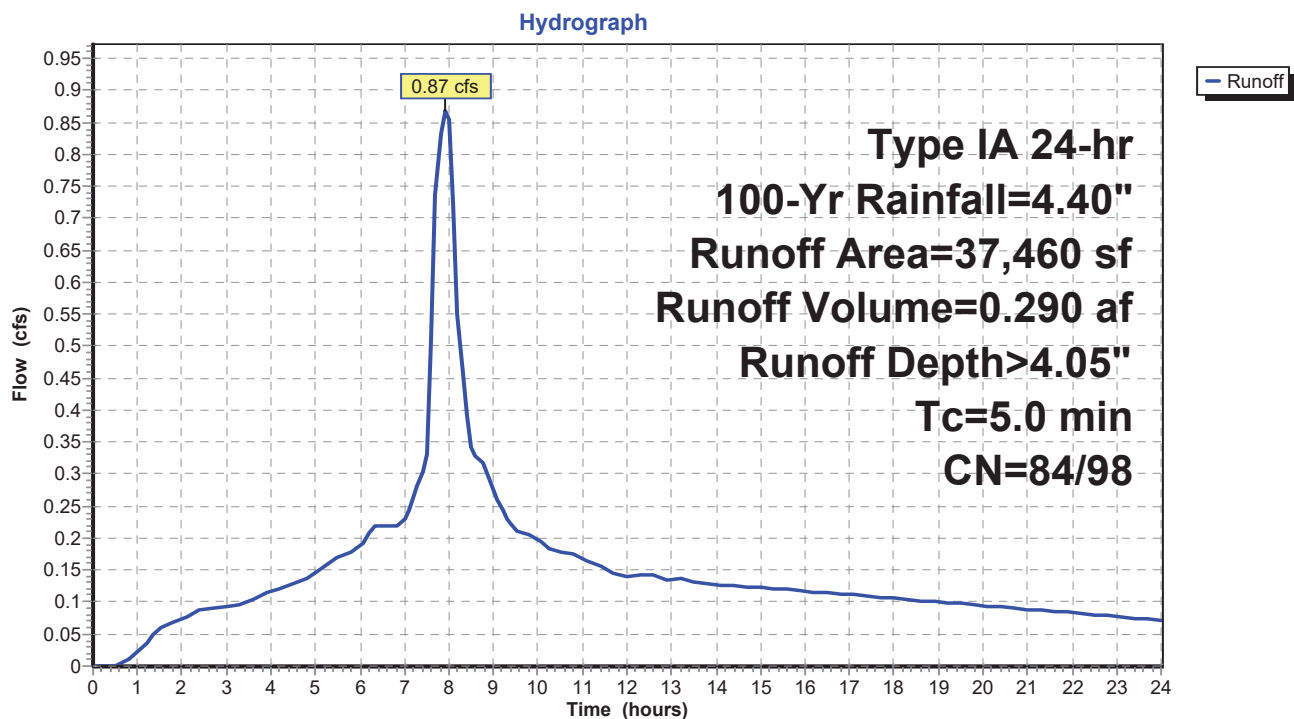
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Type IA 24-hr 100-Yr Rainfall=4.40"

Area (sf)	CN	Description
34,620	98	Paved parking, HSG D
2,840	84	50-75% Grass cover, Fair, HSG D
37,460	97	Weighted Average
2,840	84	7.58% Pervious Area
34,620	98	92.42% Impervious Area

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

Subcatchment 34S: Basin 1



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs

Type IA 24-hr 100-Yr Rainfall=4.40"

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Summary for Subcatchment 36S: Basin 4

Runoff = 0.51 cfs @ 7.92 hrs, Volume= 0.169 af, Depth> 4.05"

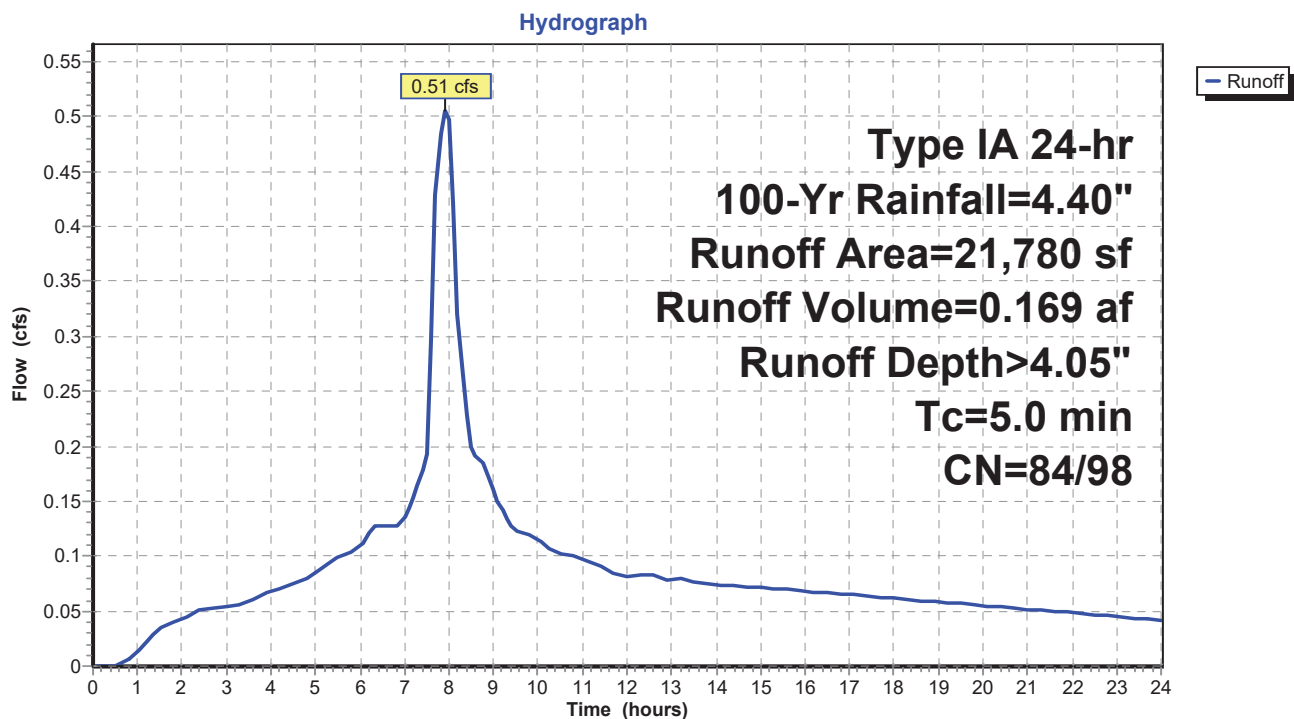
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Type IA 24-hr 100-Yr Rainfall=4.40"

Area (sf)	CN	Description
20,220	98	Paved parking, HSG D
1,560	84	50-75% Grass cover, Fair, HSG D
21,780	97	Weighted Average
1,560	84	7.16% Pervious Area
20,220	98	92.84% Impervious Area

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

Subcatchment 36S: Basin 4



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs

Type IA 24-hr 100-Yr Rainfall=4.40"

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Summary for Subcatchment 37S: Basin 2

Runoff = 1.63 cfs @ 7.92 hrs, Volume= 0.544 af, Depth> 4.05"

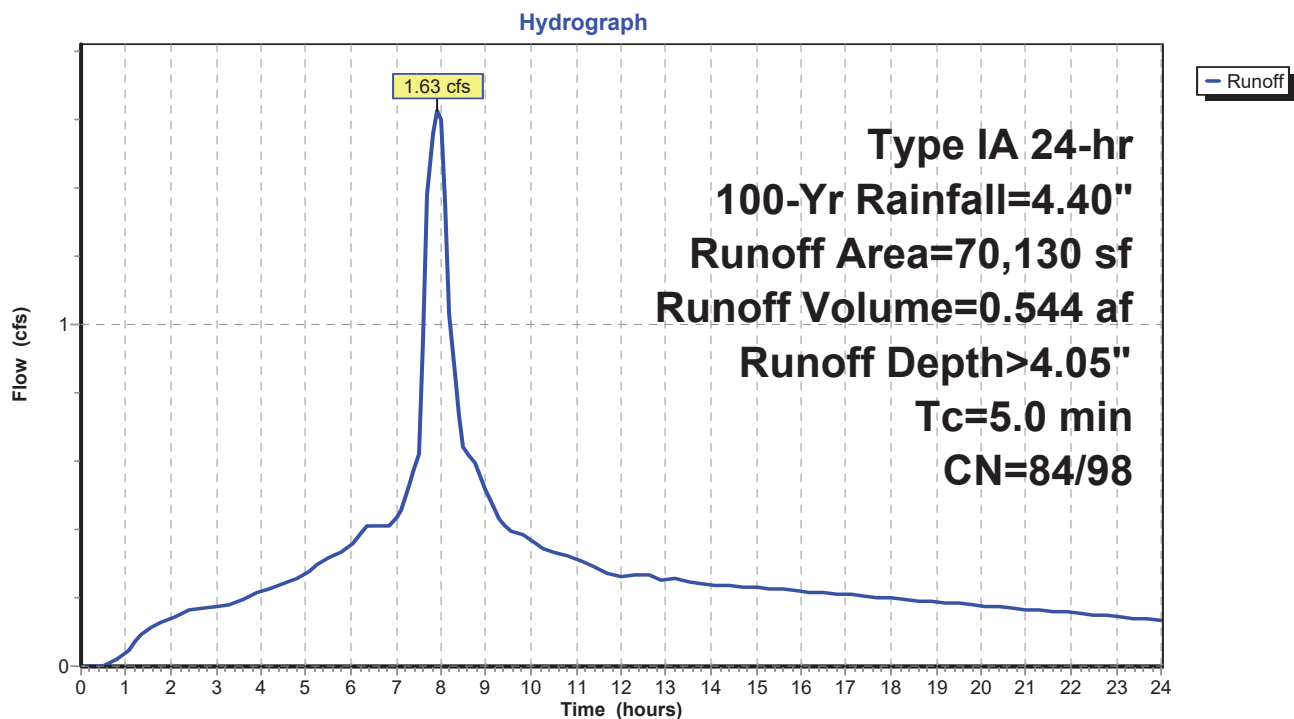
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Type IA 24-hr 100-Yr Rainfall=4.40"

Area (sf)	CN	Description
64,990	98	Paved parking, HSG D
5,140	84	50-75% Grass cover, Fair, HSG D
70,130	97	Weighted Average
5,140	84	7.33% Pervious Area
64,990	98	92.67% Impervious Area

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

Subcatchment 37S: Basin 2



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 100-Yr Rainfall=4.40"

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Summary for Subcatchment 39S: Basin 7

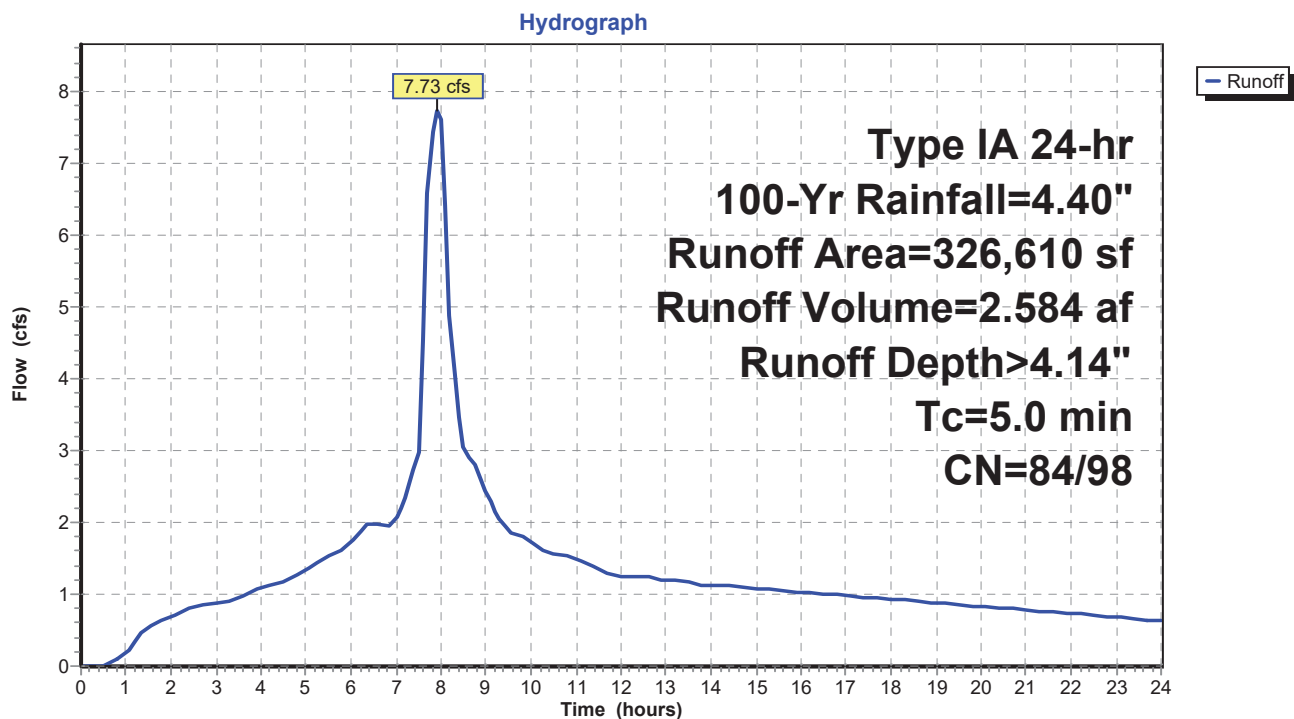
Runoff = 7.73 cfs @ 7.92 hrs, Volume= 2.584 af, Depth> 4.14"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 100-Yr Rainfall=4.40"

Area (sf)	CN	Description
321,790	98	Paved parking, HSG D
4,820	84	50-75% Grass cover, Fair, HSG D
326,610	98	Weighted Average
4,820	84	1.48% Pervious Area
321,790	98	98.52% Impervious Area

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

Subcatchment 39S: Basin 7



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 100-Yr Rainfall=4.40"

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Summary for Subcatchment 42S: Roof areas (Building A + Building B)

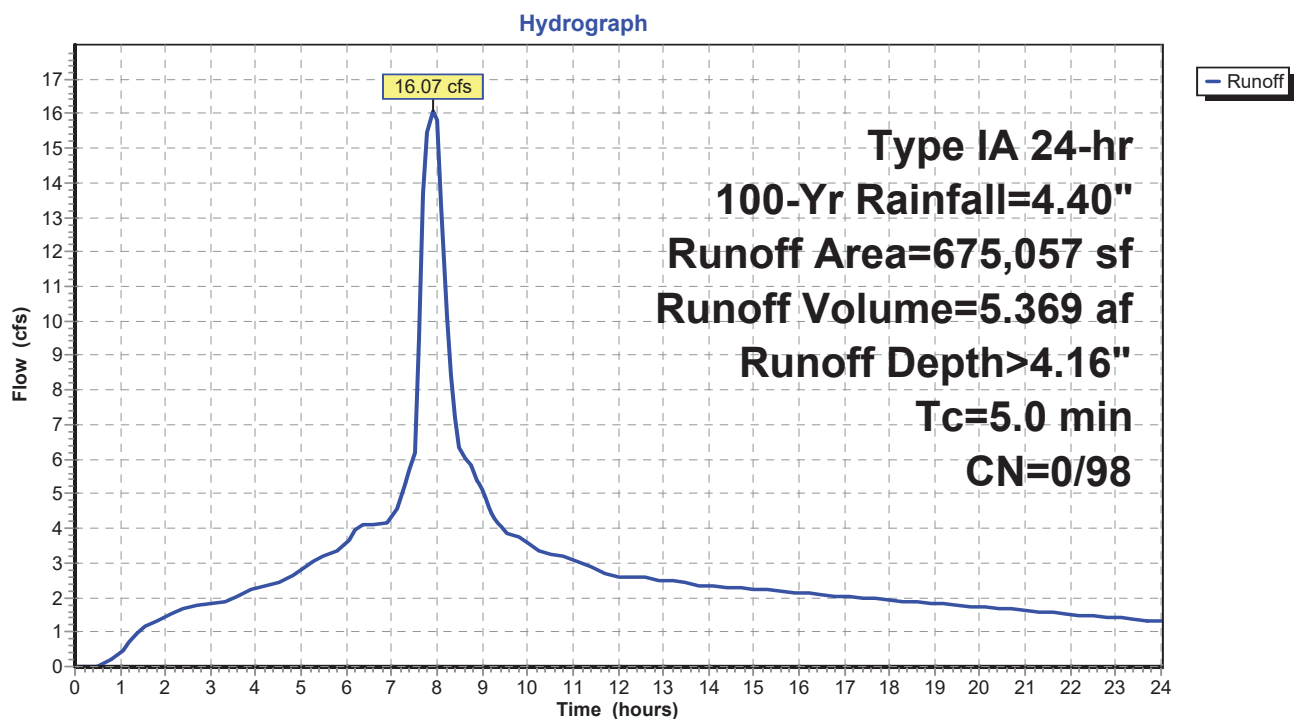
Runoff = 16.07 cfs @ 7.92 hrs, Volume= 5.369 af, Depth> 4.16"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 100-Yr Rainfall=4.40"

Area (sf)	CN	Description
439,285	98	Unconnected roofs, HSG D
235,772	98	Unconnected roofs, HSG D
675,057	98	Weighted Average
675,057	98	100.00% Impervious Area

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

Subcatchment 42S: Roof areas (Building A + Building B)



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 100-Yr Rainfall=4.40"

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Summary for Subcatchment 47S: Basin 5 Area - East

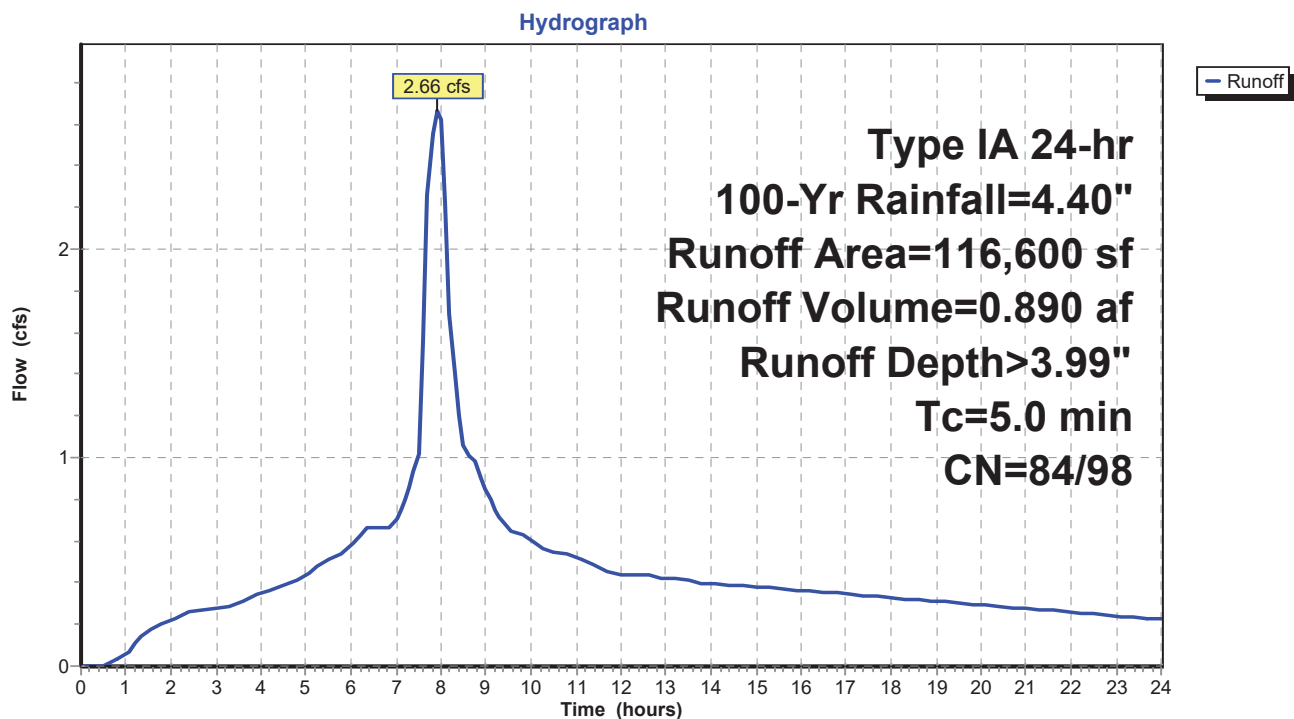
Runoff = 2.66 cfs @ 7.93 hrs, Volume= 0.890 af, Depth> 3.99"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 100-Yr Rainfall=4.40"

Area (sf)	CN	Description
102,990	98	Paved parking, HSG C
13,610	84	50-75% Grass cover, Fair, HSG D
116,600	96	Weighted Average
13,610	84	11.67% Pervious Area
102,990	98	88.33% Impervious Area

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

Subcatchment 47S: Basin 5 Area - East



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 100-Yr Rainfall=4.40"

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Summary for Subcatchment 48S: Stormwater Basin

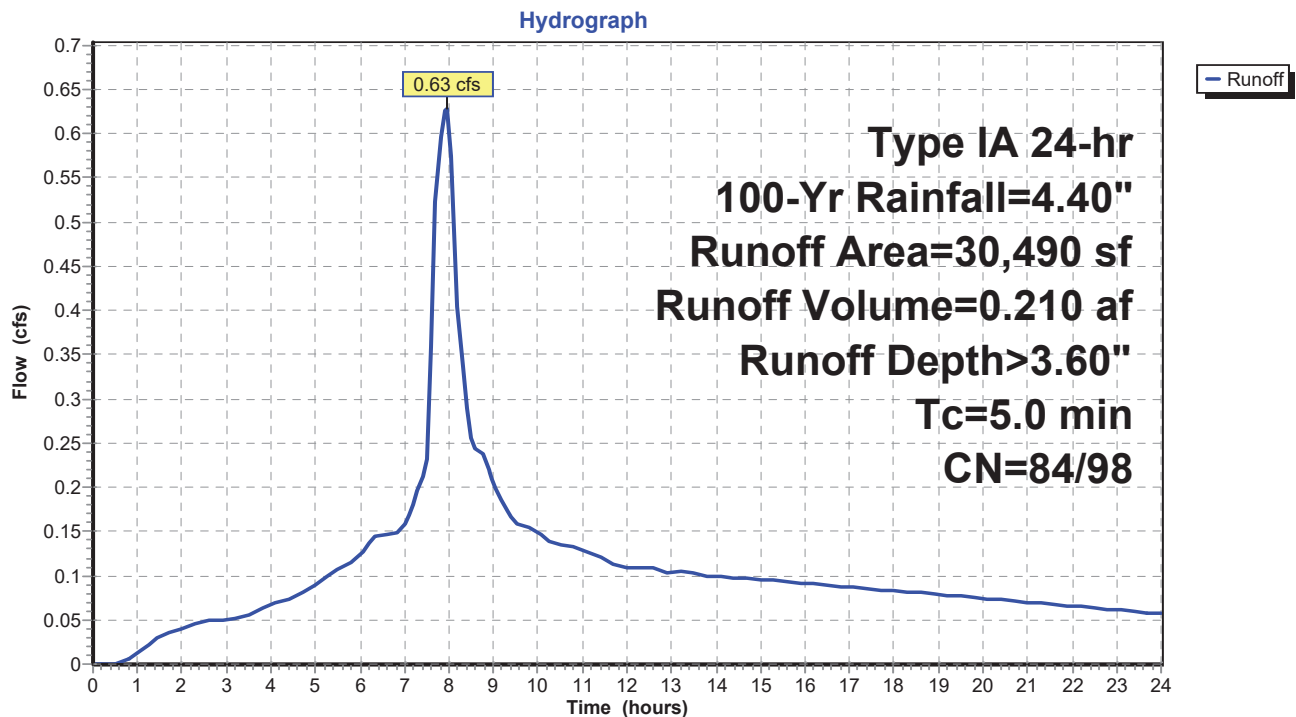
Runoff = 0.63 cfs @ 7.94 hrs, Volume= 0.210 af, Depth> 3.60"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type IA 24-hr 100-Yr Rainfall=4.40"

Area (sf)	CN	Description
18,740	98	Water Surface, HSG D
11,750	84	50-75% Grass cover, Fair, HSG D
30,490	93	Weighted Average
11,750	84	38.54% Pervious Area
18,740	98	61.46% Impervious Area

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

Subcatchment 48S: Stormwater Basin



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 100-Yr Rainfall=4.40"

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Summary for Reach 48R: Existing Outfall Pipe

Inflow Area = 31.867 ac, 97.14% Impervious, Inflow Depth > 3.81" for 100-Yr event
Inflow = 25.77 cfs @ 7.95 hrs, Volume= 10.120 af
Outflow = 25.36 cfs @ 7.95 hrs, Volume= 10.119 af, Atten= 2%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Max. Velocity= 6.66 fps, Min. Travel Time= 0.1 min

Avg. Velocity= 4.29 fps, Avg. Travel Time= 0.2 min

Peak Storage= 190 cf @ 7.95 hrs

Average Depth at Peak Storage= 1.81'

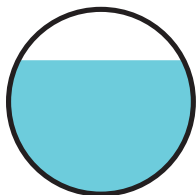
Bank-Full Depth= 2.50' Flow Area= 4.9 sf, Capacity= 29.00 cfs

30.0" Round Pipe

n= 0.013 Concrete pipe, bends & connections

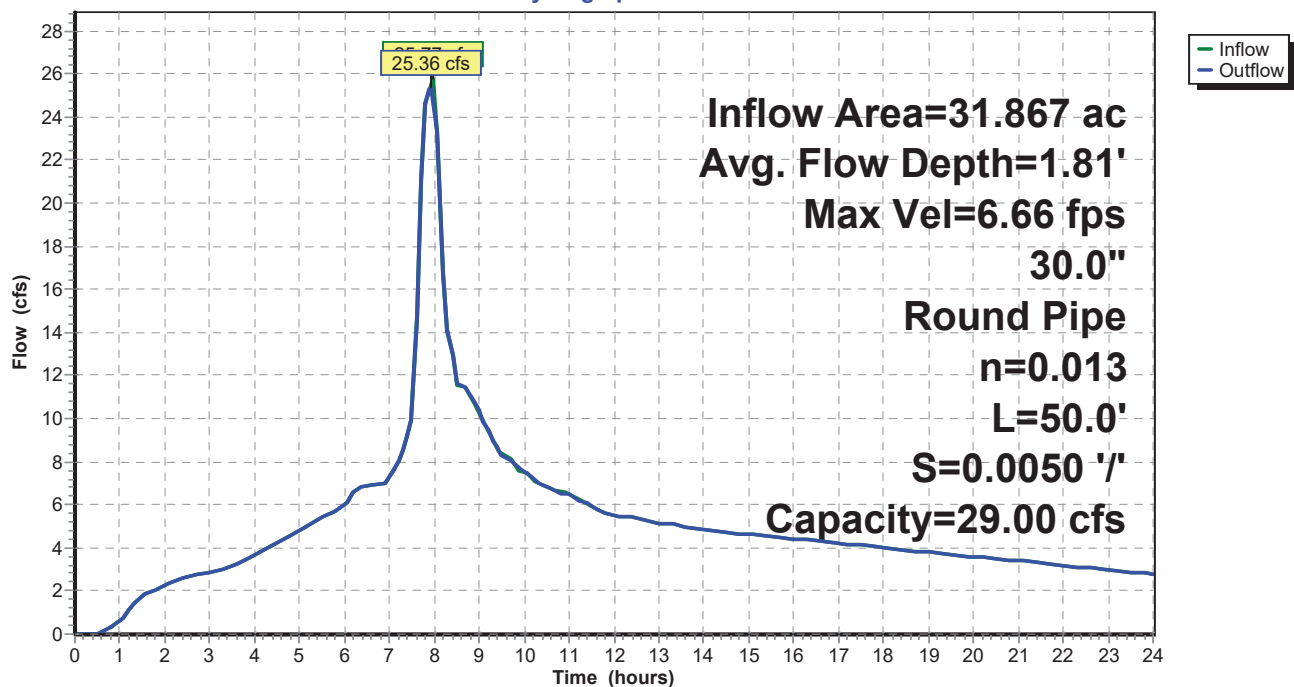
Length= 50.0' Slope= 0.0050 '/'

Inlet Invert= 28.75', Outlet Invert= 28.50'



Reach 48R: Existing Outfall Pipe

Hydrograph



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 100-Yr Rainfall=4.40"

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Summary for Reach 49R: swale cross-section

Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min

Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs

Average Depth at Peak Storage= 0.00'

Bank-Full Depth= 1.25' Flow Area= 7.2 sf, Capacity= 3.09 cfs

2.00' x 1.25' deep channel, n= 0.025 Earth, clean & winding

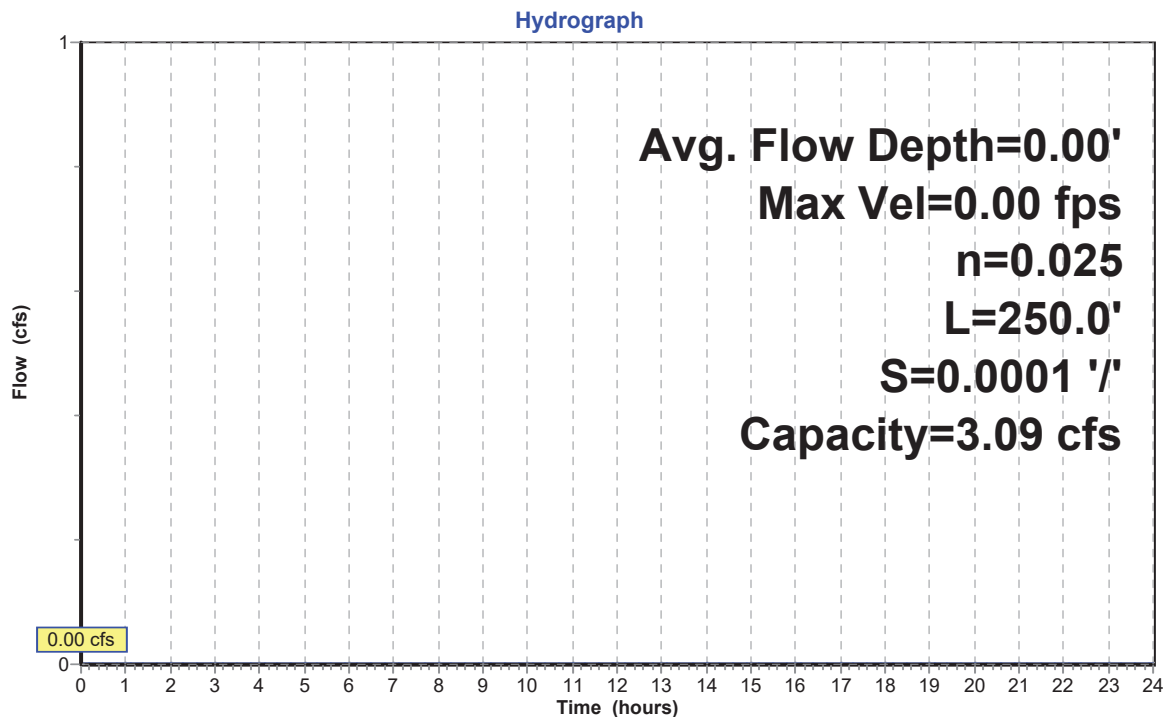
Side Slope Z-value= 3.0 '/' Top Width= 9.50'

Length= 250.0' Slope= 0.0001 '/'

Inlet Invert= 52.00', Outlet Invert= 51.98'



Reach 49R: swale cross-section



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 100-Yr Rainfall=4.40"

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Summary for Pond 31P: swale 2

Inflow Area = 5.202 ac, 93.99% Impervious, Inflow Depth > 4.07" for 100-Yr event
Inflow = 5.28 cfs @ 7.92 hrs, Volume= 1.765 af
Outflow = 5.31 cfs @ 7.95 hrs, Volume= 1.750 af, Atten= 0%, Lag= 1.6 min
Primary = 0.16 cfs @ 7.95 hrs, Volume= 0.262 af
Secondary = 4.33 cfs @ 7.95 hrs, Volume= 0.652 af
Tertiary = 0.82 cfs @ 7.95 hrs, Volume= 0.837 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Peak Elev= 48.82' @ 7.95 hrs Surf.Area= 3,528 sf Storage= 1,202 cf

Plug-Flow detention time= 14.0 min calculated for 1.750 af (99% of inflow)
Center-of-Mass det. time= 7.6 min (670.7 - 663.1)

Volume	Invert	Avail.Storage	Storage Description
#1	48.35'	5,590 cf	Custom Stage Data (Conic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
48.35	1,690	0	0	1,690
49.60	8,040	5,590	5,590	8,047

Device	Routing	Invert	Outlet Devices
#1	Primary	48.35'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	48.68'	8.0" Horiz. Orifice/Grate X 12.00 C= 0.600 Limited to weir flow at low heads
#3	Tertiary	48.35'	18.0" Round Culvert L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 48.35' / 48.15' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=0.16 cfs @ 7.95 hrs HW=48.82' TW=47.73' (Dynamic Tailwater)

↑**1=Exfiltration** (Exfiltration Controls 0.16 cfs)

Secondary OutFlow Max=4.26 cfs @ 7.95 hrs HW=48.82' TW=47.73' (Dynamic Tailwater)

↑**2=Orifice/Grate** (Weir Controls 4.26 cfs @ 1.22 fps)

Tertiary OutFlow Max=0.81 cfs @ 7.95 hrs HW=48.82' TW=47.56' (Dynamic Tailwater)

↑**3=Culvert** (Barrel Controls 0.81 cfs @ 2.57 fps)

Bridge Point I-5 Hydrological calcs

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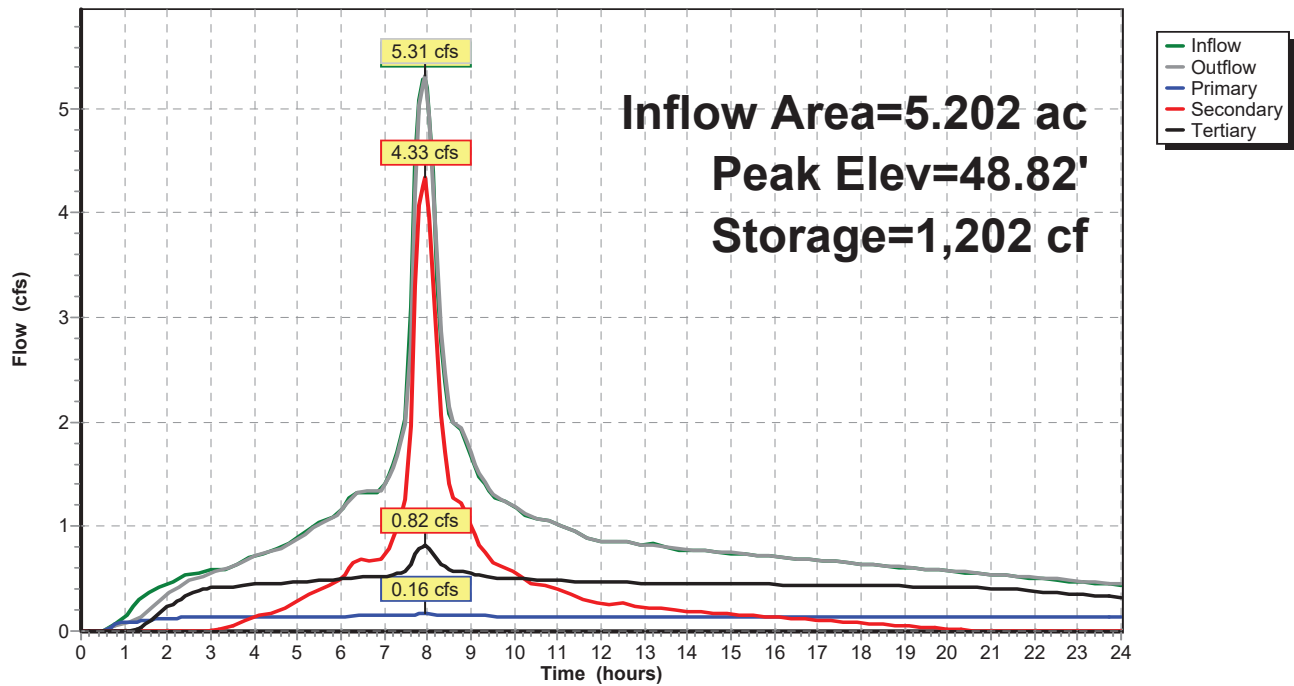
Bridge Point I-5 hydrological calcs
Type IA 24-hr 100-Yr Rainfall=4.40"

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Pond 31P: swale 2

Hydrograph



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs

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Summary for Pond 34P: drainage layer

Inflow Area = 5.202 ac, 93.99% Impervious, Inflow Depth > 2.11" for 100-Yr event
Inflow = 4.50 cfs @ 7.95 hrs, Volume= 0.913 af
Outflow = 4.56 cfs @ 7.97 hrs, Volume= 0.904 af, Atten= 0%, Lag= 1.1 min
Primary = 0.28 cfs @ 9.01 hrs, Volume= 0.393 af
Secondary = 4.30 cfs @ 7.97 hrs, Volume= 0.512 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Peak Elev= 48.31' @ 9.01 hrs Surf.Area= 1,690 sf Storage= 837 cf

Plug-Flow detention time= 24.1 min calculated for 0.904 af (99% of inflow)

Center-of-Mass det. time= 16.1 min (615.8 - 599.7)

Volume	Invert	Avail.Storage	Storage Description
#1	45.35'	837 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 2,535 cf Overall x 33.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
45.35	1,690	0	0
46.85	1,690	2,535	2,535

Device	Routing	Invert	Outlet Devices
#1	Primary	45.35'	12.0" Round Culvert L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 45.35' / 45.10' S= 0.0050 ' S= 0.0050 ' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 1	45.35'	2.5" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Secondary	45.35'	18.0" Round Culvert L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 45.35' / 45.10' S= 0.0050 ' S= 0.0050 ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#4	Device 3	46.84'	18.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.28 cfs @ 9.01 hrs HW=48.31' TW=43.51' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 0.28 cfs of 4.69 cfs potential flow)

↑ **2=Orifice/Grate** (Orifice Controls 0.28 cfs @ 8.29 fps)

Secondary OutFlow Max=2.82 cfs @ 7.97 hrs HW=47.77' TW=47.60' (Dynamic Tailwater)

↑ **3=Culvert** (Inlet Controls 2.82 cfs @ 1.59 fps)

↑ **4=Orifice/Grate** (Passes 2.82 cfs of 3.57 cfs potential flow)

Bridge Point I-5 Hydrological calcs

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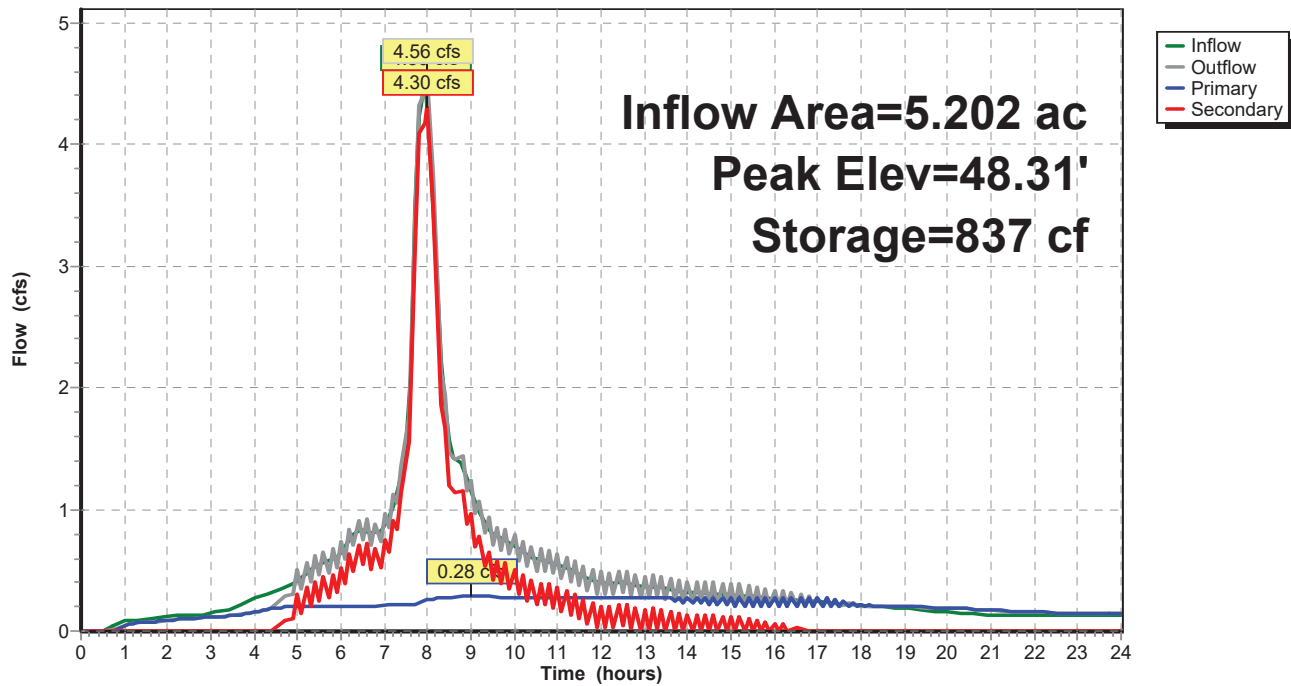
Bridge Point I-5 hydrological calcs
Type IA 24-hr 100-Yr Rainfall=4.40"

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Pond 34P: drainage layer

Hydrograph



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Type IA 24-hr 100-Yr Rainfall=4.40"

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Summary for Pond 36P: Stormwater Basin

Inflow Area = 2.810 ac, 84.93% Impervious, Inflow Depth > 9.70" for 100-Yr event
Inflow = 7.90 cfs @ 7.96 hrs, Volume= 2.271 af
Outflow = 2.29 cfs @ 9.01 hrs, Volume= 1.578 af, Atten= 71%, Lag= 63.2 min
Primary = 0.63 cfs @ 9.01 hrs, Volume= 1.034 af
Secondary = 1.66 cfs @ 9.01 hrs, Volume= 0.544 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Peak Elev= 48.30' @ 9.01 hrs Surf.Area= 13,596 sf Storage= 33,980 cf

Plug-Flow detention time= 316.8 min calculated for 1.578 af (69% of inflow)
Center-of-Mass det. time= 129.8 min (790.7 - 661.0)

Volume	Invert	Avail.Storage	Storage Description
#1	45.00'	60,466 cf	Custom Stage Data (Conic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
45.00	7,340	0	0	7,340
50.00	17,580	60,466	60,466	17,761

Device	Routing	Invert	Outlet Devices
#1	Primary	45.00'	2.000 in/hr Exfiltration over Wetted area
#2	Secondary	48.00'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.63 cfs @ 9.01 hrs HW=48.30' TW=44.18' (Dynamic Tailwater)
↑**1=Exfiltration** (Exfiltration Controls 0.63 cfs)

Secondary OutFlow Max=1.65 cfs @ 9.01 hrs HW=48.30' TW=44.18' (Dynamic Tailwater)
↑**2=Orifice/Grate** (Weir Controls 1.65 cfs @ 1.78 fps)

Bridge Point I-5 Hydrological calcs

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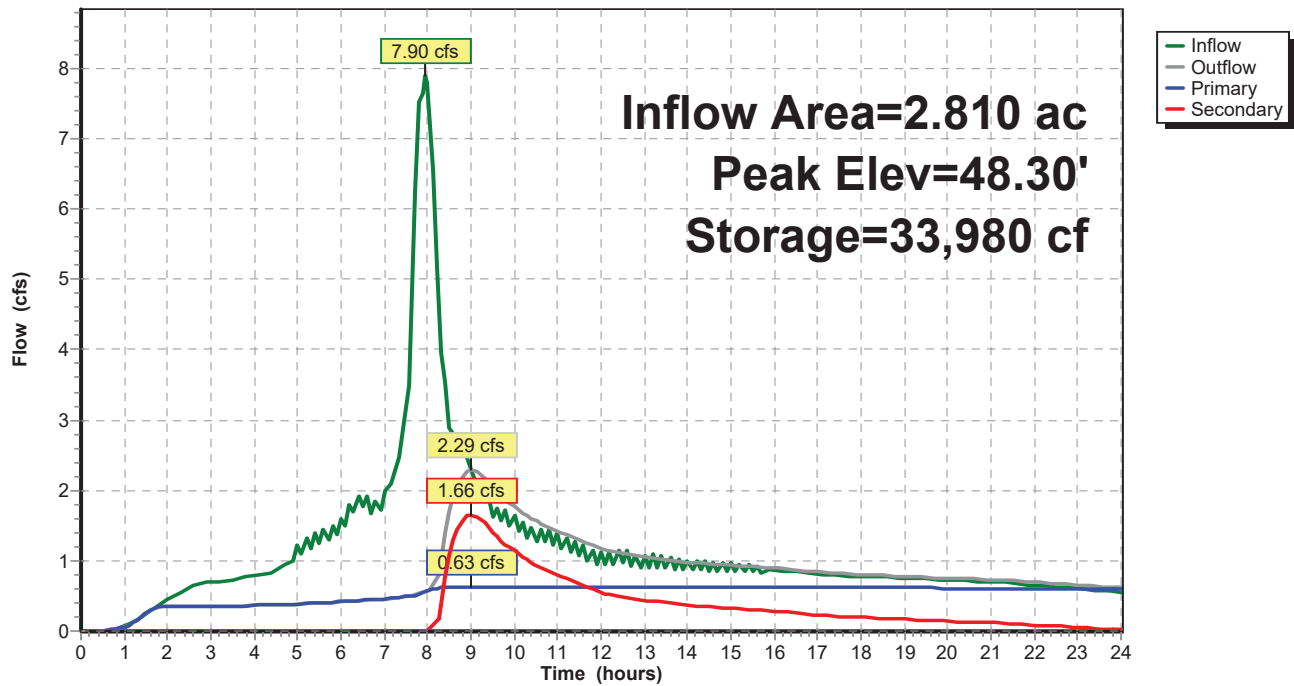
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Type IA 24-hr 100-Yr Rainfall=4.40"

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Pond 36P: Stormwater Basin

Hydrograph



Bridge Point I-5 Hydrological calcs

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Type IA 24-hr 100-Yr Rainfall=4.40"

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Summary for Pond 37P: swale 1

Inflow Area = 0.860 ac, 92.42% Impervious, Inflow Depth > 4.05" for 100-Yr event
Inflow = 0.87 cfs @ 7.92 hrs, Volume= 0.290 af
Outflow = 0.87 cfs @ 7.96 hrs, Volume= 0.284 af, Atten= 0%, Lag= 2.2 min
Primary = 0.06 cfs @ 7.96 hrs, Volume= 0.094 af
Secondary = 0.81 cfs @ 7.96 hrs, Volume= 0.190 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Peak Elev= 53.28' @ 7.96 hrs Surf.Area= 1,299 sf Storage= 427 cf

Plug-Flow detention time= 30.0 min calculated for 0.284 af (98% of inflow)
Center-of-Mass det. time= 13.9 min (678.1 - 664.2)

Volume	Invert	Avail.Storage	Storage Description		
#1	52.80'	1,396 cf	Custom Stage Data (Conic) Listed below (Recalc)		
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
52.80	530	0	0	530	
53.80	2,505	1,396	1,396	2,509	
Device	Routing	Invert	Outlet Devices		
#1	Primary	52.80'	2.000 in/hr Exfiltration over Wetted area		
#2	Secondary	53.13'	8.0" Horiz. Orifice/Grate X 2.00 C= 0.600 Limited to weir flow at low heads		

Primary OutFlow Max=0.06 cfs @ 7.96 hrs HW=53.28' TW=50.88' (Dynamic Tailwater)
↑**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Secondary OutFlow Max=0.80 cfs @ 7.96 hrs HW=53.28' TW=50.88' (Dynamic Tailwater)
↑**2=Orifice/Grate** (Weir Controls 0.80 cfs @ 1.27 fps)

Bridge Point I-5 Hydrological calcs

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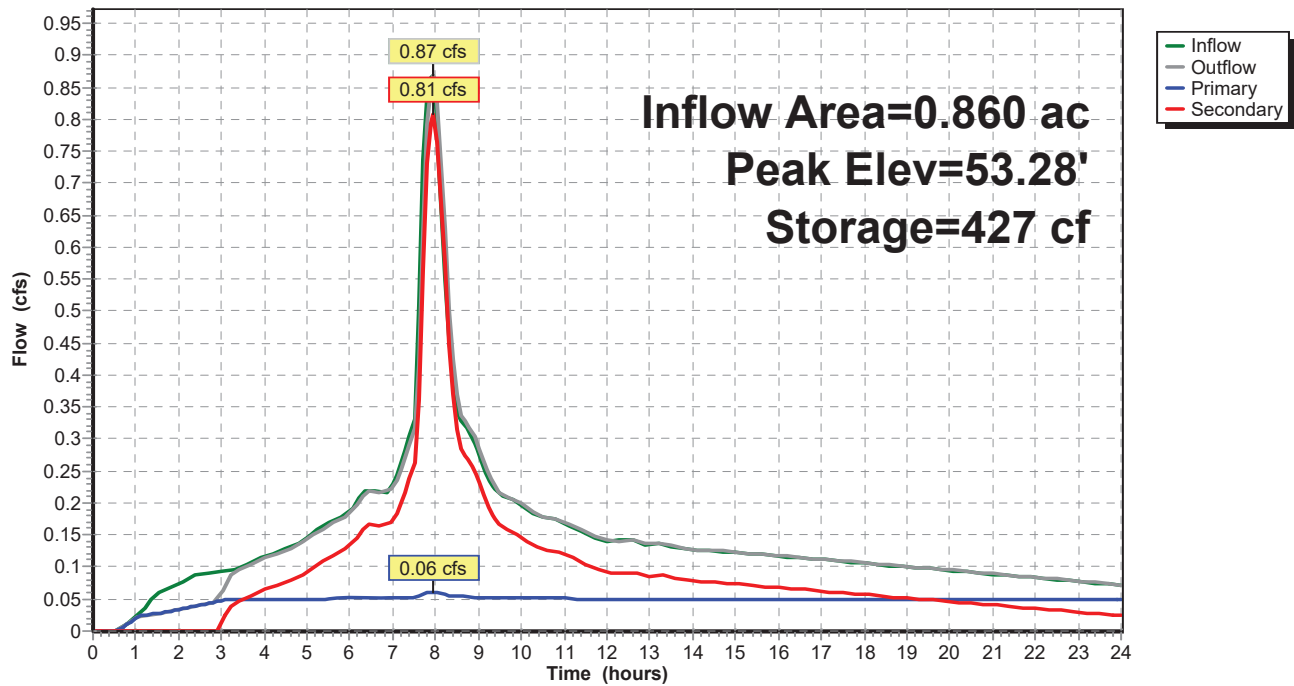
Bridge Point I-5 hydrological calcs
Type IA 24-hr 100-Yr Rainfall=4.40"

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Pond 37P: swale 1

Hydrograph



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 100-Yr Rainfall=4.40"

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Summary for Pond 38P: drainage layer

Inflow Area = 0.860 ac, 92.42% Impervious, Inflow Depth > 3.96" for 100-Yr event
Inflow = 0.87 cfs @ 7.96 hrs, Volume= 0.284 af
Outflow = 0.86 cfs @ 7.97 hrs, Volume= 0.283 af, Atten= 0%, Lag= 0.6 min
Primary = 0.86 cfs @ 7.97 hrs, Volume= 0.283 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Peak Elev= 50.88' @ 7.97 hrs Surf.Area= 530 sf Storage= 102 cf

Plug-Flow detention time= 4.2 min calculated for 0.282 af (99% of inflow)
Center-of-Mass det. time= 2.5 min (680.6 - 678.1)

Volume	Invert	Avail.Storage	Storage Description
#1	50.30'	175 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 530 cf Overall x 33.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
50.30	530	0	0
51.30	530	530	530

Device	Routing	Invert	Outlet Devices
#1	Primary	50.30'	12.0" Round Culvert L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 50.30' / 50.05' S= 0.0050 ' S= 0.0050 ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.86 cfs @ 7.97 hrs HW=50.88' TW=44.61' (Dynamic Tailwater)

↑**1=Culvert** (Barrel Controls 0.86 cfs @ 2.63 fps)

Bridge Point I-5 Hydrological calcs

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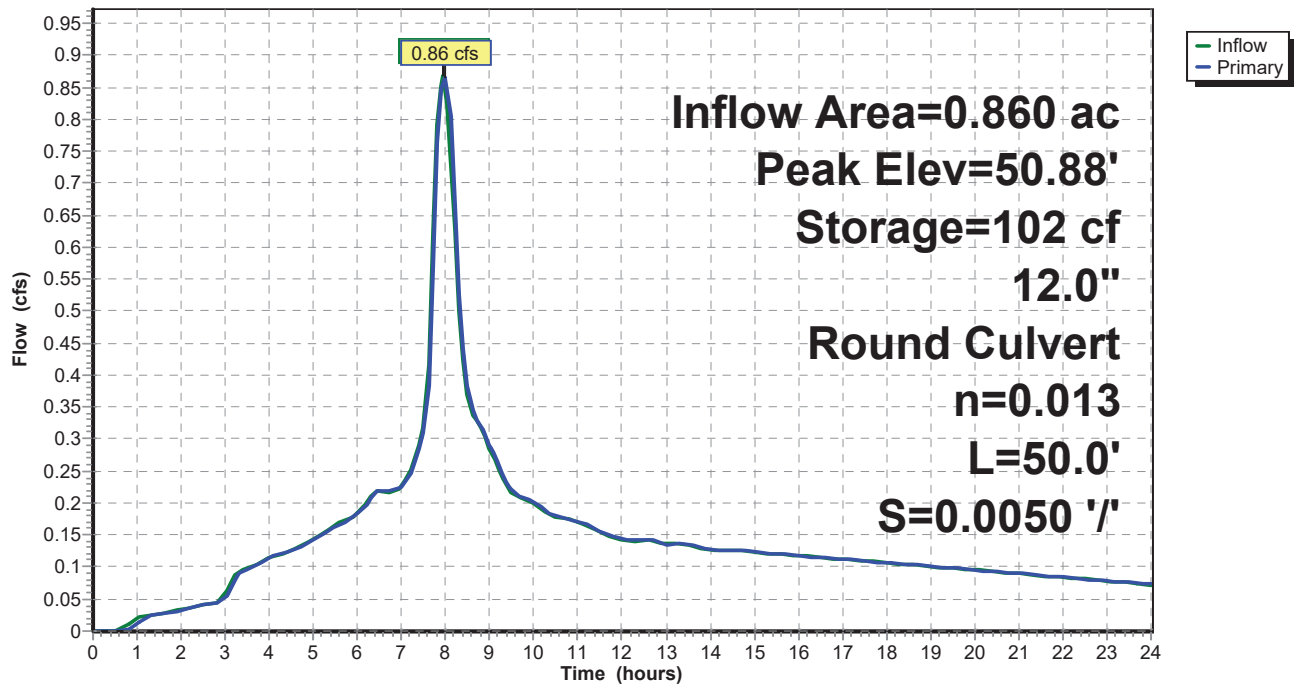
Bridge Point I-5 hydrological calcs
Type IA 24-hr 100-Yr Rainfall=4.40"

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Pond 38P: drainage layer

Hydrograph



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 100-Yr Rainfall=4.40"

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Summary for Pond 39P: MH upstream of Private Outfall

Inflow Area = 31.867 ac, 97.14% Impervious, Inflow Depth > 3.81" for 100-Yr event
Inflow = 25.77 cfs @ 7.95 hrs, Volume= 10.120 af
Outflow = 25.77 cfs @ 7.95 hrs, Volume= 10.120 af, Atten= 0%, Lag= 0.0 min
Primary = 25.77 cfs @ 7.95 hrs, Volume= 10.120 af

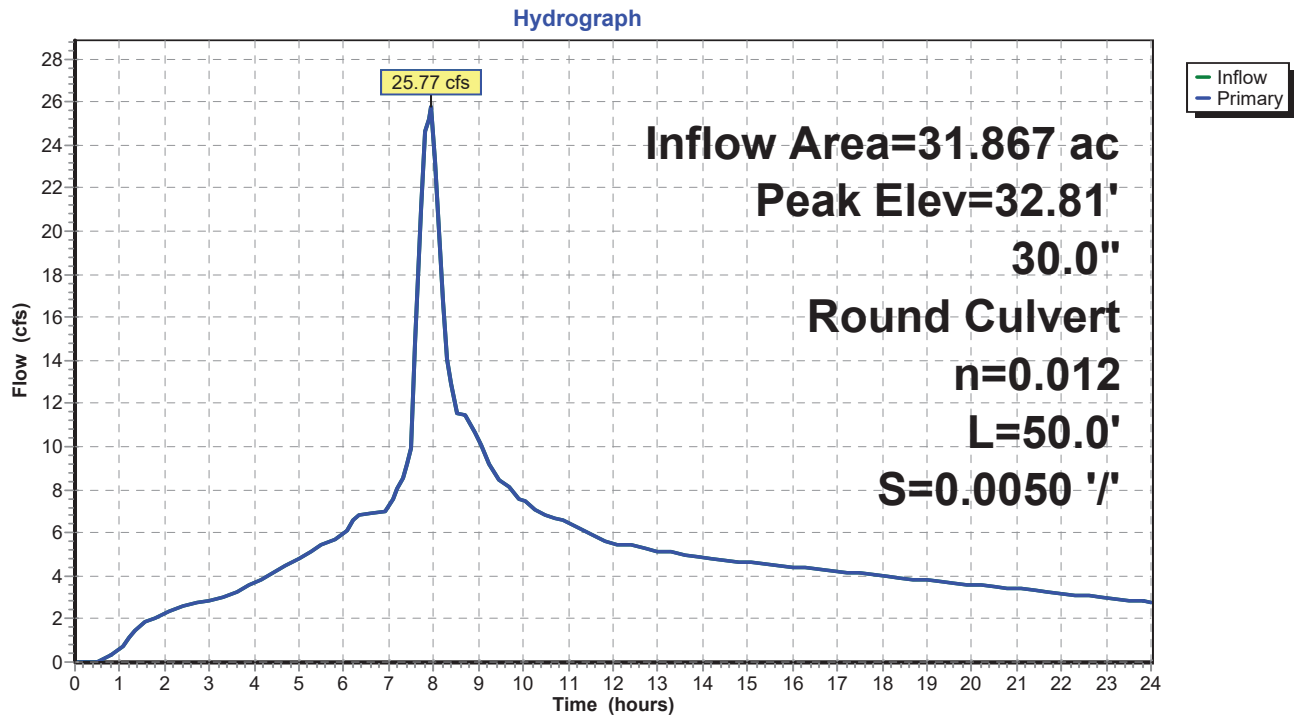
Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Peak Elev= 32.81' @ 7.95 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	30.00'	30.0" Round RCP_Round 30" L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 30.00' / 29.75' S= 0.0050 '/ Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 4.91 sf

Primary OutFlow Max=25.26 cfs @ 7.95 hrs HW=32.77' TW=30.56' (Dynamic Tailwater)
↑1=RCP_Round 30" (Barrel Controls 25.26 cfs @ 5.80 fps)

Pond 39P: MH upstream of Private Outfall



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 100-Yr Rainfall=4.40"

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Summary for Pond 40P: (new Pond)

Inflow Area = 24.369 ac, 96.71% Impervious, Inflow Depth > 3.71" for 100-Yr event
Inflow = 17.97 cfs @ 7.96 hrs, Volume= 7.536 af
Outflow = 17.97 cfs @ 7.96 hrs, Volume= 7.536 af, Atten= 0%, Lag= 0.0 min
Primary = 17.97 cfs @ 7.96 hrs, Volume= 7.536 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Peak Elev= 44.66' @ 7.96 hrs

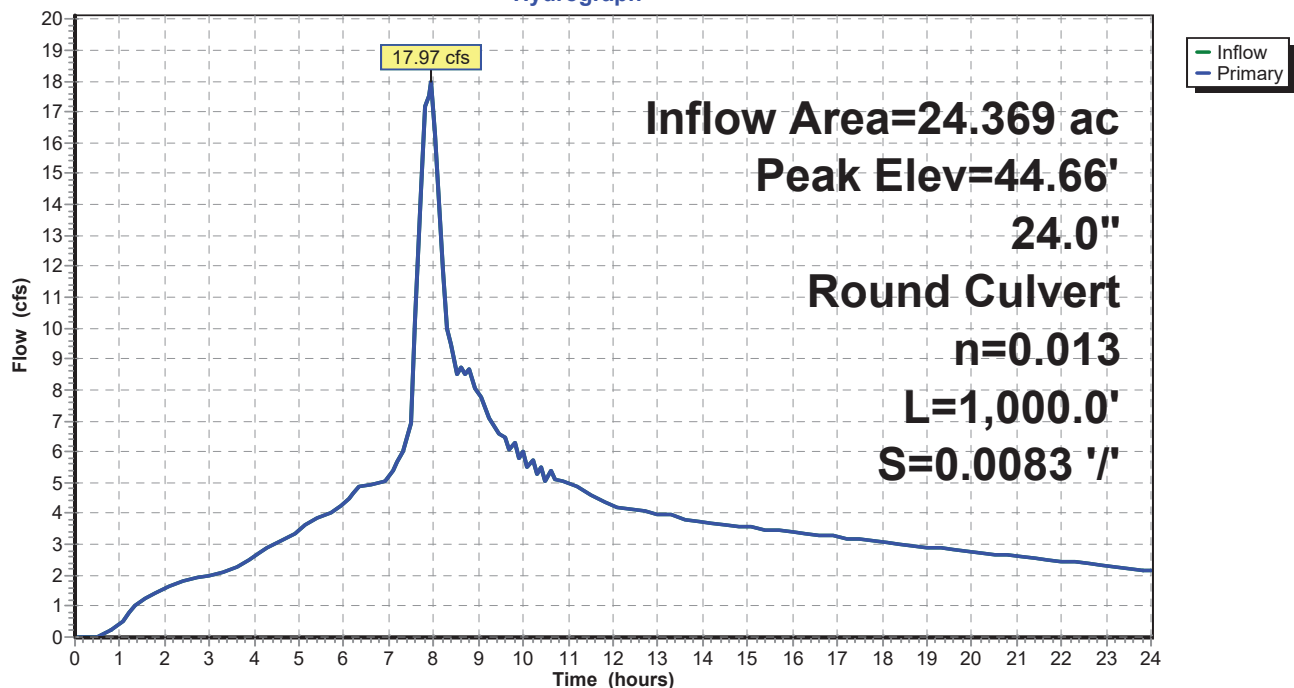
Device	Routing	Invert	Outlet Devices
#1	Primary	42.25'	24.0" Round Culvert L= 1,000.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 42.25' / 34.00' S= 0.0083 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=17.60 cfs @ 7.96 hrs HW=44.60' TW=32.77' (Dynamic Tailwater)

↑1=Culvert (Inlet Controls 17.60 cfs @ 5.60 fps)

Pond 40P: (new Pond)

Hydrograph



Bridge Point I-5 Hydrological calcs

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Summary for Pond 43P: drainage layer

Inflow Area = 2.810 ac, 84.93% Impervious, Inflow Depth > 6.74" for 100-Yr event
Inflow = 2.29 cfs @ 9.01 hrs, Volume= 1.578 af
Outflow = 2.47 cfs @ 9.00 hrs, Volume= 1.491 af, Atten= 0%, Lag= 0.0 min
Primary = 2.47 cfs @ 9.00 hrs, Volume= 1.491 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Peak Elev= 44.66' @ 8.03 hrs Surf.Area= 7,340 sf Storage= 4,844 cf

Plug-Flow detention time= 79.7 min calculated for 1.491 af (94% of inflow)
Center-of-Mass det. time= 44.7 min (835.5 - 790.7)

Volume	Invert	Avail.Storage	Storage Description
#1	41.50'	4,844 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 14,680 cf Overall x 33.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
41.50	7,340	0	0
43.50	7,340	14,680	14,680

Device	Routing	Invert	Outlet Devices
#1	Primary	42.50'	12.0" Round Culvert L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 42.50' / 42.25' S= 0.0050 ' / ' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.46 cfs @ 9.00 hrs HW=44.20' TW=43.52' (Dynamic Tailwater)

↑**1=Culvert** (Inlet Controls 2.46 cfs @ 3.13 fps)

Bridge Point I-5 Hydrological calcs

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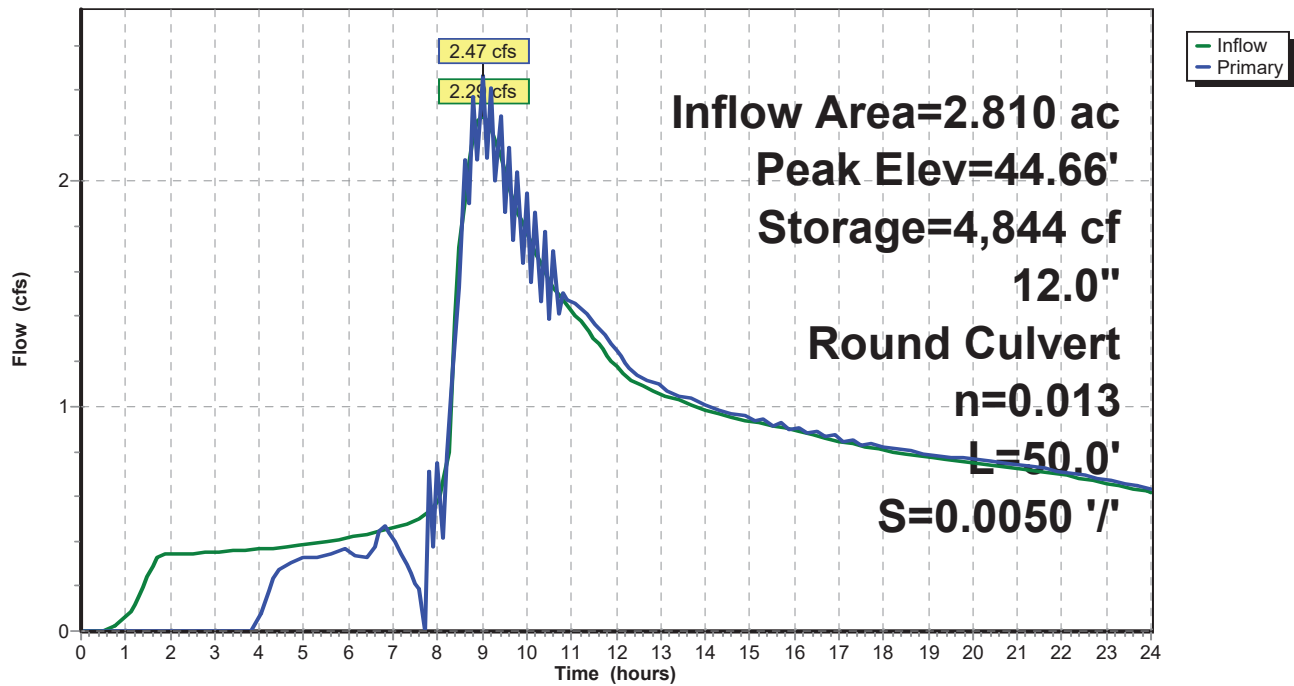
Bridge Point I-5 hydrological calcs
Type IA 24-hr 100-Yr Rainfall=4.40"

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Pond 43P: drainage layer

Hydrograph



Bridge Point I-5 Hydrological calcs

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Bridge Point I-5 hydrological calcs
Type IA 24-hr 100-Yr Rainfall=4.40"

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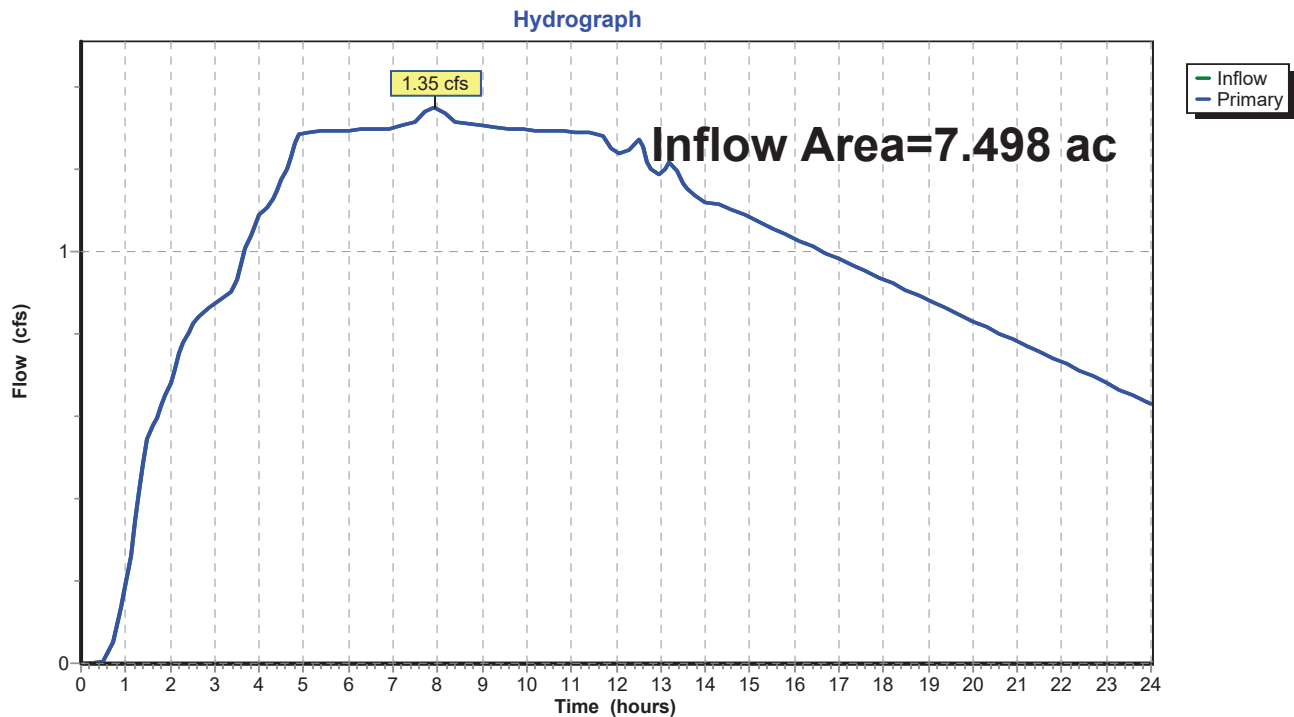
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Summary for Pond 45P: stormfilter vault

Inflow Area = 7.498 ac, 98.52% Impervious, Inflow Depth > 3.15" for 100-Yr event
Inflow = 1.35 cfs @ 7.92 hrs, Volume= 1.967 af
Primary = 1.35 cfs @ 7.92 hrs, Volume= 1.967 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Pond 45P: stormfilter vault



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Bridge Point I-5 hydrological calcs
Type IA 24-hr 100-Yr Rainfall=4.40"

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Summary for Pond 47P: flow diversion MH 1

Inflow Area = 7.498 ac, 98.52% Impervious, Inflow Depth > 4.14" for 100-Yr event
Inflow = 7.73 cfs @ 7.92 hrs, Volume= 2.584 af
Outflow = 7.73 cfs @ 7.92 hrs, Volume= 2.584 af, Atten= 0%, Lag= 0.0 min
Primary = 1.35 cfs @ 7.92 hrs, Volume= 1.967 af
Secondary = 6.39 cfs @ 7.92 hrs, Volume= 0.617 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Peak Elev= 35.06' @ 7.92 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	30.10'	8.0" Round Culvert L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 30.10' / 30.00' S= 0.0050 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf
#2	Device 1	30.10'	4.8" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Secondary	30.10'	24.0" Round Culvert L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 30.10' / 30.00' S= 0.0050 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#4	Device 3	34.60'	24.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.35 cfs @ 7.92 hrs HW=35.06' TW=0.00' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 1.35 cfs of 2.85 cfs potential flow)

↑ **2=Orifice/Grate** (Orifice Controls 1.35 cfs @ 10.72 fps)

Secondary OutFlow Max=6.35 cfs @ 7.92 hrs HW=35.06' TW=32.77' (Dynamic Tailwater)

↑ **3=Culvert** (Passes 6.35 cfs of 18.08 cfs potential flow)

↑ **4=Orifice/Grate** (Weir Controls 6.35 cfs @ 2.21 fps)

Bridge Point I-5 Hydrological calcs

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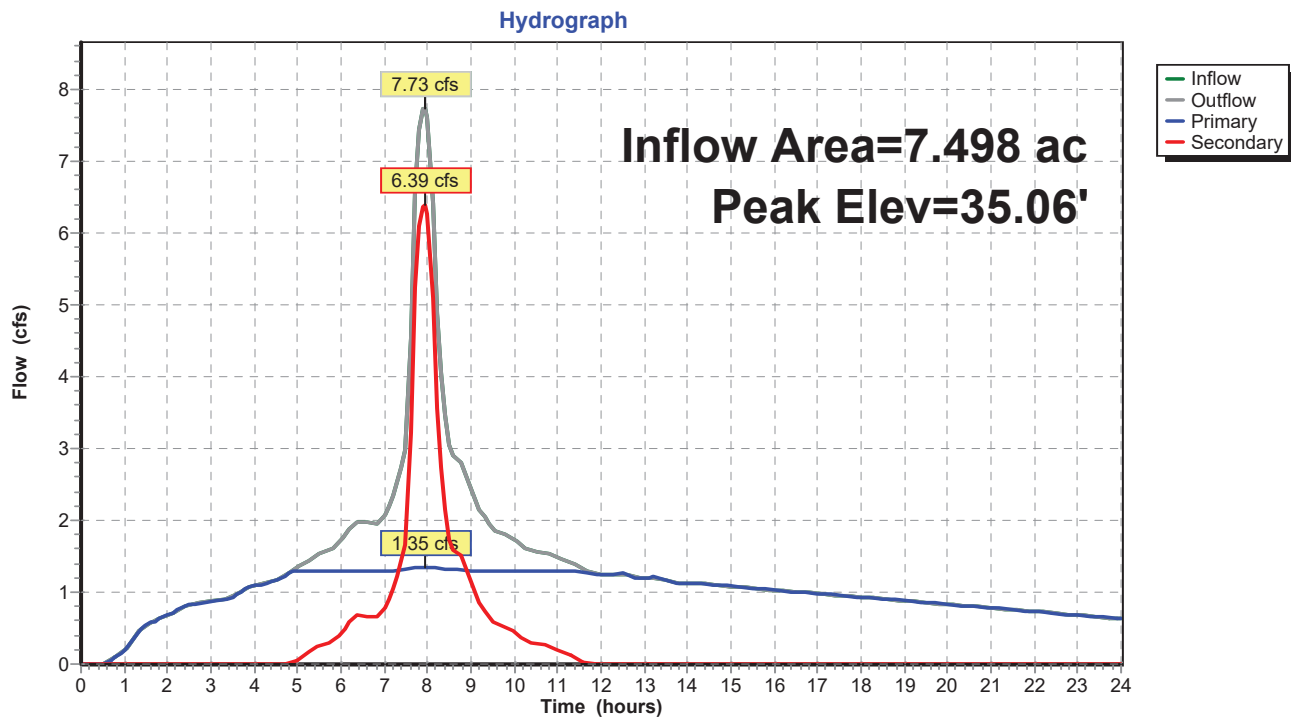
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Type IA 24-hr 100-Yr Rainfall=4.40"

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Pond 47P: flow diversion MH 1



APPENDIX B

MCDD FLOW CONTROL EXEMPTION LETTER



Date: 9.4.2019

To: James Hyatt (Bureau of Environmental Services, City of Portland)

From: Amber Ayers (Planning Department, Multnomah County Drainage District)

Subject: Flow Control Exemption

The Multnomah County Drainage District (MCDD) reduces flood risk by maintaining our levee system, managing drainage and responding to emergencies. As part of these responsibilities, MCDD reviews development applications for projects within the Districts' boundaries. These reviews ensure new development does not increase the risk of flooding and complies with local, state, and federal regulations .

District staff has reviewed the proposal for the **Bridge Point I5** project, located at **755 NE Columbia Blvd.** MCDD grants the property owner a flow control exemption per District operations and maintenance of the Columbia Slough storm drainage system.

Flow Control Exemptions. New development and redevelopment projects may be exempt from flow control requirements if they discharge stormwater runoff directly into the Willamette River, Columbia River, or Columbia Slough through a private storm sewer, separated public storm sewer, or Multnomah County Drainage District system with available capacity.

****referenced from [2016 Stormwater Management Manual](#)

