Capitol Region Watershed District
595 Aldine Street
Saint Paul, MN 55104
(651) 644-8888 • capitolregionwd.org

December 22, 2023

Jim Brummer
University of St. Thomas
2260 Summit Ave
St. Paul, MN 55105

RE: CRWD Permit 23-023 Lee & Penny Anderson Multipurpose Arena

Dear Jim Brummer:

This letter serves to inform you that the required permit documents have been received and reviewed. All conditions for permit 23-023 Lee & Penny Anderson Multipurpose Arena have been satisfied and the permit was issued on 12/20/2023 (see attached). Please contact CRWD at 651-644-8888 to schedule an erosion and sediment control inspection as soon as the required practices have been installed.

During construction, CRWD will make periodic inspections of the site, grading the site on the required ESC practices to be installed and functional throughout the life of the project. The CRWD Board of Managers has adopted the grading schedule outlined at the end of this letter. Note that each **inspection with a letter grade of C or lower is subject to an inspection charge of $120**, an amount that will not be returned at the end of the project. Keeping your practices functional and promptly maintained is the best way to avoid inspection charges and keep your project in compliance.

Upon project completion, the following items must be confirmed prior to CRWD **permit closure**. Submit at your earliest convenience when the project is complete.

1. **Full site stabilization** per plan, including any vegetation to 70% coverage;
2. **Temporary BMP removal**;
3. **Permanent BMP function**, requiring inspection during a runoff event and after 48 hours of non-runoff conditions;
4. **Maintenance personnel** contact information; and
5. **Post-construction survey acceptance** for all stormwater infrastructure to document and verify adequate stormwater treatment. This as-built survey should include, but is not limited to, all basin/swale grades, pipe inlets, outlet pipes and structures, emergency overflows, orifices, weirs, pipe sizes, draintile elevations and sizes, and any associated stormwater infrastructure.

Sincerely,
Elizabeth M Hosch
Elizabeth Hosch, CESSWI
Permit Program Manager

cc: Nathan Bruhn, City of St. Paul
Stephen Ubl, City of St. Paul
Tia Anderson, City of St. Paul

Andrew Hogg, City of St. Paul
Ashley Skarda, City of St. Paul
Matthew Graybar, City of St. Paul

CRWD Inspection Report Grading Metrics

Inspection Grade A	All report items are Compliant, Under Review, or Not Applicable (NA)
Inspection Grade B	All report items are Compliant, Under Review, NA, or Action Required*
Inspection Grade C	At least one technical+ item is Non-Compliant - automatic inspection charge deducted from surety.
Inspection Grade D	At least one item (technical OR administrative+) is Non-Compliant for 2 consecutive inspections - automatic inspection charge deducted from surety, Notice of Violation.
Inspection Grade F	At least one item (technical OR administrative) is Non-Compliant for 3 or more consecutive inspections – automatic inspection charge deducted from surety, Cease and Desist Order.

*Action Required items not addressed by the next inspection will be considered Non-Compliant
+Administrative items include SWPPP document and contractor inspection reports, technical items are all in-field adjustments not considered administrative.

Note: Inspection charges are not incurred on public projects.

Capitol Region Watershed District
595 Aldine Street
St. Paul, MN 55104
651-644-8888

PERMIT

Project Name Lee & Penny Anderson Multipurpose Arena			**Permit number** 23-023
Applicant University of St. Thomas		**Representative** Jim Brummer	**Telephone**
Applicant's Address 2260 Summit Ave	**City** St. Paul	**State** MN	**Zip** 55105
Purpose Multipurpose Arena for St. Thomas Hockey and Basketball programs with practice facilities, coaching offices, locker rooms, and student athlete support services that will also host other university events such as commencement ceremonies, academic convocations, speakers, and career fairs.			
Location 2260 Summit Ave., St. Paul			
Date of Issuance	12/20/2023	**Applicable Rules**	C, D, F

At the Capitol Region Watershed District (District) meeting on 12/20/2023, the Board of Managers reviewed and approved your permit application based upon the statements and information contained in the submitted exhibits and plans detailing the approved project. All subsequent plan revisions must be submitted to the District for review.

Pursuant to the Rules of the District, all of which are made a part hereof by reference, permission is hereby granted to the applicant named above to conduct the grading, filling, and/or drainage activity described above. This document is not transferable. Changes in ownership should be accompanied by a completed Permit Transfer Form, available at www.capitolregionwd.org.

Permit closure is contingent upon final inspection and review documenting the following conditions. Find more detail at www.capitolregionwd.org.

1. Construction is complete.
2. Permanent stabilized land cover is in place.
3. Stormwater treatment practices are determined to be functional.
4. Stormwater as-built survey is submitted and approved.
5. Temporary protections are removed.
6. Other permit needs as identified.

Mark Doneux

Mark Doneux, District Administrator

December 22, 2023

Date

MINNESOTA POLLUTION CONTROL AGENCY

AUTHORIZATION TO DISCHARGE

STORMWATER ASSOCIATED WITH CONSTRUCTION ACTIVITY

UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)/

STATE DISPOSAL SYSTEM (SDS) PROGRAM

C00068427

Permittee (Owner): University of St. Thomas

Permittee (Operator): Ryan Companies US, Inc.

Project Name: Lee & Penny Anderson Multipurpose Arena

City or Township: <NO_DATA_FOUND> **County:** <NO_DATA_FOUND>

Location description:

Issuance date: November 20, 2023

Expiration date: July 31, 2028

The state of Minnesota, on behalf of its citizens through the Minnesota Pollution Control Agency (MPCA), authorizes the Permittee(s) named above seeking coverage under this general permit to discharge stormwater associated with construction activity to waters of the state of Minnesota in accordance with the requirements of this permit.

The goal of this permit is to reduce pollutant levels in point source discharges and protect water quality in accordance with the U.S. Clean Water Act, Minnesota statutes and rules, and federal laws and regulations.

This permit is effective on the issuance date identified above. This permit expires at midnight on the expiration date identified above.

Signature: Ryan Anderson

This document has been electronically signed.

for the Minnesota Pollution Control Agency

Ryan Anderson
Manager
Stormwater Section
Municipal Division

Permit application:
Submit via MPCA e-Services at
https://rsp.pca.state.mn.us/

Questions on this permit?
Contact e-Services at
651-757-2728 or 844-828-0942

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1.1	**Permit Coverage**. [Minn. R. 7090]
1.2	This permit is required for construction activity that results in land disturbance of equal to or greater than one (1) acre or if a project is part of a common plan of development or sale that ultimately will disturb greater than one (1) acre, and authorizes, subject to the terms and conditions of this permit, the discharge of stormwater associated with construction activity. [Minn. R. 7090]
1.3	Construction activity covered by this permit cannot commence until coverage under this permit is effective as described in item 3.3 through 3.4 or, if applicable, until the Minnesota Pollution Control Agency (MPCA) has issued an individual National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) construction stormwater permit for the project. [Minn. R. 7090]
1.4	This permit covers all areas of the State of Minnesota except land wholly within the boundaries of a federally recognized Indian Reservation owned by a tribe or a tribal member or land held in trust by the federal government for a tribe or tribal member. [Minn. R. 7090]
1.5	Coverage under this permit is not required when all stormwater from construction activity is routed directly to and treated by a "treatment works," as defined in Minn. Stat. Section 115.01, subd. 21, operated under an individual NPDES/SDS permit with a Total Suspended Solids (TSS) effluent limit. [Minn. R. 7090]
1.6	This permit covers ongoing projects covered under any previous construction stormwater permit that are not complete on the issuance date of this permit. Permittees must either remain in compliance with the previous permit and terminate coverage within 18 months of the issuance date of this permit or comply with this permit, including updating the Stormwater Pollution Prevention Plan (SWPPP), within the 18-month period. Permittees of previously permitted projects are not required to incorporate any additional requirements regarding the permanent stormwater treatment system included in this reissued permit. [Minn. R. 7090]
1.7	Coverage for projects that extend beyond the expiration date of this permit remains effective for a grace period of 18 months. If Permittees cannot complete projects during the grace period, the MPCA will extend coverage under the next permit and permittees must comply with the requirements of the new permit including updating the SWPPP. Permittees are not required to follow changes to the permanent stormwater treatment section of the next permit. [Minn. R. 7090]
2.1	**Prohibitions and Limitations of Coverage**. [Minn. R. 7090]
2.2	The owner must develop a complete and accurate SWPPP that complies with item 5.2 prior to submitting the application for coverage and starting construction activity. Failure to prepare a SWPPP prior to submitting the application may result in permit revocation. [Minn. R. 7090]
2.3	This permit prohibits discharges of any material other than stormwater treated in compliance with this permit and discharges from dewatering or basin draining activities in accordance with Section 10. Prohibited discharges include, but are not limited to, wastewater from washout of concrete, stucco, paint, form release oils, curing compounds and other construction materials, fuels, oils, or other pollutants used in vehicle and equipment operation and maintenance, soaps or solvents used in vehicle and equipment washing and maintenance, and other hazardous substances or wastes. [Minn. R. 7090]
2.4	This permit does not authorize stormwater discharges related to the placement of fill into waters of the state requiring local, state or federal authorizations (such as U.S. Army Corps of Engineers Section 404 permits, Minnesota Department of Natural Resources (DNR) Public Waters Work permits or local governmental unit (LGU) Wetland Conservation Act replacement plans or determinations). [Minn. R. 7090]
2.5	This permit does not authorize stormwater discharges associated with industrial activity except for construction activity. Permittees must obtain coverage for discharges associated with industrial activity under a separate NPDES/SDS permit once day-to-day operational activities commence even if construction is ongoing. [Minn. R. 7090]
2.6	This permit does not authorize discharges from non-point source agricultural and silvicultural activities excluded from NPDES permit requirements under 40 CFR pt. 122.3(e). [Minn. R. 7090]
2.7	This permit does not authorize stormwater discharges to Prohibited, Restricted, Special or Impaired waters unless permittees follow the additional stormwater requirements in Section 23. [Minn. R. 7090]
2.8	This permit does not replace or satisfy any environmental review requirements including those under the Minnesota Environmental Policy Act or the National Environmental Policy Act. The owner must verify completion of any environmental review required by law, including any required Environmental Assessment Work Sheets or Environmental Impact Statements, Federal environmental review, or other required review prior to applying for coverage under this permit. If any part of your common plan of development or sale requires environmental review, coverage under this permit cannot be

	obtained until such environmental review is complete. [Minn. R. 7090]
2.9	This permit does not replace or satisfy any review requirements for discharges adversely impacting State or Federally designated endangered or threatened species or a designated critical habitat. The owner must comply with the National Historic Preservation Act and conduct all required review and coordination related to historic preservation, including significant anthropological sites and any burial sites, with the Minnesota Historic Preservation Officer. [Minn. R. 7090]
2.10	This permit does not authorize discharges to wetlands unless the permittee complies with the requirements in Section 22. Coverage under this permit cannot be issued until the requirements for wetland permits, decisions, other determinations, or the mitigative sequence required in section 22 have been finalized and documented. [Minn. R. 7050.0186]
3.1	**Application and Coverage Effective Date**. [Minn. R. 7090]
3.2	The owner and operator must submit a complete and accurate on-line application with the appropriate fee to the MPCA for each project that disturbs one (1) or more acres of land or for a common plan of development or sale that will ultimately disturb one (1) or more acres. [Minn. R. 7090]
3.3	For projects or common plans of development or sale that disturb less than 50 acres or do not discharge stormwater within 1 mile (aerial radius measurement) of a special or impaired water, permittees do not need to submit the SWPPP with the application. Permit coverage for these projects is effective upon application and completing the payment process. [Minn. R. 7090]
3.4	For certain projects or common plans of development or sale disturbing 50 acres or more, the complete SWPPP must be included with the application and submitted at least 30 days before the start of construction activity. This applies if there is a discharge point on the project within one mile (aerial radius measurement) of, and flows to, a special water listed in item 23.3 through 23.6 or an impaired water as described in item 23.7. Permit coverage for these projects is effective upon submitting the application and complete SWPPP, completing the payment process and receiving a determination from the MPCA that the review of the SWPPP is complete. The determination may take longer than 30 days if the SWPPP is incomplete. If the MPCA fails to contact the permittees within 30 days of application receipt, coverage is effective 30 days after completing the payment process. [Minn. R. 7090]
3.5	The application requires listing all persons meeting the definition of owner and operator as permittees. The owner is responsible for compliance with all terms and conditions of this permit. The operator is responsible for compliance with Sections 3, 4, 6-22, 24 and applicable requirements for construction activity in Section 23. [Minn. R. 7090]
3.6	Permittees will receive coverage notification in a manner determined by the MPCA. [Minn. R. 7090]
3.7	For construction projects where the owner or operator changes (e.g., an original developer sells portions of the property to various homebuilders or sells the entire site to a new owner), the current owner and the new owner or operator must submit a complete permit modification form provided by the MPCA. The current owner and the new owner or operator must submit the form prior to the new owner or operator commencing construction activity or no later than 30 days after taking ownership of the property. [Minn. R. 7090]
3.8	For construction projects where the owner or operator changes, the current owner must provide a SWPPP to the new owner and operator that specifically addresses the remaining construction activity. The new owner or operator can implement the original SWPPP, modify the SWPPP, or develop a new SWPPP. Permittees must ensure their activities do not render another party's erosion prevention and sediment control BMPs ineffective. [Minn. R. 7090]
4.1	**Termination of Coverage**. [Minn. R. 7090]
4.2	Permittees must submit a NOT within 30 days after all termination conditions listed in Section 13 are complete. [Minn. R. 7090]
4.3	Permittees must submit a NOT within 30 days after selling or otherwise legally transferring the entire site, including permit responsibility for roads (e.g., street sweeping) and stormwater infrastructure final clean out, or transferring portions of a site to another party. The permittees' coverage under this permit terminates at midnight on the submission date of the NOT. [Minn. R. 7090]
4.4	Permittees may terminate permit coverage prior to completion of all construction activity if they meet all of the following conditions: a. construction activity has ceased for at least 90 days; and b. at least 90 percent (by area) of all originally proposed construction activity has been completed and permanent cover has been established on those areas; and c. on areas where construction activity is not complete, permanent cover has been established; and d. the site complies with item 13.3 through 13.7.

	After permit coverage is terminated under this item, any subsequent development on the remaining portions of the site will require permit coverage if the subsequent development itself or as part of the remaining common plan of development or sale will result in land disturbing activities of one (1) or more acres in size. [Minn. R. 7090]
4.5	Permittees may terminate coverage upon MPCA approval after submitting information documenting the owner cancelled the project. [Minn. R. 7090]
5.1	**Stormwater Pollution Prevention Plan (SWPPP) Content**. [Minn. R. 7090]
5.2	The owner must develop and implement a SWPPP. The SWPPP must include items 5.3 through 5.26. [Minn. R. 7090]
5.3	The SWPPP must incorporate specific Best Management Practices (BMP) used to comply with the requirements of this permit. [Minn. R. 7090]
5.4	The SWPPP must include a narrative describing the timing for installation of all erosion prevention and sediment control BMPs and a description of the permanent stormwater treatment systems. [Minn. R. 7090]
5.5	The SWPPP must include the location and type of all temporary and permanent erosion prevention and sediment control BMPs along with procedures used to establish additional temporary BMPs as necessary for the site conditions during construction. Standard details and/or specifications for BMPs must be included in the final plans and specifications for the project. [Minn. R. 7090]
5.6	The SWPPP must include the calculations and other information used for the design of temporary sediment basins and any of the permanent stormwater treatment systems required in Section 15. [Minn. R. 7090]
5.7	The SWPPP must include estimated quantities anticipated at the start of the project for the life of the project for all erosion prevention and sediment control BMPs (e.g., linear feet of silt fence or square feet of erosion control blanket). [Minn. R. 7090]
5.8	The SWPPP must include the number of acres of impervious surface for both pre- and post-construction. [Minn. R. 7090]
5.9	The SWPPP must include a site map with existing and final grades, including drainage area boundaries, directions of flow and all discharge points where stormwater is leaving the site or entering a surface water. The site map must indicate the areas of steep slopes. The site map must also include impervious surfaces, soil types and locations of potential pollutant-generating activities as identified in Section 12. [Minn. R. 7090]
5.10	The SWPPP must include a map of all surface waters, existing wetlands, and stormwater ponds or basins that can be identified on maps such as United States Geological Survey 7.5-minute quadrangle maps, the National Wetland Inventory map or equivalent maps and are within one mile (aerial radius measurement) from the project boundaries that will receive stormwater from the construction site, during or after construction. The SWPPP must identify if the surface waters are special or impaired waters. [Minn. R. 7090]
5.11	The SWPPP must include a site map showing construction activity areas that are adjacent to and drain to Public Waters for which the DNR has promulgated "work in water restrictions" during specified fish spawning time frames. [Minn. R. 7090]
5.12	Permittees must identify locations of 50' buffer zones as required in item 9.17 and 100' permanent buffer zones as required in item 23.11, on plan sheets in the SWPPP. [Minn. R. 7090]
5.13	If permittees determine compliance with the following requirements is infeasible, they must document the determination in the SWPPP: a. temporary sediment basins as described in Section 14; and b. for linear projects, if the permanent stormwater treatment system cannot be constructed within the right-of-way, a reasonable attempt must be made to obtain additional right-of-way (item 15.9); and c. buffer zones as described in item 9.17 and item 23.11. [Minn. R. 7090]
5.14	If permittees determine that a temporary sediment basin is infeasible as described in item 14.10, the SWPPP must describe the alternative BMPs used. [Minn. R. 7090]
5.15	Where systems cannot meet the full volume reduction requirement on-site, (e.g., the site has infiltration prohibitions, see item 16.14 through item 16.21) the permittee must document the reasons in the SWPPP. [Minn. R. 7090]
5.16	The SWPPP must include any stormwater mitigation measures proposed to be part of the final project in any environmental review document, endangered species review, archeological or other required local, state or federal review conducted for the project. For purposes of this permit, mitigation measures mean actions necessary to avoid, minimize, or mitigate for impacts related to erosion prevention, sediment control, the permanent stormwater treatment system, pollution prevention management measures and discharges associated with the project's construction activity. [Minn. R. 7090]

5.17	The SWPPP must describe the methods used for permanent cover of all exposed soil areas. [Minn. R. 7090]
5.18	Permittees must identify the locations of areas where construction will be phased to minimize the duration of exposed soil areas in the SWPPP. [Minn. R. 7090]
5.19	For projects with a discharge point on the project within one (1) mile (aerial radius measurement) of and which flows to an impaired water, permittees must identify the impaired water(s), and any United States Environmental Protection Agency (USEPA)-approved Total Maximum Daily Load (TMDL) for the pollutant(s) or stressor(s) described in item 23.7. Permittees' identification must include those TMDLs approved at any time prior to permit application submittal and are still in effect. [Minn. R. 7090]
5.20	Permittees must document in the SWPPP, all trained individuals identified in item 21.2. Documentation must include: a. names of personnel required to be trained; and b. dates of training and name of instructor(s) and entity providing training; and c. content of training course. If permittees do not know the names of the individuals at the time of application, the permittees must ensure they document training before construction activity commences. [Minn. R. 7090]
5.21	The SWPPP must identify a person knowledgeable and experienced in the application of erosion prevention and sediment control BMPs who will coordinate with all contractors, subcontractors, and operators on-site to oversee the implementation of the SWPPP. [Minn. R. 7090]
5.22	The SWPPP must describe any specific chemicals and chemical treatment systems used for enhancing the sedimentation process and how it achieves compliance with item 9.19. [Minn. R. 7090]
5.23	The SWPPP must identify the person(s), organizations, or entities responsible for long-term operation and maintenance of permanent stormwater treatment systems. [Minn. R. 7090]
5.24	The SWPPP must describe methods to minimize soil compaction and preserve topsoil. Minimizing soil compaction is not required where the function of a specific area dictates compaction. [Minn. R. 7090]
5.25	The SWPPP must include any site assessments for groundwater or soil contamination required in item 16.15. [Minn. R. 7090]
5.26	The SWPPP must account for the following factors in designing temporary erosion prevention and sediment control BMPs: a. the expected amount, frequency, intensity, and duration of precipitation; and b. the nature of stormwater runoff and run-on at the site, including factors such as expected flow from impervious surfaces, slopes, and site drainage features; and c. the stormwater volume, velocity, and peak flowrates to minimize discharge of pollutants in stormwater and to minimize channel and streambank erosion and scour in the immediate vicinity of discharge points; and d. the range of soil particle sizes expected to be present. [Minn. R. 7090]
6.1	**SWPPP Amendments**. [Minn. R. 7090]
6.2	One of the individuals described in item 21.2.a or item 21.2.b or another qualified individual must complete all SWPPP changes. Changes involving the use of a less stringent BMP must include a justification describing how the replacement BMP is effective for the site characteristics. [Minn. R. 7090]
6.3	Permittees must amend the SWPPP within 7 days to include additional or modified BMPs whenever there is a change in design, construction, operation, maintenance, weather or seasonal conditions having a significant effect on the discharge of pollutants to surface waters or groundwater. [Minn. R. 7090]
6.4	Permittees must amend the SWPPP within 7 days to include additional or modified BMPs whenever inspections or investigations by the site owner or operator, USEPA or MPCA officials indicate the SWPPP is not effective in eliminating or significantly minimizing the discharge of pollutants to surface waters or groundwater or the discharges are causing water quality standard exceedances (e.g., nuisance conditions as defined in Minn. R. 7050.0210, subp. 2) or the SWPPP is not consistent with the objectives of a USEPA approved TMDL. [Minn. R. 7050.0210]
7.1	**BMP Selection and Stormwater Management**. [Minn. R. 7090]
7.2	Permittees must select, install, and maintain the BMPs identified in the SWPPP and in this permit in an appropriate and functional manner and in accordance with relevant manufacturer specifications and accepted engineering practices to minimize the discharge of pollutants in stormwater from construction activities. Examples of stormwater management practices for this section include but are not limited to wet sedimentation basins, temporary depressions to hold

	stormwater, stormwater routing, dikes, berms, pumping, and stormwater treatment BMPs. Permittees must phase and incorporate stormwater management principles as the construction progresses. Unless infeasible, temporary or permanent wet sedimentation basins (when required, see section 14 and 15) should be constructed as a first step in the process and stormwater routed to these. [Minn. R. 7090]
7.3	Permittees must not disturb more land (i.e., phasing) than can be effectively inspected and maintained in accordance with Section 11. [Minn. R. 7090]
7.4	If permittees will be using some type of erosion control netting on the site as part of the soil stabilization techniques, permittees are encouraged to use products that have been shown to minimize impacts on wildlife. The U.S. Fish & Wildlife Service recommends using types of netting practices that are considered "wildlife friendly," including those that use natural fiber or 100 percent biodegradable materials and that use a loose weave with a non-welded, movable jointed netting. Products that are not wildlife friendly include square plastic netting that are degradable (e.g., photodegradable, UV-degradable, oxo-degradable), netting made from polypropylene, nylon, polyethylene, or polyester. Other recommendations include removing the netting product when it is no longer needed. More information may be found at: https://www.fws.gov/initiative/protecting-wildlife/make-change-wildlife-friendly-erosion-control-products. There also may be State, Tribal, or local requirements about using wildlife friendly erosion control products. See Minnesota Department of Transportation requirements at: https://www.mndot.org/environment/erosion/rolled-erosion-prevention-products.html. [Minn. R. 7050]
8.1	**Erosion Prevention Practices**. [Minn. R. 7090]
8.2	Before work begins, permittees must delineate the location of areas not to be disturbed. [Minn. R. 7090]
8.3	Permittees must minimize the need for disturbance of portions of the project with steep slopes. When steep slopes must be disturbed, permittees must use techniques such as phasing and stabilization practices designed for steep slopes (e.g., slope draining and terracing). [Minn. R. 7090]
8.4	Permittees must stabilize all exposed soil areas, including stockpiles. Stabilization must be initiated immediately to limit soil erosion when construction activity has permanently or temporarily ceased on any portion of the site and will not resume for a period exceeding 14 calendar days (7 days for sites discharging to special or impaired waters, see section 24). Stabilization must be completed no later than 14 calendar days after the construction activity has ceased. Stabilization is not required on constructed base components of roads, parking lots and similar surfaces. Stabilization is not required on temporary stockpiles without significant silt, clay or organic components (e.g., clean aggregate stockpiles, demolition concrete stockpiles, sand stockpiles) but permittees must provide sediment controls at the base of the stockpile. [Minn. R. 7090]
8.5	For Public Waters that the Minnesota DNR has promulgated "work in water restrictions" during specified fish spawning time frames, permittees must complete stabilization of all exposed soil areas within 200 feet of the water's edge, and that drain to these waters, within 24 hours during the restriction period. [Minn. R. 7090]
8.6	Permittees must stabilize the normal wetted perimeter of the last 200 linear feet of temporary or permanent drainage ditches or swales that drain water from the site within 24 hours after connecting to a surface water or property edge. Permittees must complete stabilization of remaining portions of temporary or permanent ditches or swales within 14 calendar days (7 days for sites discharging to special or impaired waters, see section 24) after connecting to a surface water or property edge and construction in that portion of the ditch temporarily or permanently ceases. [Minn. R. 7090]
8.7	Temporary or permanent ditches or swales being used as a sediment containment system during construction (with properly designed rock-ditch checks, bio rolls, silt dikes, etc.) do not need to be stabilized. Permittees must stabilize these areas within 24 hours after their use as a sediment containment system ceases. [Minn. R. 7090]
8.8	Permittees must not use mulch, hydromulch, tackifier, polyacrylamide or similar erosion prevention practices within any portion of the normal wetted perimeter of a temporary or permanent drainage ditch or swale section with a continuous slope of greater than 2 percent. Examples of acceptable erosion prevention practices include blankets, poly, riprap, etc. [Minn. R. 7090]
8.9	Permittees must provide temporary or permanent energy dissipation at all pipe outlets within 24 hours after connection to a surface water or permanent stormwater treatment system. [Minn. R. 7090]
9.1	**Sediment Control Practices**. [Minn. R. 7090]
9.2	Permittees must establish sediment control BMPs on all downgradient perimeters of the site and downgradient areas of the site that drain to any surface water, including curb and gutter systems. Permittees must locate sediment control practices upgradient of any buffer zones. Permittees must install sediment control practices before any upgradient land-disturbing activities begin and must keep the sediment control practices in place until they establish permanent cover. [Minn. R. 7090]
9.3	If downgradient sediment controls are overloaded, based on frequent failure or excessive maintenance requirements,

	permittees must install additional upgradient sediment control practices or redundant BMPs to eliminate the overloading and amend the SWPPP to identify these additional practices as required in item 6.3. [Minn. R. 7090]
9.4	Temporary or permanent drainage ditches and sediment basins designed as part of a sediment containment system (e.g., ditches with rock-check dams) require sediment control practices only as appropriate for site conditions. [Minn. R. 7090]
9.5	A floating silt curtain placed in the water is not a sediment control BMP to satisfy item 9.2 except when working on a shoreline or below the waterline. Immediately after the construction activity (e.g., installation of rip rap along the shoreline) in that area is complete, permittees must install an upland perimeter control practice if exposed soils still drain to a surface water. [Minn. R. 7090]
9.6	Permittees must re-install all sediment control practices adjusted or removed to accommodate short-term activities such as clearing or grubbing, or passage of vehicles, immediately after the short-term activity is completed. Permittees must re-install sediment control practices before the next precipitation event even if the short-term activity is not complete. [Minn. R. 7090]
9.7	Permittees must protect all storm drain inlets using appropriate BMPs during construction until they establish permanent cover on all areas with potential for discharging to the inlet. [Minn. R. 7090]
9.8	Permittees may remove inlet protection for a particular inlet if a specific safety concern (e.g. street flooding/freezing) is identified by the permittees or the jurisdictional authority (e.g., city/county/township/Minnesota Department of Transportation engineer). Permittees must document the need for removal in the SWPPP. [Minn. R. 7090]
9.9	Permittees must provide silt fence or other effective sediment controls at the base of stockpiles on the downgradient perimeter prior to the initiation of stockpiling. Sediment controls must be managed in accordance with section 9.6. [Minn. R. 7090]
9.10	Permittees must locate stockpiles outside of natural buffers or surface waters, including stormwater conveyances such as curb and gutter systems unless there is a bypass in place for the stormwater. [Minn. R. 7090]
9.11	Permittees must install a vehicle tracking BMP to minimize the track out of sediment from the construction site or onto paved roads within the site. [Minn. R. 7090]
9.12	Permittees must use street sweeping in addition to vehicle tracking BMPs if vehicle tracking BMPs alone are not adequate to prevent sediment tracking onto the street. [Minn. R. 7090]
9.13	Permittees must install temporary sediment basins as required in Section 14. [Minn. R. 7090]
9.14	In any areas of the site where final vegetative stabilization will occur, permittees must restrict vehicle and equipment use to minimize soil compaction. [Minn. R. 7090]
9.15	Permittees must preserve topsoil on the site, unless infeasible. [Minn. R. 7090]
9.16	Permittees must direct discharges from BMPs to vegetated areas unless infeasible. [Minn. R. 7090]
9.17	Permittees must preserve a 50-foot natural buffer or, if a buffer is infeasible on the site, provide redundant (double) perimeter sediment controls when a surface water is located within 50 feet of the project's earth disturbances and stormwater flows to the surface water. Permittees must install perimeter sediment controls at least 5 feet apart unless limited by lack of available space. Natural buffers are not required adjacent to road ditches, judicial ditches, county ditches, stormwater conveyance channels, storm drain inlets, and sediment basins. If preserving the buffer is infeasible, permittees must document the reasons in the SWPPP. Sheet piling and other impermeable barriers installed in a manner that retains all stormwater are considered redundant perimeter control. [Minn. R. 7090]
9.18	Any sediment control made of soil must be temporarily or permanently stabilized within 24 hours. [Minn. R. 7090]
9.19	Permittees must use polymers, flocculants, or other sedimentation treatment chemicals in accordance with accepted engineering practices, dosing specifications and sediment removal design specifications provided by the manufacturer or supplier. The permittees must use conventional erosion and sediment controls prior to chemical addition and must direct treated stormwater to a sediment control system for filtration or settlement of the floc prior to discharge. [Minn. R. 7090]
10.1	**Dewatering and Basin Draining**. [Minn. R. 7090]
10.2	Permittees must not cause nuisance conditions (see Minn. R. 7050.0210, subp. 2) in surface waters from dewatering and basin draining (e.g., pumped discharges, trench/ditch cuts for drainage) discharges. Permittees must discharge turbid or sediment-laden waters related to dewatering or basin draining to a sediment control (e.g. sediment trap or basin, filter bag) designed to prevent discharges with visual turbidity. To the extent feasible, use well-vegetated (e.g., grassy or wooded), upland areas of the site to infiltrate dewatering water before discharge. Permittees are prohibited from using receiving waters as part of the treatment area. Permittees must visually check and photograph the discharge at the beginning and at least once every 24 hours of operation to ensure adequate treatment has been obtained and nuisance conditions will not

	result from the discharge. [Minn. R. 7050.0210]
10.3	If nuisance conditions result from the discharge, Permittees must cease dewatering immediately and corrective actions must occur before dewatering is resumed. Nuisance conditions includes, but is not limited to, a sediment plume in the discharge or the discharge appears cloudy, or opaque, or has a visible contrast, or has a visible oil film, or has aquatic habitat degradation that can be identified by an observer. [Minn. R. 7050.0210]
10.4	If permittees must discharge water containing oil or grease, they must use an oil-water separator or suitable filtration device (e.g., cartridge filters, absorbents pads) prior to discharge. [Minn. R. 7090]
10.5	Permittees must discharge all water from dewatering or basin-draining activities in a manner that does not cause erosion or scour in the immediate vicinity of discharge points or inundation of wetlands in the immediate vicinity of discharge points that causes significant adverse impact to the wetland. [Minn. R. 7090]
10.6	If permittees use filters with backwash water, they must haul the backwash water away for disposal, return the backwash water to the beginning of the treatment process, or incorporate the backwash water into the site in a manner that does not cause erosion. [Minn. R. 7090]
11.1	**Inspections and Maintenance**. [Minn. R. 7090]
11.2	Permittees must ensure a trained person, as identified in item 21.2.b, will inspect the entire construction site at least once every seven (7) days during active construction and within 24 hours after a rainfall event greater than 1/2 inch in 24 hours. [Minn. R. 7090]
11.3	Permittees must inspect and maintain all permanent stormwater treatment BMPs. [Minn. R. 7090]
11.4	Permittees must inspect all erosion prevention and sediment control BMPs and Pollution Prevention Management Measures to ensure integrity and effectiveness. Permittees must repair, replace or supplement all nonfunctional BMPs with functional BMPs by the end of the next business day after discovery unless another time frame is specified in item 11.5 or 11.6. Permittees may take additional time if field conditions prevent access to the area. [Minn. R. 7090]
11.5	During each inspection, permittees must inspect areas adjacent to the project, surface waters, including drainage ditches and conveyance systems but not curb and gutter systems, for evidence of erosion and sediment deposition. Permittees must remove all deltas and sediment deposited in areas adjacent to the project, surface waters, including drainage ways, catch basins, and other drainage systems and restabilize the areas where sediment removal results in exposed soil. Permittees must complete removal and stabilization within seven (7) calendar days of discovery unless precluded by legal, regulatory, or physical access constraints. Permittees must use all reasonable efforts to obtain access. If precluded, removal and stabilization must take place within seven (7) days of obtaining access. Permittees are responsible for contacting all local, regional, state and federal authorities and receiving any applicable permits, prior to conducting any work in surface waters. [Minn. R. 7090]
11.6	Permittees must inspect construction site vehicle exit locations, streets and curb and gutter systems within and adjacent to the project for sedimentation from erosion or tracked sediment from vehicles. Permittees must remove sediment from all paved surfaces within one (1) calendar day of discovery or, if applicable, within a shorter time to avoid a safety hazard to users of public streets. [Minn. R. 7090]
11.7	Permittees must repair, replace or supplement all perimeter control devices when they become nonfunctional or the sediment reaches 1/2 of the height of the device. [Minn. R. 7090]
11.8	Permittees must drain temporary and permanent sedimentation basins and remove the sediment when the depth of sediment collected in the basin reaches 1/2 the storage volume within 72 hours of discovery. [Minn. R. 7090]
11.9	Permittee's must inspect and photograph dewatering discharges at the beginning and at least once every 24 hours during operation. Dewatering discharges that only last for minutes, as opposed to hours, and do not reach a surface water, do not require photographs or documentation. [Minn. R. 7090]
11.10	Permittees must ensure that at least one individual present on the site (or available to the project site in three (3) calendar days) is trained in the job duties described in item 21.2.b. [Minn. R. 7090]
11.11	Permittees may adjust the inspection schedule described in item 11.2 as follows: a. inspections of areas with permanent cover can be reduced to once per month, even if construction activity continues on other portions of the site; or b. where sites have permanent cover on all exposed soil and no construction activity is occurring anywhere on the site, inspections can be reduced to once per month and, after 12 months, may be suspended completely until construction activity resumes. The MPCA may require inspections to resume if conditions warrant; or c. where construction activity has been suspended due to frozen ground conditions, inspections may be suspended.

	Inspections must resume within 24 hours of runoff occurring, or upon resuming construction, whichever comes first. d. for projects where a pollinator habitat or native prairie type vegetated cover is being established, inspections may be reduced to once per month if the site has temporary vegetation with a density of 70% temporary uniform cover. If after 24 months no significant erosion problems are observed, inspections may be suspended completely until the termination requirements in section 13 have been met. [Minn. R. 7090]
11.12	Permittees must record all inspections and maintenance activities within 24 hours of being conducted and these records must be retained with the SWPPP. These records must include: a. date and time of inspections; and b. name of persons conducting inspections; and c. accurate findings of inspections, including the specific location where corrective actions are needed; and d. corrective actions taken (including dates, times, and party completing maintenance activities); and e. date of all rainfall events greater than 1/2 inches in 24 hours, and the amount of rainfall for each event. Permittees must obtain rainfall amounts by either a properly maintained rain gauge installed on-site, a weather station that is within one (1) mile of your location, or a weather reporting system that provides site specific rainfall data from radar summaries; and f. if permittees observe a discharge during the inspection, they must record and should photograph and describe the location of the discharge (i.e., color, odor, settled or suspended solids, oil sheen, and other obvious indicators of pollutants); and g. any amendments to the SWPPP proposed as a result of the inspection must be documented as required in Section 6 within seven (7) calendar days; and h. all photographs of dewatering activities and documentation of nuisance conditions resulting from dewatering activities as described in section 10. [Minn. R. 7090]
12.1	**Pollution Prevention Management Measures**. [Minn. R. 7090]
12.2	Permittees must place construction materials and landscape materials under cover (e.g., plastic sheeting or temporary roofs) or protect them by similarly effective means designed to minimize contact with stormwater. Permittees are not required to cover or protect products which are either not a source of contamination to stormwater or are designed to be exposed to stormwater. [Minn. R. 7090]
12.3	Permittees must place pesticides, fertilizers and treatment chemicals under cover (e.g., plastic sheeting or temporary roofs) or protect them by similarly effective means designed to minimize contact with stormwater. [Minn. R. 7090]
12.4	Permittees must store hazardous materials and toxic waste, (including oil, diesel fuel, gasoline, hydraulic fluids, paint solvents, petroleum-based products, wood preservatives, additives, curing compounds, and acids) in sealed containers to prevent spills, leaks or other discharge. Storage and disposal of hazardous waste materials must be in compliance with Minn. R. ch. 7045 including secondary containment as applicable. [Minn. R. 7090]
12.5	Permittees must properly store, collect and dispose solid waste in compliance with Minn. R. ch. 7035. [Minn. R. 7035]
12.6	Permittees must position portable toilets so they are secure and will not tip or be knocked over. Permittees must properly dispose sanitary waste in accordance with Minn. R. ch. 7041. [Minn. R. 7041]
12.7	Permittees must take reasonable steps to prevent the discharge of spilled or leaked chemicals, including fuel, from any area where chemicals or fuel will be loaded or unloaded including the use of drip pans or absorbents unless infeasible. Permittees must ensure adequate supplies are available at all times to clean up discharged materials and that an appropriate disposal method is available for recovered spilled materials. Permittees must report and clean up spills immediately as required by Minn. Stat. 115.061, using dry clean up measures where possible. [Minn. Stat. 115.061]
12.8	Permittees must limit vehicle exterior washing and equipment to a defined area of the site. Permittees must contain runoff from the washing area in a sediment basin or other similarly effective controls and must dispose waste from the washing activity properly. Permittees must properly use and store soaps, detergents, or solvents. [Minn. R. 7090]
12.9	Permittees must provide effective containment for all liquid and solid wastes generated by washout operations (e.g., concrete, stucco, paint, form release oils, curing compounds and other construction materials) related to the construction activity. Permittees must prevent liquid and solid washout wastes from contacting the ground and must design the containment so it does not result in runoff from the washout operations or areas. Permittees must properly dispose liquid and solid wastes in compliance with MPCA rules. Permittees must install a sign indicating the location of the washout facility. [Minn. R. 7035, Minn. R. 7090]
13.1	**Permit Termination Conditions**. [Minn. R. 7090]
13.2	Permittees must complete all construction activity and must install permanent cover over all areas prior to submitting the NOT. Vegetative cover must consist of a uniform perennial vegetation with a density of 70 percent of its expected final

	growth. Vegetation is not required where the function of a specific area dictates no vegetation, such as impervious surfaces or the base of a sand filter. [Minn. R. 7090]
13.3	Permittees must clean the permanent stormwater treatment system of any accumulated sediment and must ensure the system meets all applicable requirements in Section 15 through 19 and is operating as designed. [Minn. R. 7090]
13.4	Permittees must remove all sediment from conveyance systems prior to submitting the NOT. [Minn. R. 7090]
13.5	Permittees must remove all temporary synthetic erosion prevention and sediment control BMPs prior to submitting the NOT. Permittees may leave BMPs designed to decompose on-site in place. [Minn. R. 7090]
13.6	For residential construction only, permit coverage terminates on individual lots if the lot is sold to the homeowner, structures are finished, and permanent cover has been established. For lots that are sold to the homeowner where permanent cover has not been established, coverage terminates if temporary erosion prevention and downgradient perimeter control is properly installed and the permittee distributes the MPCA's "Homeowner Fact Sheet" to the homeowner. [Minn. R. 7090]
13.7	For construction projects on agricultural land (e.g., pipelines across cropland), permittees must return the disturbed land to its preconstruction agricultural use prior to submitting the NOT. [Minn. R. 7090]
13.8	When submitting the NOT, Permittees must include either ground or aerial photographs showing the requirements of 13.2 have been met. Permittees are not required to take photographs of every distinct part of the site, however the conditions portrayed must be substantially similar to those areas that are not photographed. Photographs must be clear and in focus and must include the date the photo was taken. [Minn. R. 7090]
14.1	**Temporary Sediment Basins**. [Minn. R. 7090]
14.2	Where ten (10) or more acres of disturbed soil (5 acres for sites discharging to special or impaired waters, see section 24) drain to a common location, permittees must provide a temporary sediment basin to provide treatment of the runoff before it leaves the construction site or enters surface waters. Permittees may convert a temporary sediment basin to a permanent basin after construction is complete. The temporary basin is no longer required when permanent cover has reduced the acreage of disturbed soil to less than ten (10) acres draining to a common location. [Minn. R. 7090]
14.3	The temporary basin must provide live storage for a calculated volume of runoff from a two (2)-year, 24-hour storm from each acre drained to the basin or 1,800 cubic feet of live storage per acre drained, whichever is greater. [Minn. R. 7090]
14.4	Where permittees have not calculated the two (2)-year, 24-hour storm runoff amount, the temporary basin must provide 3,600 cubic feet of live storage per acre of the basins' drainage area. [Minn. R. 7090]
14.5	Permittees must design basin outlets to prevent short-circuiting and the discharge of floating debris. [Minn. R. 7090]
14.6	Permittees must design the outlet structure to withdraw water from the surface to minimize the discharge of pollutants. Permittees may temporarily suspend the use of a surface withdrawal mechanism during frozen conditions. The basin must include a stabilized emergency overflow to prevent failure of pond integrity. [Minn. R. 7090]
14.7	Permittees must provide energy dissipation for the basin outlet within 24 hours after connection to a surface water. [Minn. R. 7090]
14.8	Permittees must locate temporary basins outside of surface waters and any buffer zone required in item 23.11. [Minn. R. 7090]
14.9	Permittees must construct the temporary basins prior to disturbing 10 or more acres of soil draining to a common location. [Minn. R. 7090]
14.10	Where a temporary sediment basin meeting the requirements of item 14.3 through 14.9 is infeasible, permittees must install effective sediment controls such as smaller sediment basins and/or sediment traps, silt fences, vegetative buffer strips or any appropriate combination of measures as dictated by individual site conditions. In determining whether installing a sediment basin is infeasible, permittees must consider public safety and may consider factors such as site soils, slope, and available area on-site. Permittees must document this determination of infeasibility in the SWPPP. [Minn. R. 7090]
15.1	**Permanent Stormwater Treatment System**. [Minn. R. 7090]
15.2	Permittees must design and implement the project so all stormwater discharged from the project during and after construction activities does not cause a violation of state water quality standards, including nuisance conditions, erosion in receiving channels or on downslope properties, or a significant adverse impact to wetlands caused by inundation or decrease of flow. [Minn. R. 7090]
15.3	Permittees must design and construct a permanent stormwater treatment system to treat the water quality volume if the project's ultimate development replaces vegetation and/or other pervious surfaces creating a net increase of one (1) or

	more acres of cumulative impervious surface. [Minn. R. 7090]
15.4	Permittees must calculate the water quality volume as one (1) inch times the net increase of impervious surfaces created by the project. [Minn. R. 7090]
15.5	Permittees must first consider volume reduction practices on-site (e.g., infiltration or other) when designing the permanent stormwater treatment system. If this permit prohibits infiltration as described in item 16.14 through item 16.21, permittees may consider a wet sedimentation basin, filtration basin or regional pond. This permit does not consider wet sedimentation basins and filtration systems to be volume reduction practices. [Minn. R. 7090]
15.6	For projects where the full volume reduction requirement cannot be met on-site, (e.g., the site has infiltration prohibitions), permittees must document the reasons in the SWPPP. [Minn. R. 7090]
15.7	Permittees must discharge the water quality volume to a permanent stormwater treatment system prior to discharge to a surface water. For purposes of this item, surface waters do not include man-made drainage systems that convey stormwater to a permanent stormwater treatment system. [Minn. R. 7090]
15.8	Where the proximity to bedrock precludes the installation of any of the permanent stormwater treatment practices required by Sections 15 through 19, permittees must install other treatment such as grassed swales, smaller ponds, or grit chambers, prior to the discharge of stormwater to surface waters. [Minn. R. 7090]
15.9	For linear projects where permittees cannot treat the entire water quality volume within the existing right-of-way, permittees must make a reasonable attempt to obtain additional right-of-way, easement or other permission for stormwater treatment during the project planning process. Documentation of these attempts must be in the SWPPP. Permittees must still consider volume reduction practices first as described in item 15.5. If permittees cannot obtain additional right-of-way, easement or other permission, they must maximize the treatment of the water quality volume prior to discharge to surface waters. [Minn. R. 7090]
16.1	**Infiltration Systems**. [Minn. R. 7090]
16.2	Infiltration options include, but are not limited to: infiltration basins, infiltration trenches, rainwater gardens, bioretention areas without underdrains, swales with impermeable check dams, and natural depressions. If permittees utilize an infiltration system to meet the requirements of this permit, they must incorporate the design parameters in item 16.3 through item 16.21. Permittees must follow the infiltration prohibition in item 16.14 anytime an infiltration system is designed, including those not required by this permit. [Minn. R. 7090]
16.3	Permittees must design infiltration systems such that pre-existing hydrologic conditions of wetlands in the vicinity are not impacted (e.g., inundation or breaching a perched water table supporting a wetland). [Minn. R. 7090]
16.4	Permittees must not excavate infiltration systems to final grade, or within three (3) feet of final grade, until the contributing drainage area has been constructed and fully stabilized unless they provide rigorous erosion prevention and sediment controls (e.g., diversion berms) to keep sediment and runoff completely away from the infiltration area. [Minn. R. 7090]
16.5	When excavating an infiltration system to within three (3) feet of final grade, permittees must stake off and mark the area so heavy construction vehicles or equipment do not compact the soil in the infiltration area. [Minn. R. 7090]
16.6	Permittees must use a pretreatment device such as a vegetated filter strip, forebay, or water quality inlet (e.g., grit chamber) to remove solids, floating materials, and oil and grease from the runoff, to the maximum extent practicable, before the system routes stormwater to the infiltration system. [Minn. R. 7090]
16.7	Permittees must design infiltration systems to provide a water quality volume (calculated as an instantaneous volume) of one (1) inch of runoff, or one (1) inch minus the volume of stormwater treated by another system on the site, from the net increase of impervious surfaces created by the project. [Minn. R. 7090]
16.8	Permittees must design the infiltration system to discharge all stormwater (including stormwater in excess of the water quality volume) routed to the system through the uppermost soil surface or engineered media surface within 48 hours. Permittees must route additional flows that cannot infiltrate within 48 hours to bypass the system through a stabilized discharge point. [Minn. R. 7090]
16.9	Permittees must provide a means to visually verify the infiltration system is discharging through the soil surface or filter media surface within 48 hours or less. [Minn. R. 7090]
16.10	Permittees must provide at least one soil boring, test pit or infiltrometer test in the location of the infiltration practice for determining infiltration rates. [Minn. R. 7090]
16.11	For design purposes, permittees must divide field measured infiltration rates by 2 as a safety factor or permittees can use soil-boring results with the infiltration rate chart in the Minnesota Stormwater Manual to determine design infiltration rates. When soil borings indicate type A soils, permittees should perform field measurements to verify the rate is not above

	8.3 inches per hour. This permit prohibits infiltration if the field measured infiltration rate is above 8.3 inches per hour. [Minn. R. 7090]
16.12	Permittees must employ appropriate on-site testing to ensure a minimum of three (3) feet of separation from the seasonally saturated soils (or from bedrock) and the bottom of the proposed infiltration system. [Minn. R. 7090]
16.13	Permittees must design a maintenance access, typically eight (8) feet wide, for the infiltration system. [Minn. R. 7090]
16.14	This permit prohibits permittees from constructing infiltration systems that receive runoff from vehicle fueling and maintenance areas including construction of infiltration systems not required by this permit. [Minn. R. 7090]
16.15	This permit prohibits permittees from constructing infiltration systems where infiltrating stormwater may mobilize high levels of contaminants in soil or groundwater. Permittees must either complete the MPCA's contamination screening checklist or conduct their own assessment to determine the suitability for infiltration. Permittees must retain the checklist or assessment with the SWPPP. For more information and to access the MPCA's "contamination screening checklist" see the Minnesota Stormwater Manual. [Minn. R. 7090]
16.16	This permit prohibits permittees from constructing infiltration systems in areas where soil infiltration rates are field measured at more than 8.3 inches per hour unless they amend soils to slow the infiltration rate below 8.3 inches per hour. [Minn. R. 7090]
16.17	This permit prohibits permittees from constructing infiltration systems in areas with less than three (3) feet of separation distance from the bottom of the infiltration system to the elevation of the seasonally saturated soils or the top of bedrock. [Minn. R. 7090]
16.18	This permit prohibits permittees from constructing infiltration systems in areas of predominately Hydrologic Soil Group type D soils (clay). [Minn. R. 7090]
16.19	This permit prohibits permittees from constructing infiltration systems within a Drinking Water Supply Management Area (DWSMA) as defined in Minn. R. 4720.5100, subp. 13, if the system will be located: a. in an Emergency Response Area (ERA) within a DWSMA classified as having high or very high vulnerability as defined by the Minnesota Department of Health; or b. in an ERA within a DWSMA classified as moderate vulnerability unless a regulated MS4 Permittee performed or approved a higher level of engineering review sufficient to provide a functioning treatment system and to prevent adverse impacts to groundwater; or c. outside of an ERA within a DWSMA classified as having high or very high vulnerability, unless a regulated MS4 Permittee performed or approved a higher level of engineering review sufficient to provide a functioning treatment system and to prevent adverse impacts to groundwater. See "higher level of engineering review" in the Minnesota Stormwater Manual for more information. [Minn. R. 7090]
16.20	This permit prohibits permittees from constructing infiltration systems in areas within 1,000 feet upgradient or 100 feet downgradient of active karst features. [Minn. R. 7090]
16.21	This permit prohibits permittees from constructing infiltration systems in areas that receive runoff from the following industrial facilities not authorized to infiltrate stormwater under the NPDES stormwater permit for industrial activities: wood preserving facilities; automobile salvage yards; scrap recycling and waste recycling facilities; hazardous waste treatment, storage, or disposal facilities; or air transportation facilities that conduct deicing activities. [Minn. R. 7090]
17.1	**Filtration Systems**. [Minn. R. 7090]
17.2	Filtration options include but are not limited to: sand filters with underdrains, biofiltration areas, swales using underdrains with impermeable check dams and underground sand filters. If permittees utilize a filtration system to meet the permanent stormwater treatment requirements of this permit, they must comply with items 17.3 through 17.11. [Minn. R. 7090]
17.3	Permittees must not install filter media until they construct and fully stabilize the contributing drainage area unless they provide rigorous erosion prevention and sediment controls (e.g., diversion berms) to keep sediment and runoff completely away from the filtration area. [Minn. R. 7090]
17.4	Permittees must design filtration systems to remove at least 80 percent of TSS. [Minn. R. 7090]
17.5	Permittees must use a pretreatment device such as a vegetated filter strip, small sedimentation basin, water quality inlet, forebay or hydrodynamic separator to remove settleable solids, floating materials, and oils and grease from the runoff, to the maximum extent practicable, before runoff enters the filtration system. [Minn. R. 7090]

17.6	Permittees must design filtration systems to treat a water quality volume (calculated as an instantaneous volume) of one (1) inch of runoff, or one (1) inch minus the volume of stormwater treated by another system on the site, from the net increase of impervious surfaces created by the project. [Minn. R. 7090]
17.7	Permittees must design the filtration system to discharge all stormwater (including stormwater in excess of the water quality volume) routed to the system through the uppermost soil surface or engineered media surface within 48 hours. Additional flows that the system cannot filter within 48 hours must bypass the system or discharge through an emergency overflow. [Minn. R. 7090]
17.8	Permittees must design the filtration system to provide a means to visually verify the system is discharging through the soil surface or filter media within 48 hours. [Minn. R. 7090]
17.9	Permittees must employ appropriate on-site testing to ensure a minimum of three (3) feet of separation between the seasonally saturated soils (or from bedrock) and the bottom of the proposed filtration system. [Minn. R. 7090]
17.10	Permittees must ensure that filtration systems with less than three (3) feet of separation between seasonally saturated soils or from bedrock are constructed with an impermeable liner. [Minn. R. 7090]
17.11	The permittees must design a maintenance access, typically eight (8) feet wide, for the filtration system. [Minn. R. 7090]
18.1	**Wet Sedimentation Basin**. [Minn. R. 7090]
18.2	Permittees using a wet sedimentation basin to meet the permanent stormwater treatment requirements of this permit must incorporate the design parameters in item 18.3 through 18.10. [Minn. R. 7090]
18.3	Permittees must design the basin to have a permanent volume of 1,800 cubic feet of storage below the outlet pipe for each acre that drains to the basin. The basin's permanent volume must reach a minimum depth of at least three (3) feet and must have no depth greater than 10 feet. Permittees must configure the basin to minimize scour or resuspension of solids. [Minn. R. 7090]
18.4	Permittees must design the basin to provide live storage for a water quality volume (calculated as an instantaneous volume) of one (1) inch of runoff, or one (1) inch minus the volume of stormwater treated by another system on the site, from the net increase in impervious surfaces created by the project. [Minn. R. 7090]
18.5	Permittees must design basin outlets so the water quality volume discharges at no more than 5.66 cubic feet per second (cfs) per acre of surface area of the basin. [Minn. R. 7090]
18.6	Permittees must design basin outlets to prevent short-circuiting and the discharge of floating debris. Basin outlets must have energy dissipation. [Minn. R. 7090]
18.7	Permittees must design the basin to include a stabilized emergency overflow to accommodate storm events in excess of the basin's hydraulic design. [Minn. R. 7090]
18.8	Permittees must design a maintenance access, typically eight (8) feet wide, for the basin. [Minn. R. 7090]
18.9	Permittees must locate basins outside of surface waters and any buffer zone required in item 23.11. Permittees must design basins to avoid draining water from wetlands unless the impact to the wetland complies with the requirements of Section 22. [Minn. R. 7090]
18.10	Permittees must design basins using an impermeable liner if located within active karst terrain. [Minn. R. 7090]
19.1	**Regional Wet Sedimentation Basins**. [Minn. R. 7090]
19.2	When the entire water quality volume cannot be treated by volume reduction practices on-site, permittees can use or create regional wet sedimentation basins provided they are constructed basins, not a natural wetland or water body, (wetlands used as regional basins must be mitigated for, see Section 22). The owner must ensure the regional basin conforms to all requirements for a wet sedimentation basin as described in items 18.3 through 18.10 and must be large enough to account for the entire area that drains to the regional basin. Permittees must verify that the regional basin will discharge at no more than 5.66 cfs per acre of surface area of the basin and must provide a live storage volume of one-inch times all the impervious area draining to the basin. Permittees cannot significantly degrade waterways between the project and the regional basin. The owner must obtain written authorization from the applicable LGU or private entity that owns and maintains the regional basin. [Minn. R. 7090]
20.1	**SWPPP Availability**. [Minn. R. 7090]
20.2	Permittees must keep the SWPPP on-site, or electronically available on-site, during normal working hours with personnel who have operational control over the applicable portion of the site, including all changes to the SWPPP, inspections, and maintenance records. [Minn. R. 7090]
21.1	**Training Requirements**. [Minn. R. 7090]

21.2	Permittees must ensure all of the following individuals receive training and the content and extent of the training is commensurate with the individual's job duties and responsibilities with regard to activities covered under this permit: a. Individuals preparing the SWPPP for the project. b. Individuals overseeing implementation of, revising and/or amending the SWPPP and individuals performing inspections for the project. One of these individuals must be available for an on-site inspection within 72 hours upon request by the MPCA. c. Individuals performing or supervising the installation, maintenance and repair of BMPs. [Minn. R. 7090]
21.3	Permittees must ensure individuals identified in Section 21 receive training from local, state, federal agencies, professional organizations, or other entities with expertise in erosion prevention, sediment control, permanent stormwater treatment and the Minnesota NPDES/SDS Construction Stormwater permit. Permittees must ensure these individuals attend a refresher-training course every three (3) years. [Minn. R. 7090]
22.1	**Requirements for Discharges to Wetlands**. [Minn. R. 7050.0186]
22.2	If the project has any discharges with the potential for significant adverse impacts to a wetland, (e.g., conversion of a natural wetland to a stormwater pond) permittees must demonstrate that the wetland mitigative sequence has been followed in accordance with items 22.3 or 22.4. [Minn. R. 7050.0186]
22.3	If the potential adverse impacts to a wetland on a specific project site are addressed by permits or other approvals from an official statewide program (U.S. Army Corps of Engineers 404 program, Minnesota Department of Natural Resources, or the State of Minnesota Wetland Conservation Act) that are issued specifically for the project and project site, permittees may use the permit, decision or other determination issued by these agencies to show the potential adverse impacts are addressed. For purposes of this permit, deminimus actions are determinations by the permitting agency that address the project impacts, whereas a non-jurisdictional determination does not address project impacts. [Minn. R. 7090]
22.4	If there are impacts from the project not addressed in one of the permits, decisions or other determinations discussed in item 22.3 (e.g., permanent inundation or flooding of the wetland, significant degradation of water quality, excavation, filling, draining), permittees must minimize all adverse impacts to wetlands by utilizing appropriate measures. Permittees must use measures based on the nature of the wetland, its vegetative community types and the established hydrology. These measures include in order of preference: a. avoid all significant adverse impacts to wetlands from the project and post-project discharge; b. minimize any unavoidable impacts from the project and post-project discharge; c. provide compensatory mitigation when the permittees determine(s) that there is no reasonable and practicable alternative to having a significant adverse impact on a wetland. For compensatory mitigation, wetland restoration or creation must be of the same type, size and whenever reasonable and practicable in the same watershed as the impacted wetland. [Minn. R. 7050.0186]
23.1	**Additional Requirements for Discharges to Special (Prohibited, Restricted, Other) and Impaired Waters**. [Minn. R. 7090]
23.2	The BMPs identified for each special or impaired water are required for those areas of the project draining to a discharge point on the project that is within one mile (aerial radius measurement) of special or impaired water and flows to that special or impaired water. [Minn. R. 7090]
23.3	Discharges to the following special waters identified as Prohibited in Minn. R. 7050.0335 subp. 3 must incorporate the BMPs outlined in items 23.9, 23.10, 23.11, 23.13 and 23.14: a. Boundary Waters Canoe Area Wilderness; Voyageurs National Park; Kettle River from the site of the former dam at Sandstone to its confluence with the Saint Croix River; Rum River from Ogechie Lake spillway to the northernmost confluence with Lake Onamia. b. Those portions of Lake Superior North of latitude 47 degrees, 57 minutes, 13 seconds, East of Hat Point, South of the Minnesota-Ontario boundary, and West of the Minnesota-Michigan boundary; c. Scientific and Natural Areas identified as in Minn. R. 7050.0335 Subp. 3: Boot Lake, Anoka County; Kettle River in sections 15, 22, 23, T 41 N, R 20, Pine County; Pennington Bog, Beltrami County; Purvis Lake-Ober Foundation, Saint Louis County; waters within the borders of Itasca Wilderness Sanctuary, Clearwater County; Iron Springs Bog, Clearwater County; Wolsfeld Woods, Hennepin County; Green Water Lake, Becker County; Blackdog Preserve, Dakota County; Prairie Bush Clover, Jackson County; Black Lake Bog, Pine County; Pembina Trail Preserve, Polk County; and Falls Creek, Washington County. [Minn. R. 7050.0335, subp. 3]
23.4	Discharges to the following special waters identified as Restricted in Minn. R. 7050.0335 subp.1 must incorporate the BMPs

	outlined in items 23.9, 23.10 and 23.11: a. Lake Superior, except those portions identified as prohibited in item 23.3.b; b. Mississippi River in those portions from Lake Itasca to the southerly boundary of Morrison County that are included in the Mississippi Headwaters Board comprehensive plan dated February 12, 1981; c. Scenic or Recreational River Segments: Saint Croix River, entire length; Cannon River from northern city limits of Faribault to its confluence with the Mississippi River; North Fork of the Crow River from Lake Koronis outlet to the Meeker-Wright county line; Kettle River from north Pine County line to the site of the former dam at Sandstone; Minnesota River from Lac que Parle dam to Redwood County State Aid Highway 11; Mississippi River from County State Aid Highway 7 bridge in Saint Cloud to northwestern city limits of Anoka; and Rum River from State Highway 27 bridge in Onamia to Madison and Rice streets in Anoka; d. Lake Trout Lakes identified in Minn. R. 7050.0335 including lake trout lakes inside the boundaries of the Boundary Waters Canoe Area Wilderness and Voyageurs National Park; e. Calcareous Fens listed in Minn. R. 7050.0335, subp. 1. [Minn. R. 7050.0335, subp. 1]
23.5	Discharges to the Trout Lakes (other special water) identified in Minn. R. 6264.0050, subp. 2 and Minn. R. 7050.0420 must incorporate the BMPs outlined in items 23.9, 23.10 and 23.11. [Minn. R. 6264.0050, subp. 2, Minn. R. 7050]
23.6	Discharges to the Trout Streams (other special water) listed in Minn. R. 6264.0050, subp. 4 and Minn. R. 7050.0420 must incorporate the BMPs outlined in items 23.9, 23.10, 23.11 and 23.12. [Minn. R. 6264.0050, subp. 4, Minn. R. 7050]
23.7	Discharges to impaired waters or a water with an USEPA approved TMDL for any of the impairments listed in this item must incorporate the BMPs outlined in items 23.9 and 23.10. Impaired waters are waters identified as impaired under section 303 (d) of the federal Clean Water Act for phosphorus (nutrient eutrophication biological indicators, nutrients), turbidity, TSS, dissolved oxygen or aquatic biota (fish bioassessment, aquatic plant bioassessment and aquatic macroinvertebrate bioassessment, benthic macroinvertebrate bioassessment). Terms used for the pollutants or stressors in this item are subject to change. [Minn. R. 7090]
23.8	Where the additional BMPs in this Section conflict with requirements elsewhere in this permit, items 23.9 through 23.14 take precedence. [Minn. R. 7090]
23.9	Permittees must immediately initiate stabilization of exposed soil areas, as described in item 8.5 & 8.8, and complete the stabilization within seven (7) calendar days after the construction activity in that portion of the site temporarily or permanently ceases. [Minn. R. 7090]
23.10	Permittees must provide a temporary sediment basin as described in Section 14 for common drainage locations that serve an area with five (5) or more acres disturbed at one time. [Minn. R. 7090]
23.11	Permittees must include an undisturbed buffer zone of not less than 100 linear feet from a special water (not including tributaries) and must maintain this buffer zone at all times, both during construction and as a permanent feature post construction, except where a water crossing or other encroachment is necessary to complete the project. Permittees must fully document the circumstance and reasons the buffer encroachment is necessary in the SWPPP and include restoration activities. This permit allows replacement of existing impervious surface within the buffer. Permittees must minimize all potential water quality, scenic and other environmental impacts of these exceptions by the use of additional or redundant (double) BMPs and must document this in the SWPPP for the project. [Minn. R. 7090]
23.12	Permittees must design the permanent stormwater treatment system so the discharge from the project minimizes any increase in the temperature of trout streams resulting from the one (1) and two (2) year 24-hour precipitation events. This includes all tributaries of designated trout streams located within the same Public Land Survey System (PLSS) Section. Permittees must incorporate one or more of the following measures, in order of preference: a. Provide stormwater infiltration or other volume reduction practices as described in item 15.4 and 15.5, to reduce runoff. Infiltration systems must discharge all stormwater routed to the system within 24 hours. b. Provide stormwater filtration as described in Section 17. Filtration systems must discharge all stormwater routed to the system within 24 hours. c. Minimize the discharge from connected impervious surfaces by discharging to vegetated areas, or grass swales, and through the use of other non-structural controls. d. If ponding is used, the design must include an appropriate combination of measures such as shading, vegetated swale discharges or constructed wetland treatment cells that limit temperature increases. The pond must be designed as a dry pond and should draw down in 24 hours or less. e. Other methods that minimize any increase in the temperature of the trout stream. [Minn. R. 7090]

23.13	Permittees must conduct routine site inspections once every three (3) days as described in item 11.2 for projects that discharge to prohibited waters. [Minn. R. 7090]
23.14	If discharges to prohibited waters cannot provide volume reduction equal to one (1) inch times the net increase of impervious surfaces as required in item 15.4 and 15.5, permittees must develop a permanent stormwater treatment system design that will result in no net increase of TSS or phosphorus to the prohibited water. Permittees must keep the plan in the SWPPP for the project. [Minn. R. 7090]
24.1	**General Provisions**. [Minn. R. 7090]
24.2	If the MPCA determines that an individual permit would more appropriately regulate the construction activity, the MPCA may require an individual permit to continue the construction activity. Coverage under this general permit will remain in effect until the MPCA issues an individual permit. [Minn. R. 7001.0210, subp. 6]
24.3	If the permittee cannot meet the terms and conditions of this general permit, an owner may request an individual permit, in accordance with Minn. R. 7001.0210 subp. 6. [Minn. R. 7001.0210, subp. 6]
24.4	Any interested person may petition the MPCA to require an individual NPDES/SDS permit in accordance with 40 CFR 122.28(b)(3). [40 CFR 122.28(b)(3)]
24.5	In addition to the requirement found in section 20, permittees must make the SWPPP, including all inspection reports, maintenance records, training records and other information required by this permit, available to federal, state, and local officials within three (3) days upon request for the duration of the permit and for three (3) years following the NOT. [Minn. R. 7090]
24.6	Permittees may not assign or transfer this permit except when the transfer occurs in accordance with the applicable requirements of item 3.7 and 3.8. [Minn. R. 7090]
24.7	Nothing in this permit must be construed to relieve the permittees from civil or criminal penalties for noncompliance with the terms and conditions provided herein. Nothing in this permit must be construed to preclude the initiation of any legal action or relieve the permittees from any responsibilities, liabilities, or penalties to which the permittees is/are or may be subject to under Section 311 of the Clean Water Act and Minn. Stat. Section 115 and 116, as amended. Permittees are not liable for permit requirements for activities occurring on those portions of a site where the permit has been transferred to another party as required in item 3.7 or the permittees have submitted the NOT as required in Section 4. [Minn. R. 7090]
24.8	The provisions of this permit are severable. If any provision of this permit or the application of any provision of this permit to any circumstances is held invalid, the application of such provision to other circumstances, and the remainder of this permit must not be affected thereby. [Minn. R. 7090]
24.9	The permittees must comply with the provisions of Minn. R. 7001.0150, subp. 3 and Minn. R. 7001.1090, subp. 1(A), 1(B), 1(C), 1(H), 1(I), 1(J), 1(K), and 1(L). [Minn. R. 7001]
24.10	The permittees must allow access as provided in 40 CFR 122.41(i) and Minn. Stat. Section 115.04. The permittees must allow representatives of the MPCA or any member, employee or agent thereof, when authorized by it, upon presentation of credentials, to enter upon any property, public or private, for the purpose of obtaining information or examination of records or conducting surveys or investigations. [40 CFR 122.41(i)]
24.11	For the purposes of Minn. R. 7090 and other documents that reference specific sections of this permit, "Stormwater Discharge Design Requirements" corresponds to Sections 5, 6 and 14 through 21; "Construction Activity Requirements" corresponds to Sections 7 through 13; and "Appendix A" corresponds to Sections 22 and 23. [Minn. R. 7090]
25.1	**Definitions**. [Minn. R. 7090]
25.2	"Active karst" means a terrain having distinctive landforms and hydrology created primarily from the dissolution of soluble rocks within 50 feet of the land surface. [Minn. R. 7090]
25.3	"Aerial radius measurement" means the shortest straight line distance measurement between the point of stormwater discharge from a project construction site to the nearest edge of the water body receiving the stormwater. This measurement does not follow the meander flow path. [Minn. R. 7090]
25.4	"Best Management Practices (BMPs)" means the most effective and practicable means of erosion prevention and sediment control, and water quality management practices that are the most effective and practicable means of to control, prevent, and minimize degradation of surface water, including avoidance of impacts, construction-phasing, minimizing the length of time soil areas are exposed, prohibitions, pollution prevention through good housekeeping, and other management practices published by state or designated area-wide planning agencies. [Minn. R. 7090]
25.5	"Common Plan of Development or Sale" means one proposed plan for a contiguous area where multiple separate and distinct land-disturbing activities may be taking place at different times, on different schedules, but under one proposed

	plan. One plan is broadly defined to include design, permit application, advertisement or physical demarcation indicating that land-disturbing activities may occur. [Minn. R. 7090]
25.6	"Construction Activity" means activities including clearing, grading, and excavating, that result in land disturbance of equal to or greater than one acre, including the disturbance of less than one acre of total land area that is part of a larger common plan of development or sale if the larger common plan will ultimately disturb equal to or greater than one acre. This includes a disturbance to the land that results in a change in the topography, existing soil cover, both vegetative and nonvegetative, or the existing soil topography that may result in accelerated stormwater runoff that may lead to soil erosion and movement of sediment. Construction activity does not include a disturbance to the land of less than five acres for the purpose of routine maintenance performed to maintain the original line and grade, hydraulic capacity, and original purpose of the facility. Routine maintenance does not include activities such as repairs, replacement and other types of non-routine maintenance. Pavement rehabilitation that does not disturb the underlying soils (e.g., mill and overlay projects) is not construction activity. [Minn. R. 7090]
25.7	"Dewatering" means the removal of surface or ground water to dry and/or solidify a construction site to enable construction activity. Dewatering may require a Minnesota Department of Natural Resources water appropriation permit and, if dewatering water is contaminated, discharge of such water may require an individual MPCA NPDES/SDS permit. [Minn. R. 7090]
25.8	"Energy Dissipation" means methods employed at pipe outlets to prevent erosion caused by the rapid discharge of water scouring soils. [Minn. R. 7090]
25.9	"Erosion Prevention" means measures employed to prevent erosion such as soil stabilization practices, permanent cover or construction phasing. [Minn. R. 7090]
25.10	"General Contractor" means the party who signs the construction contract with the owner to construct the entire project described in the final plans and specifications. Where the construction project involves more than one contractor, the general contractor is the party responsible for managing the entire project on behalf of the owner. In some cases, the owner is the general contractor. In these cases, the owner signs the permit application as the operator and becomes the sole permittee. [Minn. R. 7090]
25.11	"Groundwater" means the water contained below the surface of the earth in the saturated zone including, without limitation, all waters whether under confined, unconfined, or perched conditions, in near surface unconsolidated sediment or regolith, or in rock formations deeper underground. [Minn. R. 7060]
25.12	"Homeowner Fact Sheet" means an MPCA fact sheet available on the MPCA Construction Stormwater website for permittees to give to homeowners at the time of sale. [Minn. R. 7090]
25.13	"Infeasible" means not technologically possible or not economically practicable and achievable in light of the best industry practices. [Minn. R. 7090]
25.14	"Initiated immediately" means taking an action to commence soil stabilization as soon as practicable, but no later than the end of the workday, following the day when the land-disturbing activities temporarily or permanently cease, if the permittees know that construction work on that portion of the site will be temporarily ceased for 14 or more additional calendar days or 7 calendar days where item 23.9 applies. Permittees can initiate stabilization by: a. prepping the soil for vegetative or non-vegetative stabilization; or b. applying mulch or other non-vegetative product to the exposed soil area; or c. seeding or planting the exposed area; or d. starting any of the activities in a - c on a portion of the area to be stabilized, but not on the entire area; or e. finalizing arrangements to have stabilization product fully installed in compliance with the applicable deadline for completing stabilization. [Minn. R. 7090]
25.15	"Impervious Surface" means a constructed hard surface that either prevents or retards the entry of water into the soil and causes water to run off the surface in greater quantities and at an increased rate of flow than prior to development. Examples include rooftops, driveways, parking lots, and concrete, asphalt, or gravel roads. Bridges over surface waters are considered impervious surfaces. Recreational trails that are distinctly set apart from a roadway (i.e. not parallel) and intended for non-motorized recreational uses are not considered impervious surfaces. Sidewalks that are parallel to a roadway (or generally following alongside a roadway) must still be included as impervious surfaces. [Minn. R. 7090]
25.16	"National Pollutant Discharge Elimination System (NPDES)" means the program for issuing, modifying, revoking, reissuing, terminating, monitoring, and enforcing permits under the Clean Water Act, as amended (33 U.S.C. 1251 et seq. Section 1342 and 40 CFR parts 122, 123, 124 and 450). [Minn. R. 7001.1020]
25.17	"Natural Buffer" means an area of undisturbed cover surrounding surface waters within which construction activities are

	restricted. Natural buffer includes the vegetation, exposed rock, or barren ground that exists prior to commencement of earth-disturbing activities. [Minn. R. 7090]
25.18	"Normal Wetted Perimeter" means the area of a conveyance, such as a ditch or channel, that is in contact with water during flow events that are expected to occur from a two-year, 24-hour storm event. [Minn. R. 7090]
25.19	"Notice of Termination (NOT)" means the form (electronic or paper) required for terminating coverage under the Construction General permit. [Minn. R. 7090]
25.20	"Operator" means the person (usually the general contractor), firm, governmental agency, or other entity designated by the owner who has day to day operational control and/or the ability to modify project plans and specifications related to the SWPPP. The permit application must list the operator as a permittee. Subcontractors hired by and under supervision of the general contractor are not operators. [Minn. R. 7090]
25.21	"Owner" means the person, firm, governmental agency, or other entity possessing the title of the land on which the construction activities will occur or, if the construction activity is for a lease, easement, or mineral rights license holder, the party or individual identified as the lease, easement or mineral rights license holder; or the contracting government agency responsible for the construction activity. [Minn. R. 7090]
25.22	"Permanent Cover" means surface types that will prevent soil failure under erosive conditions. Examples include: gravel, concrete, perennial cover, or other landscaped material that will permanently arrest soil erosion. Permittees must establish a uniform perennial vegetative cover (i.e., evenly distributed, without large bare areas) with a density of 70 percent of the vegetative cover native to local undisturbed areas on all areas not covered by permanent structures, or equivalent permanent stabilization measures. Permanent cover does not include temporary BMPs such as wood fiber blanket, mulch, and rolled erosion control products. [Minn. R. 7090]
25.23	"Permittee(s)" means the person(s), firm, governmental agency, or other entity identified as the owner and operator on the application submitted to the MPCA and are responsible for compliance with the terms and conditions of this permit. [Minn. R. 7090]
25.24	"Project(s)" means all construction activity planned and/or conducted under a particular permit. The project occurs on the site or sites described in the permit application, the SWPPP and in the associated plans, specifications and contract documents. [Minn. R. 7090]
25.25	"Public Waters" means all water basins and watercourses described in Minn. Stat. Section 103G.005 subd. 15. [Minn. Stat. 103G.005, subd.15]
25.26	"Redoximorphic Features" means a color pattern in soil, formed by oxidation and reduction process of iron and/or manganese in seasonally saturated soil. [Minn. R. 7090]
25.27	"Section" includes all item numbers of the same whole number. For example, "Section 3" of the permit refers to items 3.1 through 3.8. [Minn. R. 7090]
25.28	"Seasonally Saturated Soil" means the highest seasonal elevation in the soil in a reduced chemical state because of soil voids filled with water causing anaerobic conditions. Seasonally saturated soil is evidenced by the presence of redoximorphic features or other information determined by scientifically established methods or empirical field measurements. [Minn. R. 7090]
25.29	"Sediment Control" means methods employed to prevent suspended sediment in stormwater from leaving the site (e.g. silt fences, compost logs and storm drain inlet protection). [Minn. R. 7090]
25.30	"Stabilize", "Stabilized", "Stabilization" means the exposed ground surface has been covered by appropriate materials such as mulch, staked sod, riprap, erosion control blanket, mats or other material that prevents erosion from occurring. Grass seeding, agricultural crop seeding or other seeding alone is not stabilization. Mulch materials must achieve approximately 90 percent ground coverage (typically 2 ton/acre). [Minn. R. 7090]
25.31	"Stormwater" means precipitation runoff, stormwater runoff, snowmelt runoff, and any other surface runoff and drainage. [Minn. R. 7090]
25.32	"Steep Slopes" means slopes that are 1:3 (V:H) (33.3 percent) or steeper in grade. [Minn. R. 7090]
25.33	"Storm Water Pollution Prevention Plan (SWPPP)" means a plan for stormwater discharge that includes all required content under in Section 5 that describes the erosion prevention, sediment control and waste control BMPs and permanent stormwater treatment systems. [Minn. R. 7090]
25.34	"Surface Water or Waters" means all streams, lakes, ponds, marshes, wetlands, reservoirs, springs, rivers, drainage systems, waterways, watercourses, and irrigation systems whether natural or artificial, public or private, except that surface waters do not include stormwater treatment systems constructed from upland. This permit does not consider stormwater

	treatment systems constructed in wetlands and mitigated in accordance with Section 22 as surface waters. [Minn. R. 7090]
25.35	"Waters of the State" means all streams, lakes, ponds, marshes, watercourses, waterways, wells, springs, reservoirs, aquifers, irrigation systems, drainage systems and all other bodies or accumulations of water, surface or underground, natural or artificial, public or private, which are contained within, flow through, or border upon the state or any portion thereof. [Minn. Stat. 115.01, subd. 22]
25.36	"Water Quality Volume" means one (1) inch of runoff from the net increase in impervious surfaces created by the project (calculated as an instantaneous volume). [Minn. R. 7090]
25.37	"Wetlands" means those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Constructed wetlands designed for wastewater treatment are not waters of the state. Wetlands must have the following attributes: a. a predominance of hydric soils; and b. inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of hydrophytic vegetation typically adapted for life in a saturated soil condition; and c. under normal circumstances support a prevalence of such vegetation. [Minn. R. 7050.0186, subp. 1(a)B]

Doc No **A05015662**

Certified, filed and/or recorded on
Feb 2, 2024 9:03 AM

Office of the County Recorder
Ramsey County, Minnesota
Todd J. Uecker, County Recorder
Tracy M. West, County Auditor and Treasurer

Deputy 317 Pkg ID 1604062E

Document Recording Fee Abstract	$46.00
Document Total	$46.00

This cover sheet is now a permanent part of the recorded document.

MAINTENANCE AGREEMENT

This Maintenance Agreement (this "Agreement") is made this 25th day of January, 2024, by and between the **University of St. Thomas**, a Minnesota non-profit corporation (hereinafter referred to as "Owner"), and the **City of Saint Paul**, a municipal corporation under the laws of the State of Minnesota (hereinafter referred to as the "City") to provide for the maintenance of the stormwater facilities (hereinafter referred to as the "Facilities") constructed pursuant to City of Saint Paul Project **SPR23-079985**.

1. Owner owns the property legally described on Exhibit "A" attached hereto (the "Property"); and

2. Owner is intending to construct certain storm water facilities on the Property as depicted in Exhibit "B" attached hereto (the "Facilities"); and

In order to meet the City's permitting requirements, said Facilities are necessary and it is reasonable for the City to require Owner and all subsequent owners of said parcel to inspect and maintain the Facilities on a regular basis to ensure that the Facilities function as intended.

3. Now, therefore, it is mutually agreed by and between all parties:

A. Owner, at its expense, shall be responsible for the inspection and maintenance of the Facilities so that the Facilities function properly.

i. Owner shall inspect the Facilities at least annually.

ii. Owner shall maintain and repair the Facilities:

a. In the case of basins and other facilities where sediment collects, to preserve the storage or capacity at or above the design volume or, where no design storage volume or capacity is incorporated into the permit, the volume or capacity recommended by the manufacturer.

b. In the case of conveyances and other structures, to preserve design hydraulic capacity.

c. In the case of facilities relying on soils and vegetation for stormwater management or treatment, to preserve healthy vegetation and design soil permeability.

d. In the case of all facilities, as necessary to preserve the integrity and intended function of the facility.

iii. On an annual basis, Owner shall submit a report to the City that includes the inspection date(s) of the Facilities, conditions of the Facilities, and any corrective actions taken.

B. The City shall have discretion to determine the need to clean the Facilities, either in conjunction with the annual inspection or more often as deemed necessary. The City shall notify the Owner in writing if it reasonably determines that the Facilities require cleaning. The Owner shall clean the Facilities within sixty (60) days of receipt of notice from the City or District. The City shall act reasonably in exercising said discretion.

In the event Owner fails to clean said Facilities in accordance with the City's request, the City may have the Facilities cleaned either through its own employees or through an outside third party, the cost of which shall be the responsibility of Owner. Owner shall indemnify the for any and all costs incurred by the City for cleaning the Facilities, as well as for costs and fees incurred by the City to enforce this Agreement.

C. This Agreement shall be binding on the Owner of said real estate as described in the Exhibit "A" attached hereto, and its representatives, heirs, transferors, successors and/or assigns. This Agreement shall run with the land.

[Signature page(s) follow]

DATE: 12/19/2023

CITY OF SAINT PAUL

By: Andrew Hogg
Andrew Hogg, its Water Resources Coordinator

STATE OF MINNESOTA)
) ss.
COUNTY OF Ramsey)

The foregoing instrument was acknowledged before me this 19 day of December, 2023, by Andrew Hogg, the Water Resource Coor. of the City of Saint Paul, a municipal corporation under the laws of the State of Minnesota, on behalf of said municipal corporation.

ANGELIA MARIE CRUZ
Notary Public-Minnesota
My Commission Expires Jan 31, 2022

Notary Public

IN WITNESS WHEREOF, the parties hereto execute this Maintenance Agreement.

DATE: 1/25/2024

OWNER

University of St. Thomas,
a Minnesota non-profit corporation

By: _____
Name: James Brummer
Its: Vice President for Facilities Management

STATE OF MINNESOTA)
) ss.
COUNTY OF Ramsey)

The foregoing instrument was acknowledged before me this 25th day of January, 2024 by James Brummer as Vice President for Facilities Management for University of St. Thomas, a Minnesota non-profit corporation.

_____
Notary Public

MELISSA J. TOFTE
Notary Public-Minnesota
My Commission Expires Jan 31, 2024

Drafted by:
Fredrikson & Byron, P.A. (JGP)
60 South Sixth Street, Suite 1500
Minneapolis, MN 55402

Exhibit A
to Maintenance Agreement

Legal Description of the Property

Lot 2, Block 1, St. Paul Seminary Addition

Exhibit B
to Maintenance Agreement

Depiction of Facilities

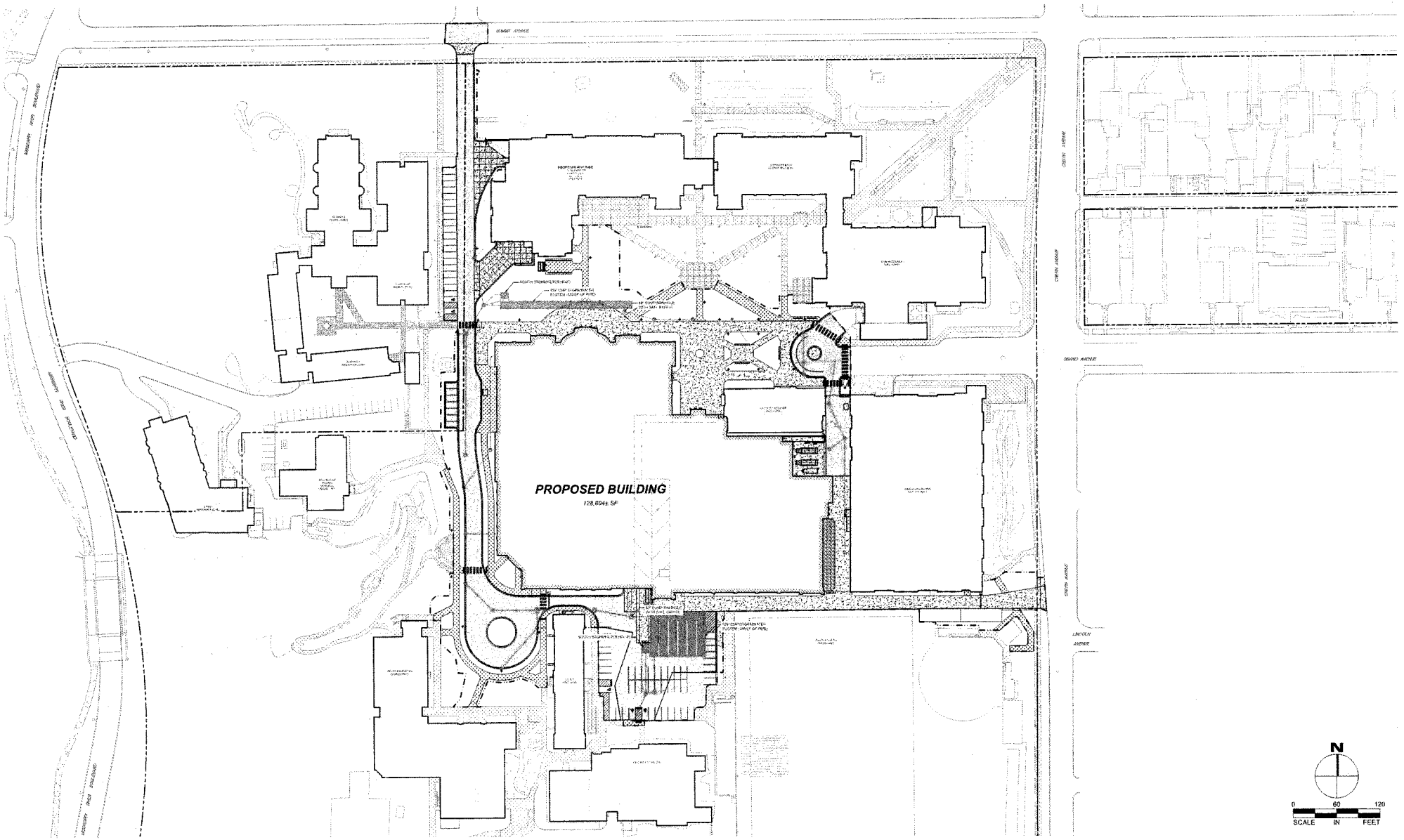

Exhibit B to Maintenance Agreement- Depiction of Facilities

TEMPORARY CONSTRUCTION LICENSE

THIS TEMPORARY CONSTRUCTION LICENSE (this "Agreement") is effective as of January 31, 2024 (the "Effective Date"), by and between THE SAINT PAUL SEMINARY, a Minnesota nonprofit corporation ("Grantor") and THE UNIVERSITY OF ST. THOMAS, a Minnesota nonprofit corporation ("Grantee").

RECITALS

A. Grantor is the fee owner of the real property located in Ramsey County, Minnesota, legally described on Exhibit A, attached hereto and incorporated herein ("Lot 1").

B. Grantee is the fee owner of the real property located in Ramsey County, Minnesota legally described on Exhibit B, attached hereto and incorporated herein ("Lot 2").

C. Lot 1 is contiguous to Lot 2. Lot 1 and Lot 2 are sometimes hereinafter collectively referred to as the "Lots" or individually and generically referred to as a "Lot".

D. Grantee intends to build a new sports arena on Lot 2 and wishes to use portions of Lot 1 for construction staging, alternative access, and other similar purposes (the "Construction-Related Activities"). As part of the construction of the arena, Grantee also intends to modify certain utilities that currently serve Lots 1 and 2, including but not limited to facilities relating to water, electrical, gas, steam, fiber, sanitary-sewer and storm-sewer service, which will require Grantee to undertake work on Lot 1 (the "Utility Work").

E. Grantee has presented to Grantor and Grantor has approved plans for the Construction-Related Activities and the Utility Work identified in Exhibit C (the "Approved Plans").

F. Grantor desires to grant to Grantee a non-exclusive temporary construction license across and under that portion of Lot 1 depicted as the hashed area on Exhibit D, which is attached hereto and incorporated herein (the "License Area"), to undertake the Construction-Related Activities and the Utility Work pursuant to the Approved Plans, upon the terms and conditions set forth in this Agreement.

AGREEMENT

NOW, THEREFORE, for good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, Grantor and Grantee agree as follows:

1. Recitals. The above recitals are true and correct and are incorporated herein.

2. Construction License. Grantor hereby grants Grantee a temporary construction license (the "Construction License") for ingress and egress in, on, and across the License Area for purposes of undertaking the Construction-Related Activities and the Utility Work pursuant to the Approved Plans, on the following terms and conditions:

a. The Construction-Related Activities and the Utility Work shall be performed at Grantee's

sole cost and expense.

b. Grantee shall at its own expense restore all areas of Lot 1 that are affected by the Construction-Related Activities and the Utility Work to their immediately prior condition.

c. The Construction License is also for the benefit of, and allows access for, specific contractors, agents, employees, or representatives of Grantee, the identity of which shall be disclosed to Grantor in advance of any activities associated with the Construction-Related Activities and the Utility Work.

d. Grantee will conduct its activities under this Agreement in a manner so as to minimize, to the extent reasonably possible, any interference with any operations upon, and occupancy of, Lot 1. With specific regard to parking, Grantee may not interfere with Grantor's use of any parking stalls in the License Area without the prior approval of Grantor, which approval will not be unreasonably withheld. Grantee shall provide as much advanced notice as reasonably possible to Grantor's Operations Coordinator when such interference (including parking closures) is requested in the License Area.

e. Any proposed changes to the Approved Plans that require or involve work or operations on Lot 1 are subject to the approval of Grantor, which approval Grantor shall not unreasonably withhold. Grantor shall have seven days to review and respond to any proposed changes to the Approved Plans that require or involve work or operations on Lot 1. Notwithstanding the foregoing, Grantee may make and implement changes to the Approved Plans that require or involve work or operations on Lot 1 necessitated by exigent circumstances, including emergency or safety concerns, and shall provide prompt notice of the changes to Grantor. If Grantor reasonably objects to such changes, it will notify Grantee and the parties will work in good faith to attempt to mitigate any effects the changes may have on Grantor's property.

3. Other Access. It is understood by the parties that Grantee may require access to certain areas of Grantor's buildings or facilities (including mechanical space) outside of the License Area in order to complete the Approved Plans ("Other Access"). With respect to Other Access that does not entail any actual construction work or activities that could cause loud noises or disturbances, Grantee may proceed with such access after providing Grantor's Operations Coordinator with as much advance notice as is reasonably possible. Grantee may proceed with Other Access that involves construction work or activities that could cause loud noises or disturbances only with the prior approval of Grantor, which approval will not be unreasonably withheld.

4. Insurance. Grantee shall require its designer/builder, Ryan Companies ("Ryan"), at Grantee's or Ryan's cost, to maintain commercial general liability insurance with policy limits of not less than $2,000,000 per occurrence and $2,000,000 in the aggregate, naming Grantor as an additional insured; provided that Ryan may satisfy this liability insurance under any combination of separate or blanket policies, or under any combination of primary insurance and umbrella or blanket insurance.

Grantee will indemnify, defend, release and hold Grantor harmless from and against all claims, damages, costs, expenses or losses (including reasonable attorneys' fees and costs) for injury to persons and damage to property to the extent caused by any of the following related to this Agreement

or the Lots: (a) any claims, demands, or liability of any kind arising out of, or related to, the negligence, intentional misconduct, or breach or default of this Agreement by Grantee or its representatives, guests, lessees, invitees, employees, vendors, contractors or agents under this Agreement; and (b) any lien for labor or material caused by Grantee or its representatives, guests, lessees, invitees, employees, vendors, contractors or agents.

5. License Term. The term of the Construction License shall commence on the Effective Date and shall expire nineteen (19) months after the Effective Date (the "Term"). Upon expiration of the Term, Grantee shall have no further rights under the construction license and shall have no further rights with respect to Lot 1 pursuant to this Agreement.

6. Termination. This Agreement shall terminate if Grantee shall violate or fail to perform any of the conditions, covenants or agreements of this Agreement, provided that any such violation or failure to perform any of such conditions, covenants or agreements shall continue for a period of ten (10) days after Grantee is notified thereof in accordance with Section 7 hereof and provided further Grantee has failed to take material steps to cure the violation or failure within such timeframe.

7. Notices. Every notice, demand, request, or other communication which any party is required or desires to give to the other pursuant to this Agreement shall be in writing, properly addressed, and shall be given by (i) personal delivery, (ii) established overnight commercial carrier (such as FedEx) for delivery on the next business day with delivery charged prepaid or duly charged, (iii) by registered or certified mail (return receipt requested, first class postage prepaid), or (iv) email, as follows:

If to The Saint Paul Seminary:	The Saint Paul Seminary Attn: Rev. Joseph C. Taphorn 2260 Summit Avenue Saint Paul, MN 55105-1010 jctaphorn@stthomas.edu
With a copy to:	Siegel Brill, P.A. Attn: Mark Thieroff 100 Washington Avenue South, Suite 1300 Minneapolis, MN 55401 Telephone (612) 337-6100 Facsimile (612) 339-6591 markthieroff@siegelbrill.com
If to the University of St. Thomas:	University of St. Thomas Attn: Jim Brummer Vice President of Facilities Management PHP 219 2115 Summit Ave St. Paul, MN 55105 Jim.brummer@stthomas.edu
With a copy to:	University of St. Thomas Office of General Counsel AQU 104, Attn: Peter Shaw

2115 Summit Ave
St. Paul, MN 55105
Peter.shaw@stthomas.edu

Any party may, by like notice given at least ten (10) days before such change becomes effective, designate a new address to which such notices shall be sent. Notice shall be deemed effective when personally delivered, or one (1) business day after having been delivered to a recognized overnight courier, or three (3) business days after mailing, if said notice is by mail. An acknowledgement signed by the party getting notice shall constitute conclusive evidence that the notice has been received.

8. No Third Party Beneficiary. The parties hereto mutually agree that no indemnification provisions of this Agreement shall create in the public, or in any person or entity other than those signing this Agreement as parties hereto, rights as a third party beneficiary hereunder, and no provision of this Agreement shall be interpreted to authorize any person or entity, not a party hereto, to maintain any action for personal injury, property damage, or breach of contract pursuant to the terms of this Agreement or otherwise.

9. Governing Law. This Agreement shall be governed by and construed in accordance with the laws of the State of Minnesota without regard to conflict of law principles. All legal actions instituted by Grantor or Grantee concerning this Agreement shall be filed solely in the Ramsey County District Court.

10. Entire Agreement; Modification; Assignment. No representation or statements have been made which would modify, add to or change the terms of this Agreement. This Agreement may be amended only by a written document signed by Grantor and Grantee, or their respective successors and assigns. Grantee may not assign its rights under, or interest in, this Agreement without Grantor's prior written consent, which consent may be withheld in Grantor's sole discretion.

11. Exhibits. All Exhibits referenced in this Agreement are incorporated in this Agreement by this reference as if fully set forth herein.

12. Binding Effect; No Recording. This Agreement (i) shall be binding upon the successors in interest of each party; and (ii) may not be recorded, in the Office of the Ramsey County Recorder or Registrar of Titles or otherwise.

13. Counterparts. This Agreement may be executed in any number of counterparts, each of which when executed shall be deemed an original with all such counterparts taken together shall constitute one and the same instrument. Facsimile or email (PDF format) signatures shall be deemed and treated as originals.

[Signature Page Follows]

[Signature Page to Temporary Construction License]

IN WITNESS WHEREOF, the parties hereto have duly executed this Temporary Construction License effective as of the Effective Date.

THE SAINT PAUL SEMINARY,
a Minnesota nonprofit corporation

By: Joseph C. Taphorn
Rev. Joseph C. Taphorn,
Rector and Vice President

THE UNIVERSITY OF ST. THOMAS,
a Minnesota nonprofit corporation

By: _____
Name: Mark Vangsgard
Its: CFO

EXHIBIT A
TO TEMPORARY CONSTRUCTION LICENSE

LEGAL DESCRIPTION OF LOT 1

Lot 1, Block 1, St. Paul Seminary Addition, Ramsey County, Minnesota.

EXHIBIT B
TO TEMPORARY CONSTRUCTION LICENSE

LEGAL DESCRIPTION OF LOT 2

Lot 2, Block 1, St. Paul Seminary Addition, Ramsey County, Minnesota.

EXHIBIT C
THE APPROVED PLANS

Plan Sheet No.	Date
C140A REMOVALS PLAN – OVERALL – PH 1	01/19/2024
C140B REMOVALS PLAN – OVERALL – PH 2	01/19/2024
C141 REMOVALS PLAN – NW	01/19/2024
C143 REMOVALS PLAN – SW	01/19/2024
C200A EROSION CONTROL PLAN – OVERALL – PH 1	01/19/2024
C200B EROSION CONTROL PLAN – OVERALL – PH 2	01/19/2024
C201 EROSION CONTROL PLAN – NW	01/19/2024
C203 EROSION CONTROL PLAN – SW	01/19/2024
C300A SITE PLAN – OVERALL – PH 1	01/19/2024
C300B SITE PLAN – OVERALL – PH 2	01/19/2024
C301 SITE PLAN – NW	01/19/2024
C303 SITE PLAN – SW	01/19/2024
C400 GRADING PLAN – OVERALL	01/19/2024
C401 GRADING PLAN – NW	01/19/2024
C403 GRADING PLAN – SW	01/19/2024
C500A UTILITY PLAN – OVERALL – PH 1	01/19/2024
C501A UTILITY PLAN – NW – PH 1	01/19/2024
C503A UTILITY PLAN – SW – PH 1	01/19/2024
C500B UTILITY PLAN – OVERALL – PH 2	01/19/2024
C501 UTILITY PLAN – NW	01/19/2024
C503 UTILITY PLAN – SW	01/19/2024

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RYAN

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816-421-2640 tel
816-421-2650 fax
WWW.CRAWFORDARCH.COM

OWNER

University of St. Thomas
Minneapolis, MN

CONSULTANTS

IMEG
MEYER BORGMAN JOHNSON

PROJECT INFORMATION

LEE & PENNY ANDERSON MULTIPURPOSE ARENA

2260 SUMMIT AVE ST.
PAUL, MN 55105

I hereby certify that this plan, specification, or rep
was prepared by me or under my direct supervisi
and that I am a duly Licensed Professional Engine
under the laws of the State of Minnesota

JARED B. OLSON

REGISTRATION NO. 42340 — DATE 11/03/2023

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DRAWN BY ZAT — CHECKED BY ATA

JOB NO. 701480 — DATE 01.19.2024

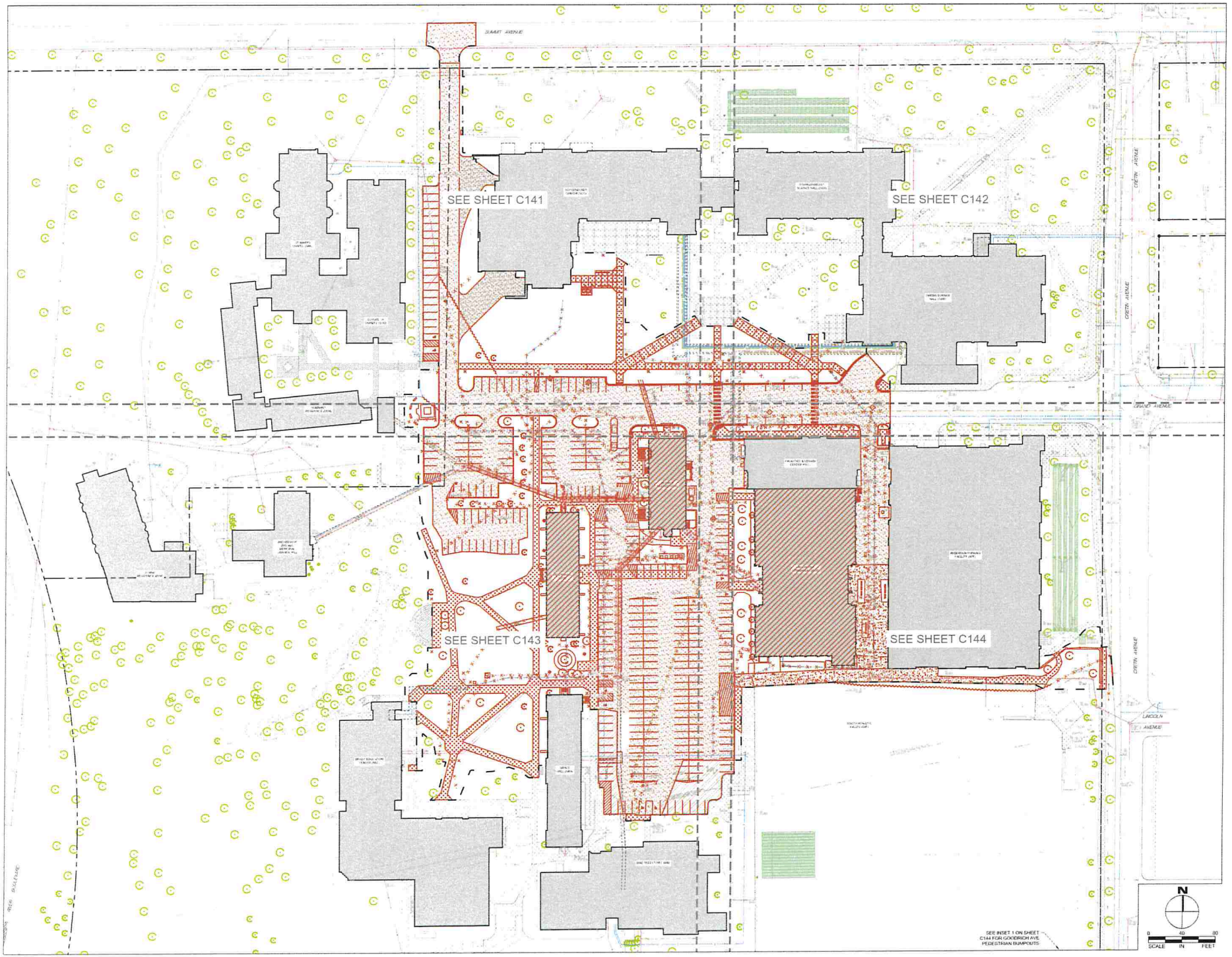
ISSUE RECORD

ISSUE #	DATE	DESCRIPTION
1	03/03/2023	CONCEPT DESIGN
2	06/22/2023	50% SCHEMATIC DESIGN
3	09/01/2023	100% SCHEMATIC DESIGN
4	11/03/2023	1X CD SET - BULL 1
5	11/17/2023	50% DESIGN DEVELOPMENT
6	12/11/2023	ARENA BID PKG 2
7	12/15/2023	ARENA BID PKG 2
8	01/12/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

REMOVALS PLAN - OVERALL - PH 1

C140A



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JARED B. OLSON

REGISTRATION NO. 42449
DATE 11/03/2023

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CHECKED BY AFA
JOB NO. 701400
DATE 01.19.2024

ISSUE RECORD

ISSUE #	DATE	DESCRIPTION
1	03/08/2023	CONCEPT DESIGN
2	06/22/2023	50% SCHEMATIC DESIGN
3	09/01/2023	100% SCHEMATIC DESIGN
4	11/03/2023	LB CD SET - BULL 1
5	11/17/2023	50% DESIGN DEVELOPMENT
6	12/11/2023	ARENA BID PKG-2
7	12/15/2023	ARENA BID PKG-2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

REMOVALS PLAN - OVERALL - PH 2

C140B

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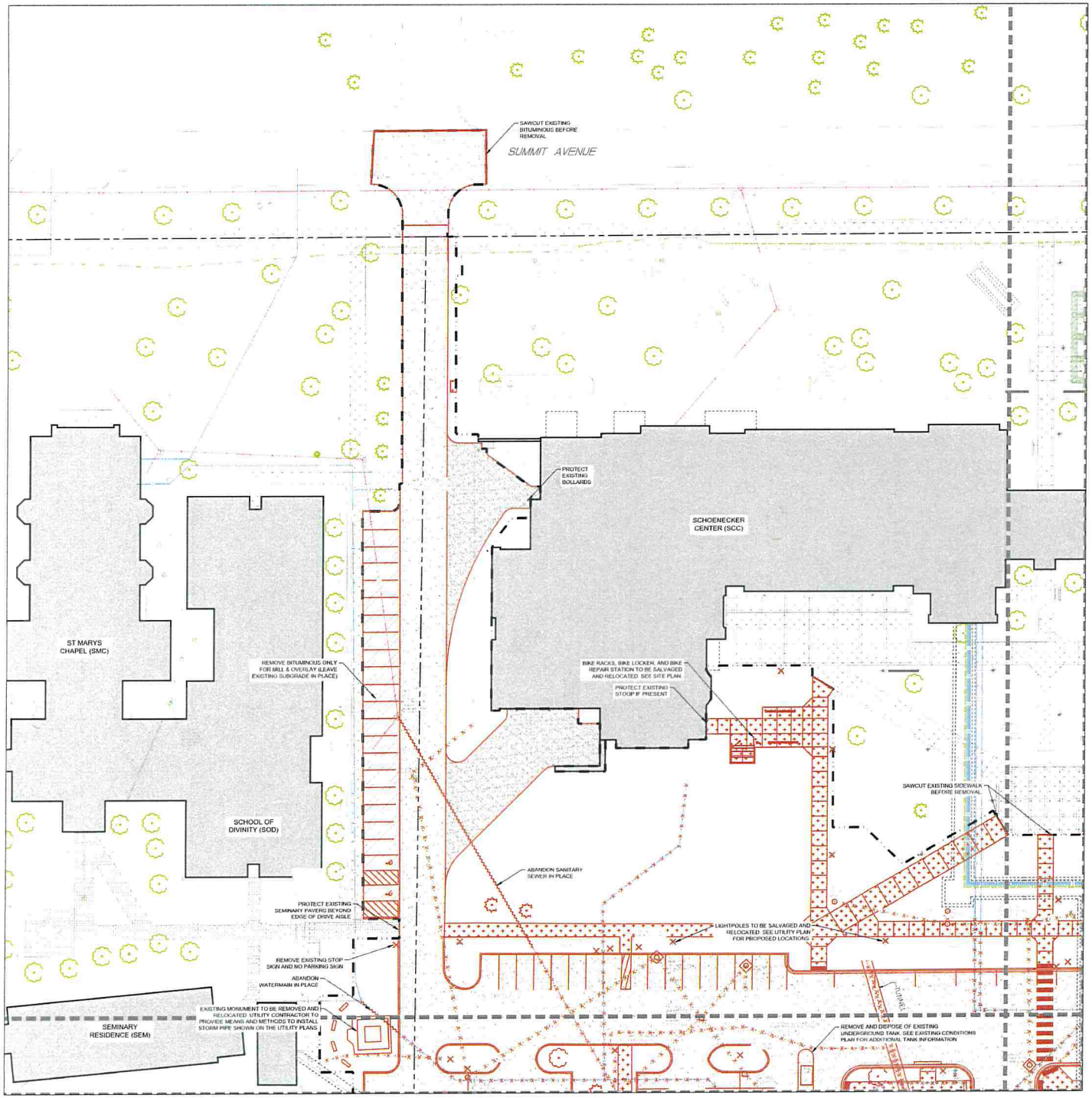

SHEET KEY:

NW	NE
SW	SE

LEGEND:

REMOVAL

- CURB
- BITUMINOUS
- BITUMINOUS MILL & OVERLAY
- CONCRETE PAVEMENT
- CONCRETE SIDEWALK
- GRAVEL
- BUILDING
- ARTIFICIAL TURF
- CHAIN LINK FENCE
- ORNAMENTAL FENCE
- SAWCUT
- ABANDON IN PLACE
- UTILITY
- BULKHEAD
- EACH
- CONSTRUCTION LIMITS

N

0 20 40

SCALE IN FEET

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LEE & PENNY ANDERSON MULTIPURPOSE ARENA

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PAUL, MN 55105

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REGISTRATION NO. 42340 — DATE 11/03/2023

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ISSUE RECORD		
ISSUE #	DATE	DESCRIPTION
1	03/03/2023	CONCEPT DESIGN
2	05/22/2023	50% SCHEMATIC DESIG
3	09/01/2023	100% SCHEMATIC DESIG
4	11/03/2023	UI CD SET - BULL 1
5	11/17/2023	50% DESIGN DEVELOPMENT
6	12/11/2023	ARENA BID PKG-3
7	12/15/2023	ARENA BID PKG-2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

REMOVALS PLAN - NW

C141

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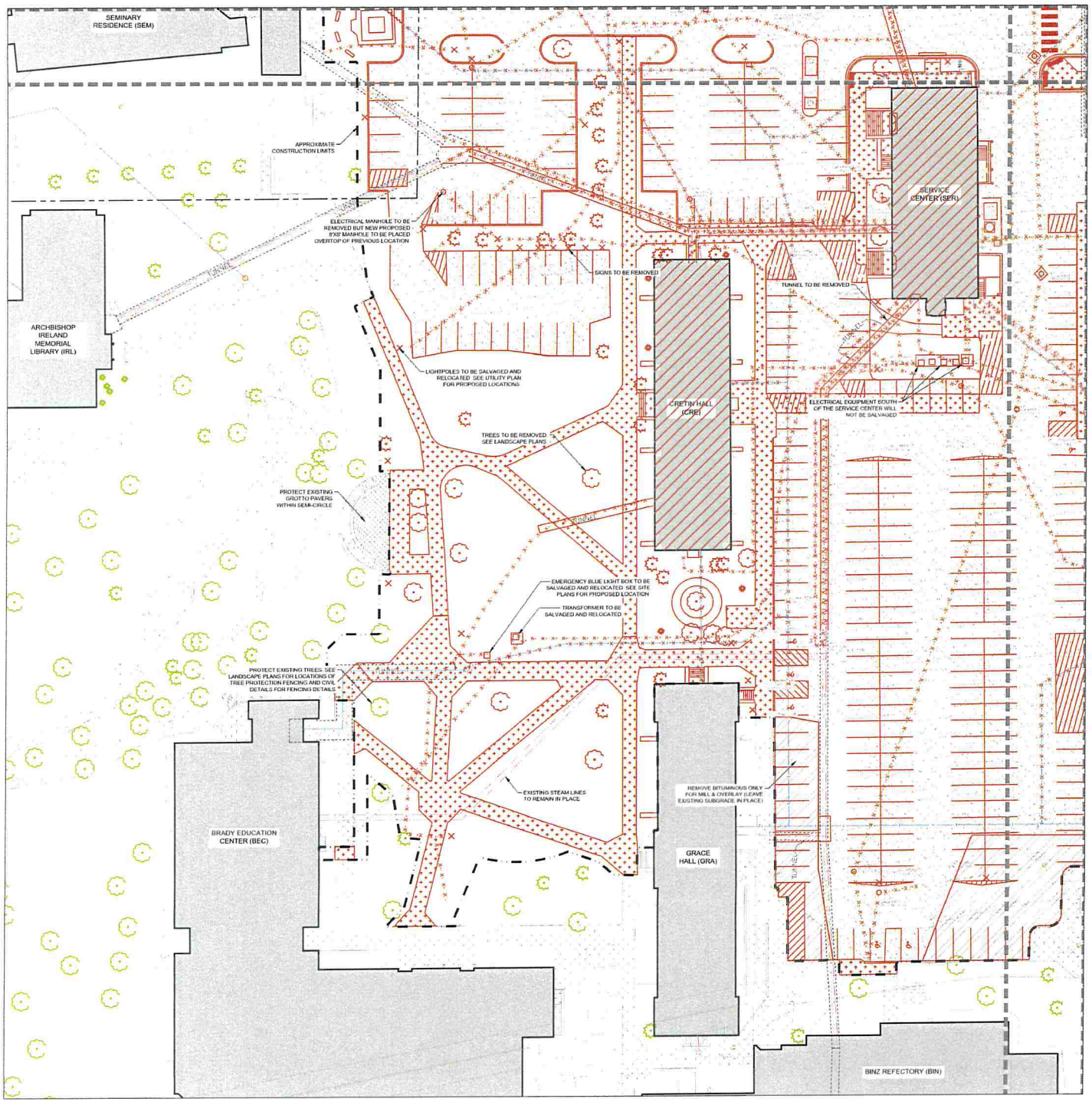

SHEET KEY:

NW	NE
SW	SE

LEGEND:

REMOVAL

- CURB
- BITUMINOUS
- BITUMINOUS MILL & OVERLAY
- CONCRETE PAVEMENT
- CONCRETE SIDEWALK
- GRAVEL
- BUILDING
- ARTIFICIAL TURF
- CHAIN LINK FENCE
- ORNAMENTAL FENCE
- SAWCUT
- ABANDON IN PLACE
- UTILITY
- BULKHEAD
- EACH
- CONSTRUCTION LIMITS

N

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DATE 01.19.2024

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1	03/08/2023	CONCEPT DESIGN
2	06/02/2023	50% SCHEMATIC DESIG
3	09/01/2023	100% SCHEMATIC DESIG
4	11/03/2023	LE CD SET - BULL T
5	11/17/2023	50% DESIGN DEVELOPMENT
6	12/15/2023	ARENA BID PKG-3
7	12/15/2023	ARENA BID PKG-2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

REMOVALS PLAN - SW

C143

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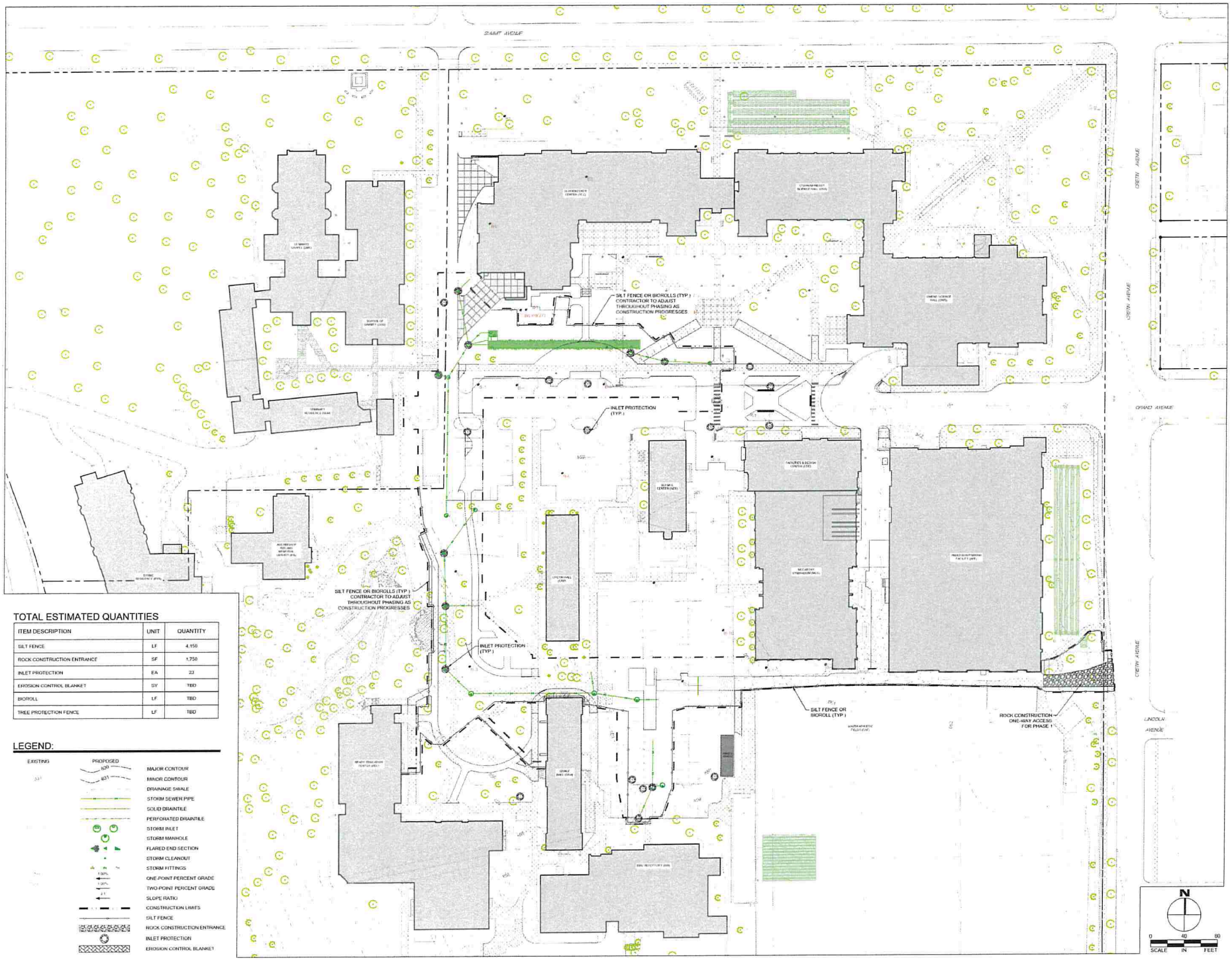

TOTAL ESTIMATED QUANTITIES

ITEM DESCRIPTION	UNIT	QUANTITY
SILT FENCE	LF	4,150
ROCK CONSTRUCTION ENTRANCE	SF	1,750
INLET PROTECTION	EA	23
EROSION CONTROL BLANKET	SY	TBD
BIOROLL	LF	TBD
TREE PROTECTION FENCE	LF	TBD

LEGEND:

EXISTING / PROPOSED

- MAJOR CONTOUR
- MINOR CONTOUR
- DRAINAGE SWALE
- STORM SEWER PIPE
- SOLID DRAINTILE
- PERFORATED DRAINTILE
- STORM INLET
- STORM MANHOLE
- FLARED END SECTION
- STORM CLEANOUT
- STORM FITTINGS
- ONE-POINT PERCENT GRADE
- TWO-POINT PERCENT GRADE
- SLOPE RATIO
- CONSTRUCTION LIMITS
- SILT FENCE
- ROCK CONSTRUCTION ENTRANCE
- INLET PROTECTION
- EROSION CONTROL BLANKET

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MEYER BORGMAN JOHNSON

PROJECT INFORMATION

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PAUL, MN 55105

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REGISTRATION NO.	DATE
42340	1/19/2024

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JOB NO.	DATE
701480	01.19.2024

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1	03/03/2023	CONCEPT DESIGN
2	05/22/2023	50% SCHEMATIC DESIGN
3	06/01/2023	100% SCHEMATIC DESIGN
4	11/03/2023	1ST CD SET - BULL 1
5	11/17/2023	50% DESIGN DEVELOPMENT
6	12/15/2023	ARENA BID PKG 2
7	12/15/2023	ARENA BID PKG 2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

EROSION CONTROL PLAN - OVERALL - PH 1

C200A

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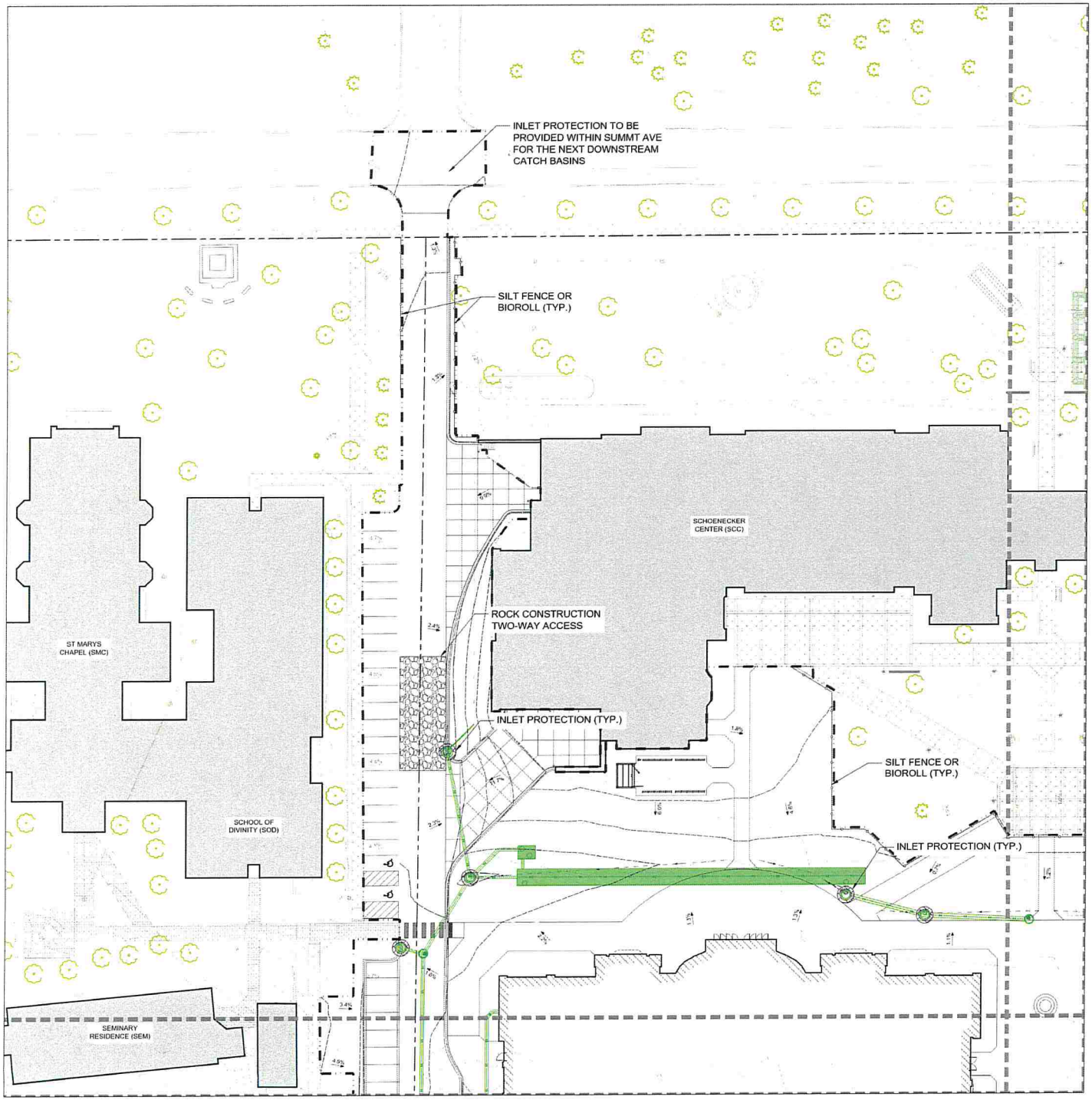
4	11/03/2023	LE CD SET - BULL 1
5	11/17/2023	50% DESIGN DEVELOPMENT
6	12/15/2023	ARENA BID PKG-3
7	12/15/2023	ARENA BID PKG-2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

EROSION CONTROL PLAN - OVERALL - PH 2

C200B

C:\Users\JAT\DC\ACCDocs\Ryan Companies\701480 UST Athletics Hockey Arena Project Files\Ryan Civil\02 Sheet Files\701480 - C200 EROSION CONTROL PLAN.dwg



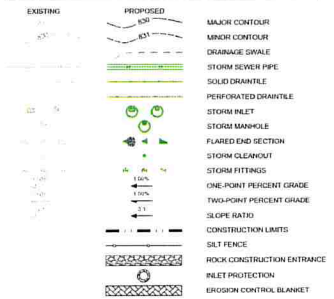
SHEET KEY:

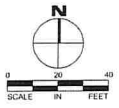
NW	NE
SW	SE

TOTAL ESTIMATED QUANTITIES

ITEM DESCRIPTION	UNIT	QUANTITY
SILT FENCE	LF	2,500
ROCK CONSTRUCTION ENTRANCE	SF	5,300
INLET PROTECTION	EA	39
EROSION CONTROL BLANKET	SY	TBD
BIOROLL	LF	TBD
TREE PROTECTION FENCE	LF	TBD

LEGEND:





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ISSUE RECORD

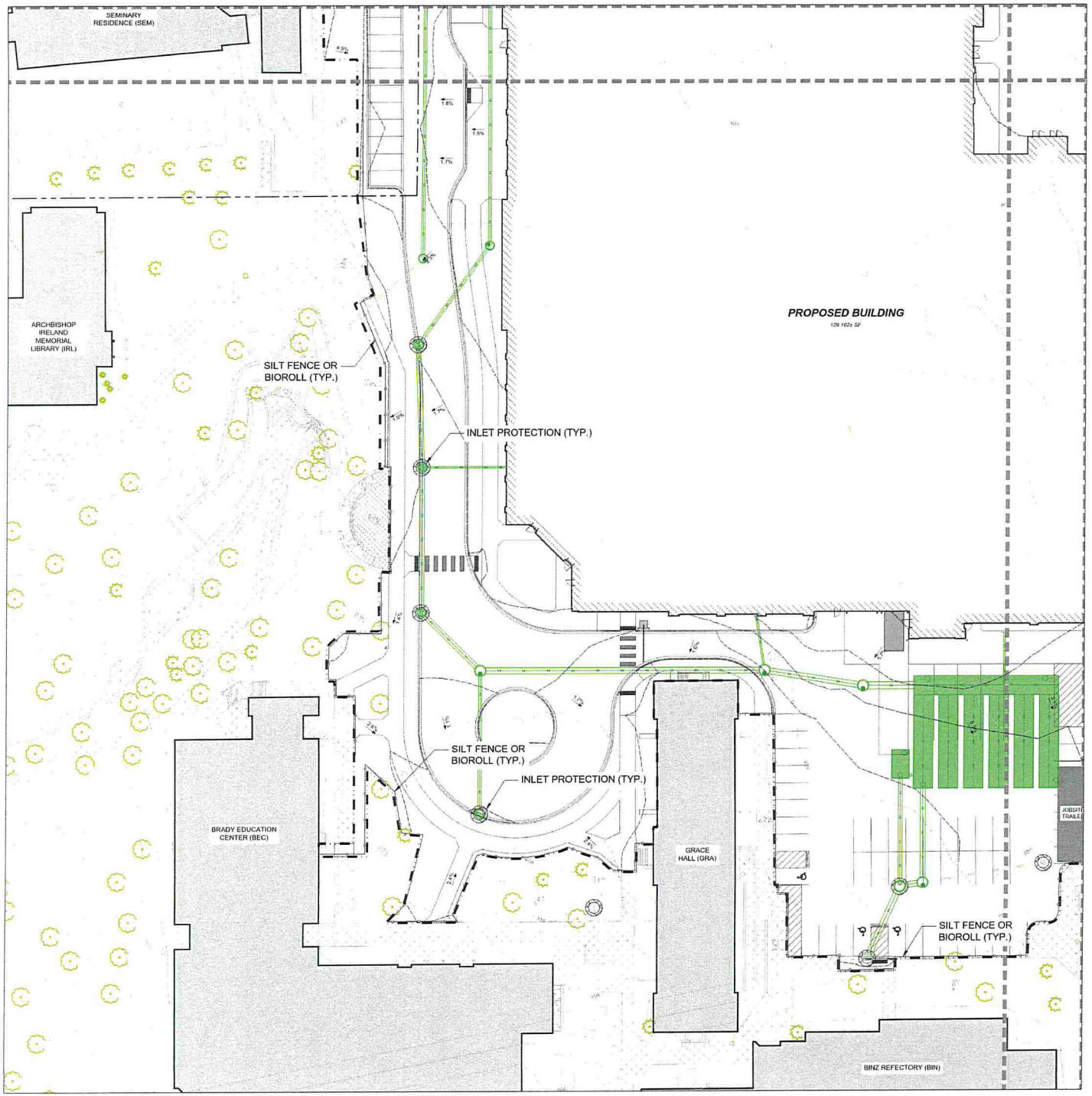
ISSUE #	DATE	DESCRIPTION
1	03/08/2023	CONCEPT DESIGN
2	04/12/2023	50% SCHEMATIC DESIGN
3	05/01/2023	100% SCHEMATIC DESIG
4	11/03/2023	1X CD SET - BULL 1
5	11/17/2023	50% DESIGN DEVELOPMENT
6	12/11/2023	ARENA BID PKG-3
7	12/15/2023	ARENA BID PKG-2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

EROSION CONTROL PLAN - NW

C201

C:\Users\zfhor\DC\ACCDocs\Ryan Companies\701480 UST Athletics Hockey Arena\Project Files\Ryan Civil\02 Sheet Files\701480 - C201 EROSION CONTROL PLAN.dwg



SHEET KEY:

NW	NE
SW	SE

LEGEND:

EXISTING	PROPOSED	
	830	MAJOR CONTOUR
	831	MINOR CONTOUR
		DRAINAGE SWALE
		STORM SEWER PIPE
		SOLID DRAINTILE
		PERFORATED DRAINTILE
		STORM INLET
		STORM MANHOLE
		FLARED END SECTION
		STORM CLEANOUT
		STORM FITTINGS
	1.00%	ONE-POINT PERCENT GRADE
	1.00%	TWO-POINT PERCENT GRADE
	3:1	SLOPE RATIO
		CONSTRUCTION LIMITS
		SILT FENCE
		ROCK CONSTRUCTION ENTRANCE
		INLET PROTECTION
		EROSION CONTROL BLANKET

N

0 20 40
SCALE IN FEET

RYAN A+E, INC.
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MEYER BORGMAN JOHNSON

PROJECT INFORMATION

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2260 SUMMIT AVE ST.
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I hereby certify that this plan, specification, or rep
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under the laws of the State of Minnesota.

JARED E. OLSON

REGISTRATION NO.	DATE
42340	11/03/2023

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ZAT	ATA
JOB NO.	DATE
701480	01.19.2024

ISSUE RECORD

ISSUE #	DATE	DESCRIPTION
1	03/03/2023	CONCEPT DESIGN
2	05/22/2023	50% SCHEMATIC DESIGN
3	09/07/2023	100% SCHEMATIC DESIG
4	11/03/2023	LS CD SET - BULL 1
5	11/17/2023	50% DESIGN DEVELOPMENT
6	12/15/2023	ARENA BID PKG-3
7	12/18/2023	ARENA BID PKG-2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

EROSION CONTROL PLAN - SW

C203

C:\Users\zhur.ZACHCD\Documents\Ryan Companies\701480 UST Athletics Hockey Arena Project Files\Ryan Civil 62 Sheet Files\701480 - C206 EROSION CONTROL PLAN.dwg

C:\Users\Other DC\ACCDocs\Ryan Companies\701480 UST Arkansa Hockey Arena Project Files\Ryan Civil\02 Sheet Files\701480 - C300A PHASE 1 SITE PLAN.dwg

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REGISTRATION NO. 42340
DATE 11/03/2022

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CHECKED BY ATA
JOB NO. 701480
DATE 01.19.2024

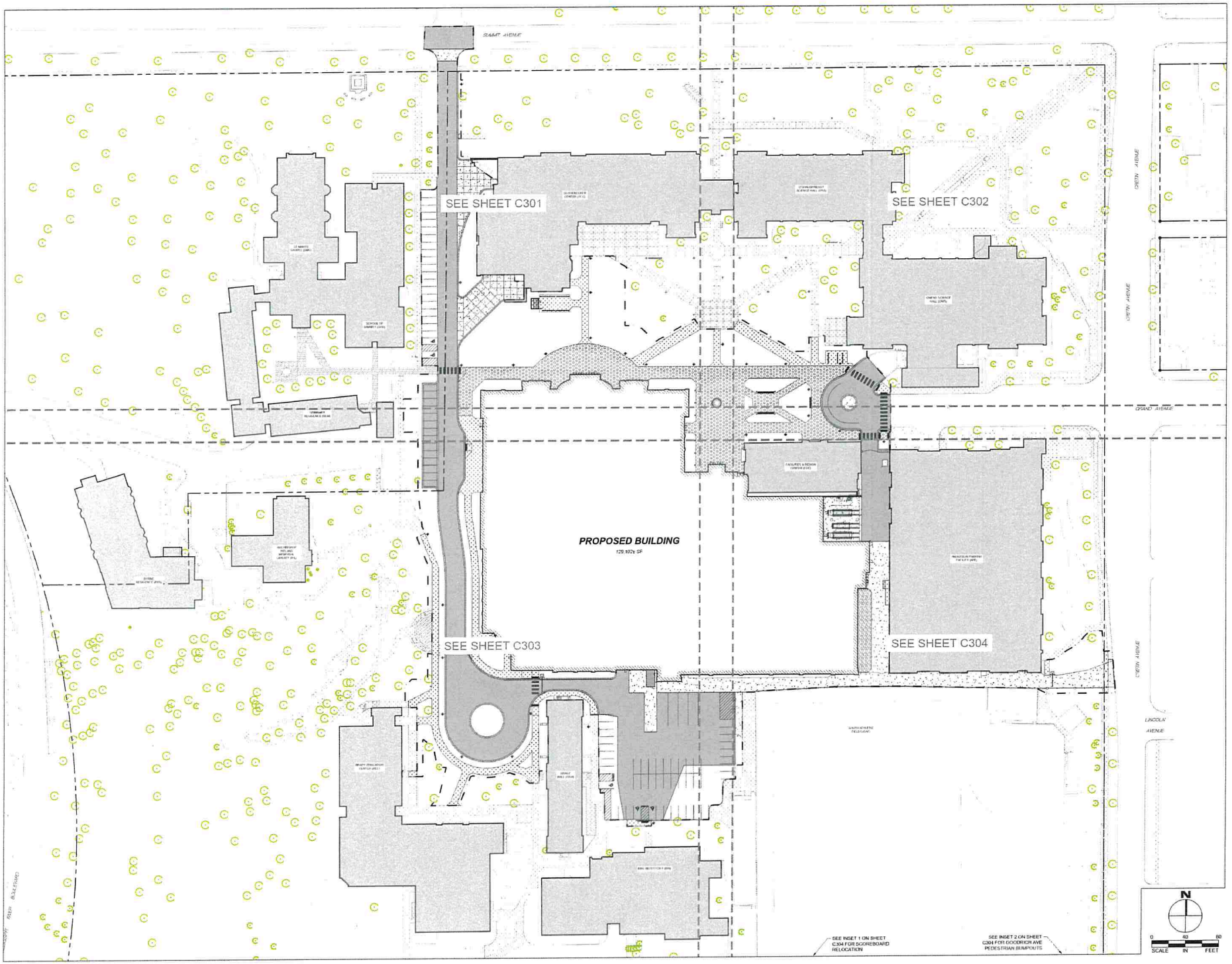
ISSUE RECORD

ISSUE #	DATE	DESCRIPTION
1	03/03/2023	CONCEPT DESIGN
2	05/02/2023	50% SCHEMATIC DESIGN
3	06/01/2023	100% SCHEMATIC DESIG
4	11/03/2023	UI CD SET - BULL 1
5	11/17/2023	50% DESIGN DEVELOPMENT
6	12/11/2023	ARENA BID PKG-3
7	12/15/2023	ARENA BID PKG-2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

SITE PLAN - OVERALL - PH 1

C300A



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JOB NO. 701480
DATE 01.19.2024

ISSUE RECORD

ISSUE #	DATE	DESCRIPTION
1	03/09/2023	CONCEPT DESIGN
2	05/22/2023	50% SCHEMATIC DESIG
3	09/01/2023	100% SCHEMATIC DESIG
4	11/03/2023	UI CD SET - BULL 1
5	11/17/2023	50% DESIGN DEVELOPMENT
6	12/11/2023	ARENA BID PKG-2
7	12/18/2023	ARENA BID PKG-2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

SITE PLAN - OVERALL - PH 2

C300B

SHEET KEY:

NW	NE
SW	SE

LEGEND:

EXISTING	PROPOSED	
		PROPERTY BOUNDARY
		LOT/TRACT LINE
	18" CUT	CURB
		EASEMENT
		BITUMINOUS
		HEAVY DUTY BITUMINOUS (DETAIL 9/C600)
		BITUMINOUS MILL & OVERLAY (DETAIL 11/C600)
		CONCRETE PAVEMENT - BROOM FINISH (DETAIL 12/C600)
		CONCRETE PAVEMENT - PICTURE FRAMED SHINED FINISH (DETAIL 12/C600)
		CONCRETE SIDEWALK - PICTURE FRAMED SHINED FINISH (DETAIL 13/C600)
		SEMINARY PAVERS
		GRAVEL
		CHAIN LINK FENCE
		ORNAMENTAL FENCE
		GUARD RAIL
		DRAINAGE SWALE
		TREE
		TRUNCATED DOMES
		CONSTRUCTION LIMITS
		BOLLARDS
		LIGHT POLES

N

0 20 40

SCALE IN FEET

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JOB NO. 701480 — DATE: 01.19.2024

ISSUE RECORD

ISSUE #	DATE	DESCRIPTION
1	03/03/2023	CONCEPT DESIGN
2	05/22/2023	50% SCHEMATIC DESIG
3	09/01/2023	100% SCHEMATIC DESIG
4	11/03/2023	UI CD SET - BULL 1
5	11/17/2023	50% DESIGN DEVELOPMENT
6	12/11/2023	ARENA BID PKG 3
7	12/15/2023	ARENA BID PKG 2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

SITE PLAN - NW

C301

C:\Users\jdiller\DCAD\Docs\Ryan Companies\701480 UST Athletics Hockey Arena\Project Files\Ryan Civil 02 Sheet Files\701480 - C300 SITE PLAN.dwg

SHEET KEY:

NW	NE
SW	SE

LEGEND:

EXISTING / PROPOSED

- PROPERTY BOUNDARY
- LOT/TRACT LINE
- CURB
- EASEMENT
- BITUMINOUS
- HEAVY DUTY BITUMINOUS (DETAIL 9/C600)
- BITUMINOUS MILL & OVERLAY (DETAIL 11/C600)
- CONCRETE PAVEMENT - BROOM FINISH (DETAIL 12/C600)
- CONCRETE PAVEMENT - PICTURE FRAMED SHINED FINISH (DETAIL 12/C600)
- CONCRETE SIDEWALK - PICTURE FRAMED SHINED FINISH (DETAIL 13/C600)
- SEMINARY PAVERS
- GRAVEL
- CHAIN LINK FENCE
- ORNAMENTAL FENCE
- GUARD RAIL
- DRAINAGE SWALE
- TREE
- TRUNCATED DOMES
- CONSTRUCTION LIMITS
- BOLLARDS
- LIGHT POLES

N

0 20 40
SCALE IN FEET

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JARED B. OLSON

REGISTRATION NO.	DATE
42348	11/03/2023

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ZAT	ATA
JOB NO.	DATE
701480	01.19.2024

ISSUE RECORD

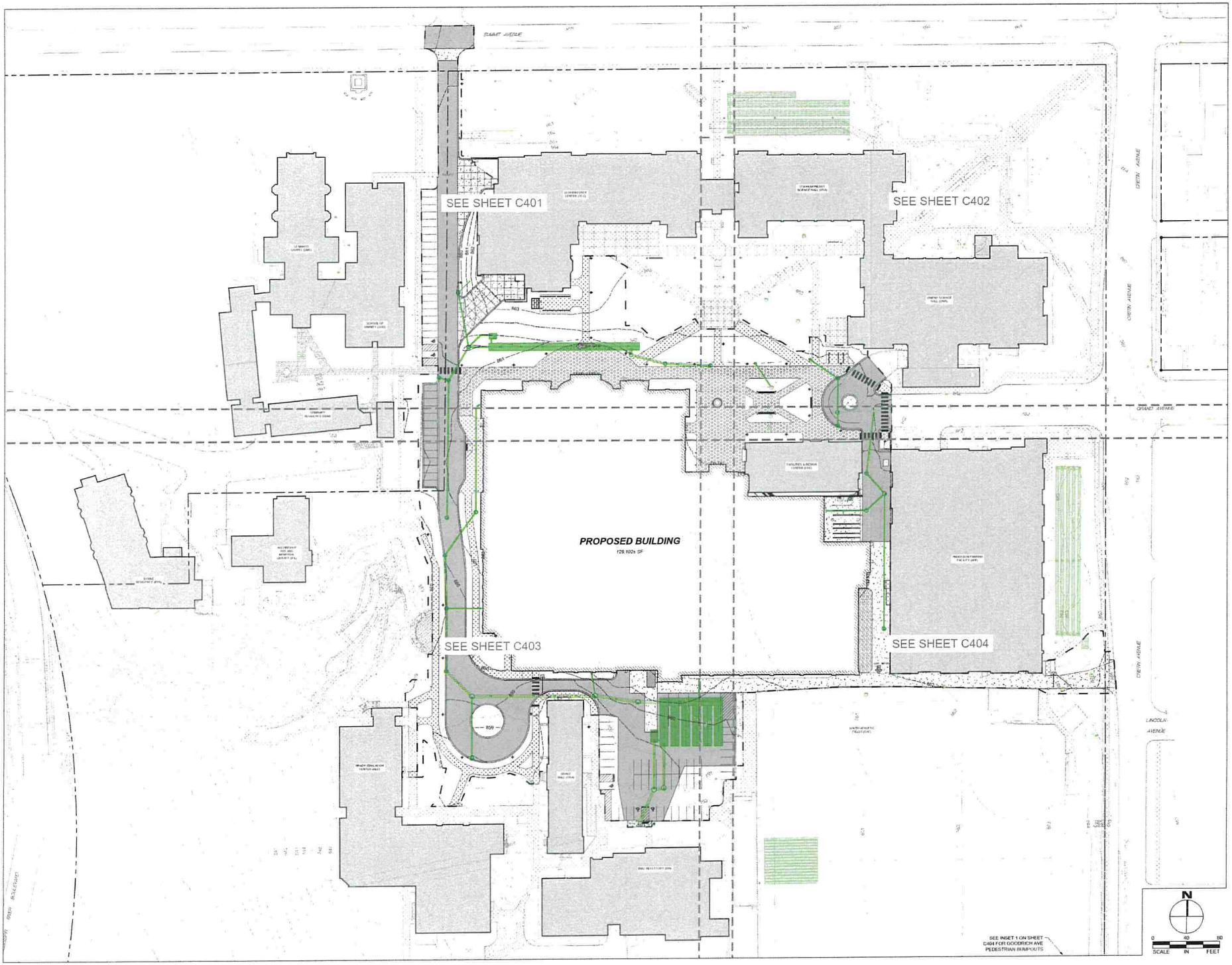
ISSUE #	DATE	DESCRIPTION
1	03/03/2023	CONCEPT DESIGN
2	06/22/2023	50% SCHEMATIC DESIGI
3	09/01/2023	100% SCHEMATIC DESIG
4	11/03/2023	LX CD SET - BULLT
5	11/17/2023	50% DESIGN DEVELOPMENT
6	12/15/2023	ARENA BID PKG-3
7	12/15/2023	ARENA BID PKG-2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

SITE PLAN - SW

C303

C:\Users\ztaf\DOCACDocs\Ryan Companies\701480 - UST Amatus Hockey Arena\Project Files\Ryan Civil\2 Sheet Files\701480 - C300 SITE PLAN.dwg



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JAREDD OLSON

REGISTRATION NO.	DATE
42340	1/19/2024

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ZAT	ATA
JOB NO.	DATE
701481	01.19.2024

ISSUE RECORD

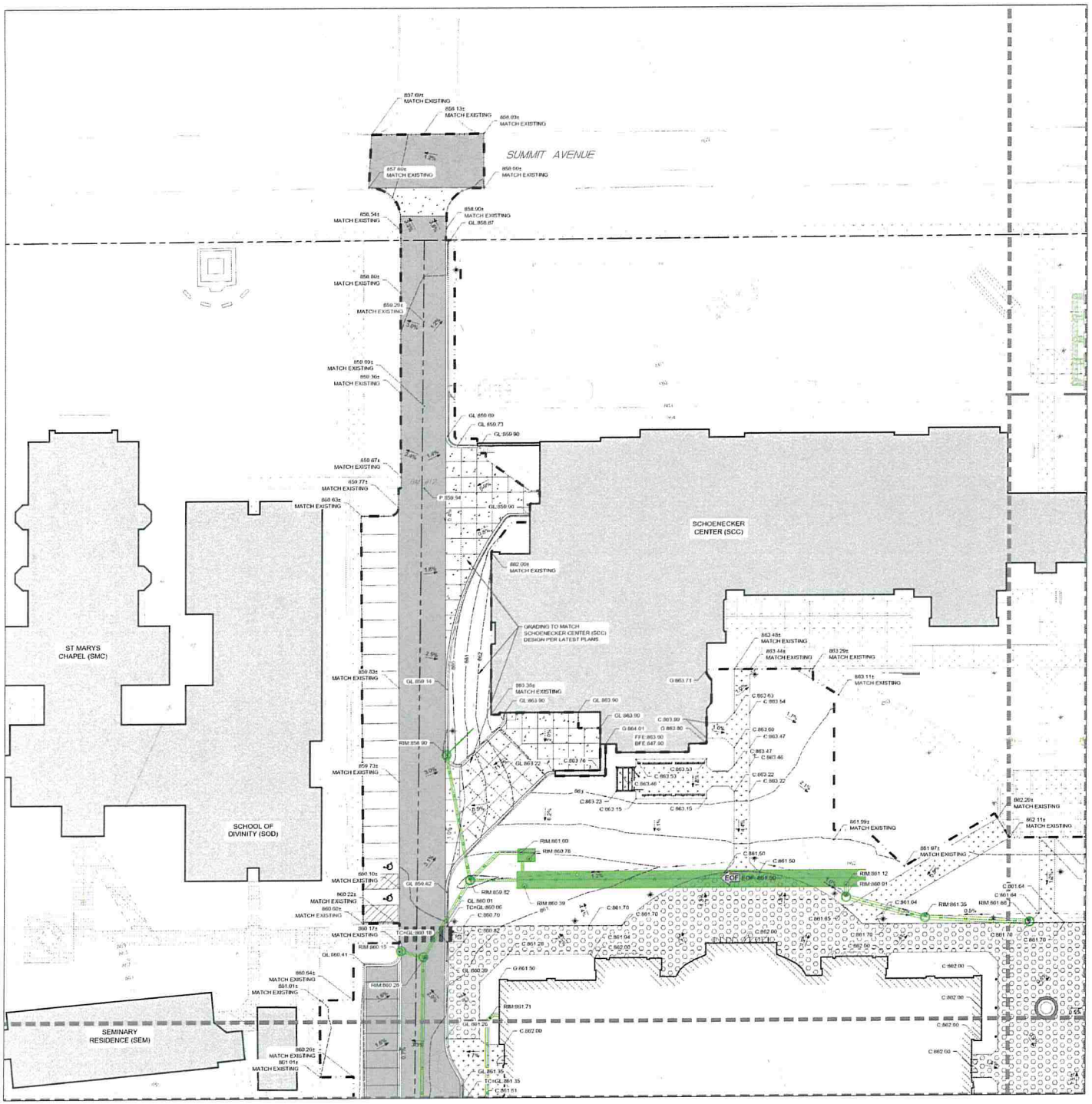
ISSUE #	DATE	DESCRIPTION
1	03/08/2023	CONCEPT DESIGN
2	05/22/2023	50% SCHEMATIC DESIG
3	06/07/2023	100% SCHEMATIC DESIG
4	11/03/2023	LD CD SET - BULL T
5	11/17/2023	50% DESIGN DEVELOPMENT
6	12/11/2023	ARENA BID PKG-3
7	12/18/2023	ARENA BID PKG-2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

GRADING PLAN - OVERALL

C400

C:\Users\ther.EDC4CD\Docs\Ryan Companies\701481 UST Athletics Hockey Arena Project Files\Ryan Civil\02 Sheet Files\701481 - (400) GRADING PLAN.dwg



SHEET KEY:

NW	NE
SW	SE

LEGEND:

EXISTING	PROPOSED	
	830	MAJOR CONTOUR
	831	MINOR CONTOUR
		DRAINAGE SWALE
		STORM SEWER PIPE
		SOLID DRAINTILE
		PERFORATED DRAINTILE
		STORM INLET
		STORM MANHOLE
		STORM CLEANOUT
	1.00%	ONE-POINT PERCENT GRADE
	1.00%	TWO-POINT PERCENT GRADE
	3:1	SLOPE RATIO
		CUT / FILL DEPTH
	P 830.62	PAVEMENT ELEVATION
	C 830.62	CONCRETE ELEVATION
	GL 830.62	GUTTER LINE ELEVATION
	TC 830.62	TOP OF CURB ELEVATION
	TC=GL 830.62	TOP OF CURB=GUTTER LINE
	TW830.62	TOP OF WALL ELEVATION
	BW830.62	BOTTOM OF WALL ELEVATION
	G 830.62	GROUND ELEVATION
		NATURAL GROUND
	FFE 830.62	FINISHED FLOOR ELEVATION
	RIM 830.62	STRUCTURE RIM ELEVATION
		SOIL BORING
		CONSTRUCTION LIMITS

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Minneapolis, MN

CONSULTANTS

IMEG
MEYER BORGMAN JOHNSON

PROJECT INFORMATION

LEE & PENNY ANDERSON MULTIPURPOSE ARENA

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I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

JARED B OLSON

REGISTRATION NO.	DATE
42340	11/03/2023

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JOB NO.	DATE
701480	01.19.2024

ISSUE RECORD

ISSUE #	DATE	DESCRIPTION
1	03/02/2023	CONCEPT DESIGN
2	05/22/2023	50% SCHEMATIC DESIGN
3	09/01/2023	100% SCHEMATIC DESIGN
4	11/03/2023	IA CD SET - BULL 1
5	11/17/2023	50% DESIGN DEVELOPMENT
6	12/13/2023	ARENA BID PKG-2
7	12/18/2023	ARENA BID PKG-2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

GRADING PLAN - NW

C401

C:\Users\jtaylor.DOMAIN\Documents\Ryan Companies\701480 USF Athletics Hockey Arena\Project Files\Ryan Civil\02 Sheet Files\701480 - C401 GRADING PLAN.dwg

SHEET KEY:

NW	NE
SW	SE

LEGEND:

EXISTING	PROPOSED	
	830	MAJOR CONTOUR
	831	MINOR CONTOUR
		DRAINAGE SWALE
		STORM SEWER PIPE
		SOLID DRAINTILE
		PERFORATED DRAINTILE
		STORM INLET
		STORM MANHOLE
		STORM CLEANOUT
	1.00%	ONE-POINT PERCENT GRADE
	1.00%	TWO-POINT PERCENT GRADE
	3:1	SLOPE RATIO
		CUT / FILL DEPTH
	P 850.62	PAVEMENT ELEVATION
	C 850.62	CONCRETE ELEVATION
	GL 850.62	GUTTER LINE ELEVATION
	TC 850.62	TOP OF CURB ELEVATION
	TC=GL 850.62	TOP OF CURB=GUTTER LINE
	TW=GL 850.62	TOP OF WALL ELEVATION
	BW=GL 850.62	BOTTOM OF WALL ELEVATION
	G 850.62	GROUND ELEVATION
		NATURAL GROUND
	FFE 850.62	FINISHED FLOOR ELEVATION
	RIM 850.62	STRUCTURE RIM ELEVATION
		SOIL BORING
		CONSTRUCTION LIMITS

N

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SCALE IN FEET

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PROJECT INFORMATION

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PAUL, MN 55105

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JARED B. OLSON

REGISTRATION NO. 42340 — DATE 11/03/2023

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JOB NO. 701480 — DATE 01.19.2024

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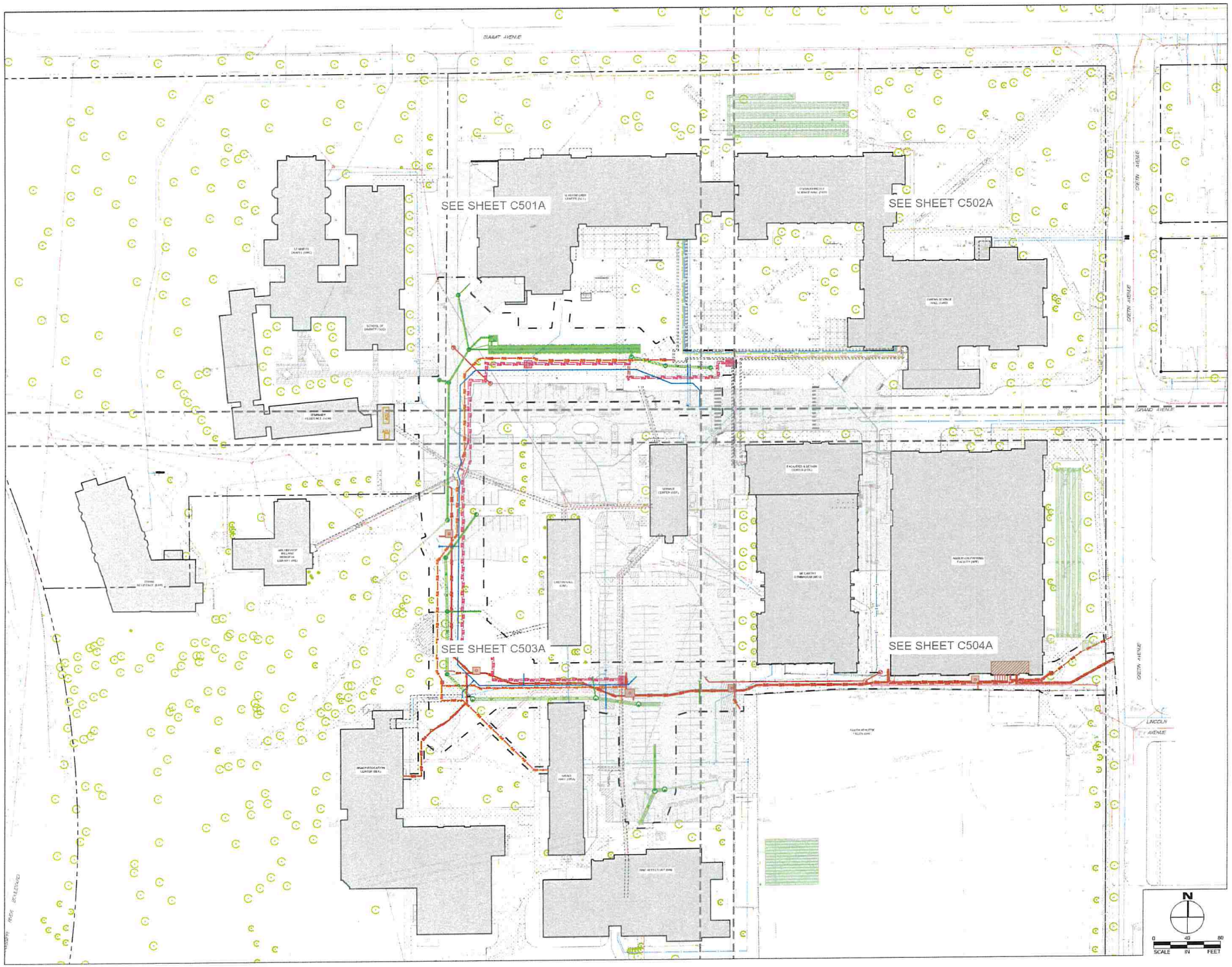
1	03/08/2023	CONCEPT DESIGN
2	05/22/2023	50% SCHEMATIC DESIG
3	06/07/2023	100% SCHEMATIC DESIG
4	11/03/2023	LB CD SET - BULL T
5	11/17/2023	50% DESIGN DEVELOPMENT
6	12/11/2023	ARENA BID PKG-2
7	12/15/2023	ARENA BID PKG-2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

GRADING PLAN - SW

C403

C:\Users\zfisher.DOMAIN\Documents\Ryan Companies\701480 UofT Athletics Hockey Arena Project Files Ryan Cmf\02 Sheet Files\701480 - C400 GRADING PLAN.dwg



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JARED B. OLSON

REGISTRATION NO.	DATE
42340	1/19/2023

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JOB NO. 701480	DATE 01.19.2024

ISSUE RECORD

ISSUE #	DATE	DESCRIPTION
1	03/08/2023	CONCEPT DESIGN
2	06/22/2023	50% SCHEMATIC DESIG
3	08/01/2023	100% SCHEMATIC DESIG
4	11/03/2023	1X CD SET - BUILL 1
5	11/17/2023	50% DESIGN DEVELOPMENT
6	12/11/2023	ARENA BID PKG 2
7	12/18/2023	ARENA BID PKG 2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

UTILITY PLAN - OVERALL - PH 1

C500A

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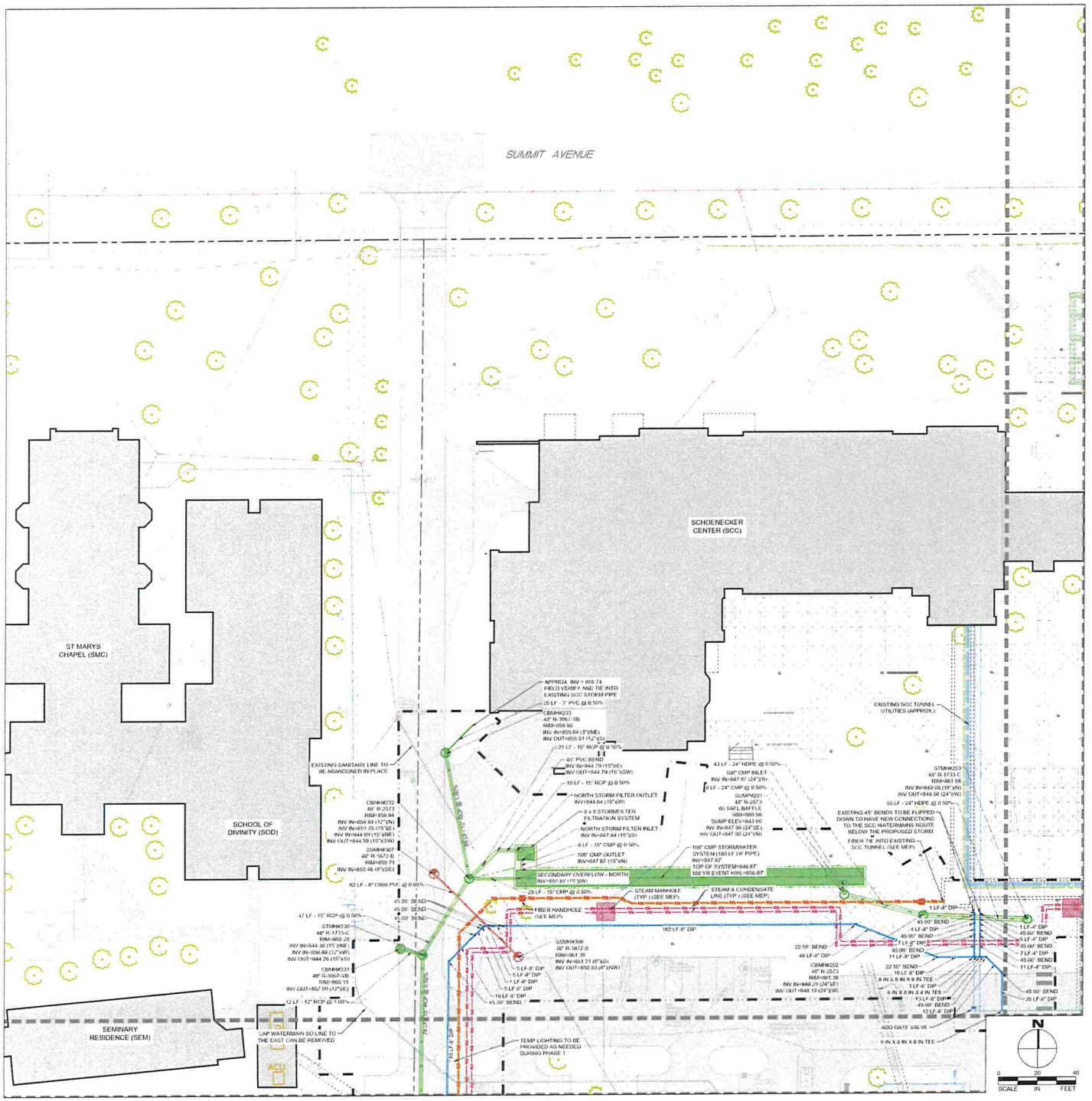

SHEET KEY:

NW	NE
SW	SE

LEGEND:

EXISTING	PROPOSED	
		STORM SEWER PIPE
		SOLID DRAINTILE
		PERFORATED DRAINTILE
		STORM INLET
		STORM MANHOLE
		STORM CLEANOUT
		SANITARY SEWER PIPE
		SANITARY SEWER MANHOLE
		SANITARY SEWER CLEANOUT
		WATER MAIN
		HYDRANT
		GATE VALVE
		FIRE DEPARTMENT CONNECTION
		WELL
		FIRE SPRINKLER
		IRRIGATION
		IRRIGATION CONTROL BOX
GAS	GAS	NATURAL GAS
EOH	EOH	ELECTRIC OVERHEAD
EUG	EUG	ELECTRIC UNDERGROUND
FUG	FUG	FIBER OPTIC UNDERGROUND
TOH	TOH	TELEPHONE OVERHEAD
TUG	TUG	TELEPHONE UNDERGROUND
STM	STM	STEAM
		CHILLED WATER
		ELECTRIC HANDHOLE
		ELECTRIC MANHOLE
		ELECTRIC METER
		TRANSFORMER
GEN	GEN	GENERATOR
		LIGHT POLES
		POWER POLE
		GAS VALVE
		GAS METER
		FIBER OPTIC MANHOLE
		UTILITY TUNNEL
		INSULATION
		SAND WEDGE (1/C002)

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OWNER

University of St. Thomas
Minneapolis, MN

CONSULTANTS

IMEG
MEYER BORGMAN JOHNSON

PROJECT INFORMATION

LEE & PENNY ANDERSON MULTIPURPOSE ARENA

2260 SUMMIT AVE ST.
PAUL, MN 55105

I hereby certify that this plan, specification, or rep
was prepared by me or under my direct supervisi
and that I am a duly Licensed Professional Engine
under the laws of the State of Minnesota

JARED B. OLSON

REGISTRATION NO. 42349 — DATE 11/03/2023

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DRAWN BY ZAT — CHECKED BY AEA

JOB NO. 79140 — DATE 01/19/2024

ISSUE RECORD

ISSUE #	DATE	DESCRIPTION
1	03/08/2023	CONCEPT DESIGN
2	06/23/2023	50% SCHEMATIC DESIGN
3	09/01/2023	100% SCHEMATIC DESIG
4	11/03/2023	LB CD SET - BULL 1
5	11/17/2023	50% DESIGN DEVELOPMENT
6	12/15/2023	ARENA BID PKG-2
7	12/18/2023	ARENA BID PKG-2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

UTILITY PLAN - NW - PH 1

C501A

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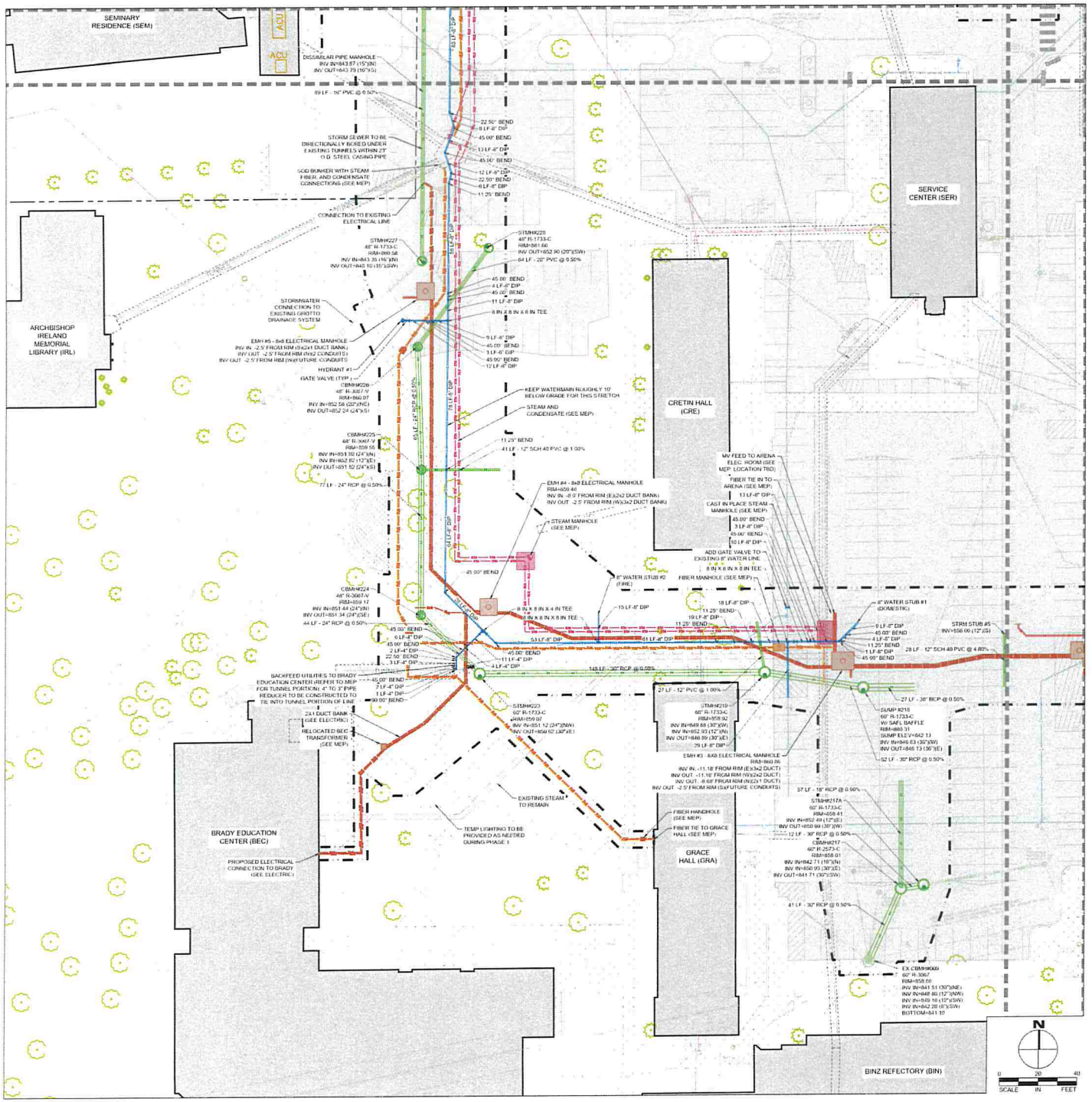

SHEET KEY:

NW	NE
SW	SE

LEGEND:

EXISTING	PROPOSED	
		STORM SEWER PIPE
		SOLID DRAINTILE
		PERFORATED DRAINTILE
		STORM INLET
		STORM MANHOLE
		STORM CLEANOUT
		SANITARY SEWER PIPE
		SANITARY SEWER MANHOLE
		SANITARY SEWER CLEANOUT
		WATER MAIN
		HYDRANT
		GATE VALVE
		FIRE DEPARTMENT CONNECTION
		WELL
		FIRE SPRINKLER
		IRRIGATION
		IRRIGATION CONTROL BOX
GAS	GAS	NATURAL GAS
EOH	EOH	ELECTRIC OVERHEAD
EUG	EUG	ELECTRIC UNDERGROUND
FUG	FUG	FIBER OPTIC UNDERGROUND
TOH	TOH	TELEPHONE OVERHEAD
TUG	TUG	TELEPHONE UNDERGROUND
STM	STM	STEAM
		CHILLED WATER
		ELECTRIC HANDHOLE
		ELECTRIC MANHOLE
		ELECTRIC METER
		TRANSFORMER
GEN	GEN	GENERATOR
		LIGHT POLES
		POWER POLE
		GAS VALVE
		GAS METER
		FIBER OPTIC MANHOLE
		UTILITY TUNNEL
		INSULATION
		SAND WEDGE (1/C602)

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JARED B. OLSON

REGISTRATION NO. 42340 DATE 11/03/2023

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JOB NO. 297400 DATE 01.19.2024

ISSUE RECORD

ISSUE #	DATE	DESCRIPTION
1	03/08/2023	CONCEPT DESIGN
2	06/23/2023	50% SCHEMATIC DESIGN
3	09/01/2023	100% SCHEMATIC DESIGN
4	11/03/2023	LB CD SET - BULL 1
5	11/17/2023	50% DESIGN DEVELOPMENT
6	12/11/2023	ARENA BID PKG-2
7	12/18/2023	ARENA BID PKG-2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

UTILITY PLAN - SW - PH 1

C503A

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JARED B. OLSON

REGISTRATION NO.	DATE
42349	11/03/2023

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DRAWN BY	CHECKED BY
ZAT	ATA
JOB NO.	DATE
701400	01/19/2024

ISSUE RECORD

ISSUE #	DATE	DESCRIPTION
1	03/08/2023	CONCEPT DESIGN
2	04/25/2023	75% SCHEMATIC DESIGN
3	05/01/2023	100% SCHEMATIC DESIGN
4	11/03/2023	LP CD SET - BULL 1
5	11/17/2023	50% DESIGN DEVELOPMENT
6	12/11/2023	ARENA BID PKG-2
7	12/18/2023	ARENA BID PKG-2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

UTILITY PLAN - OVERALL - PH 2

C500B

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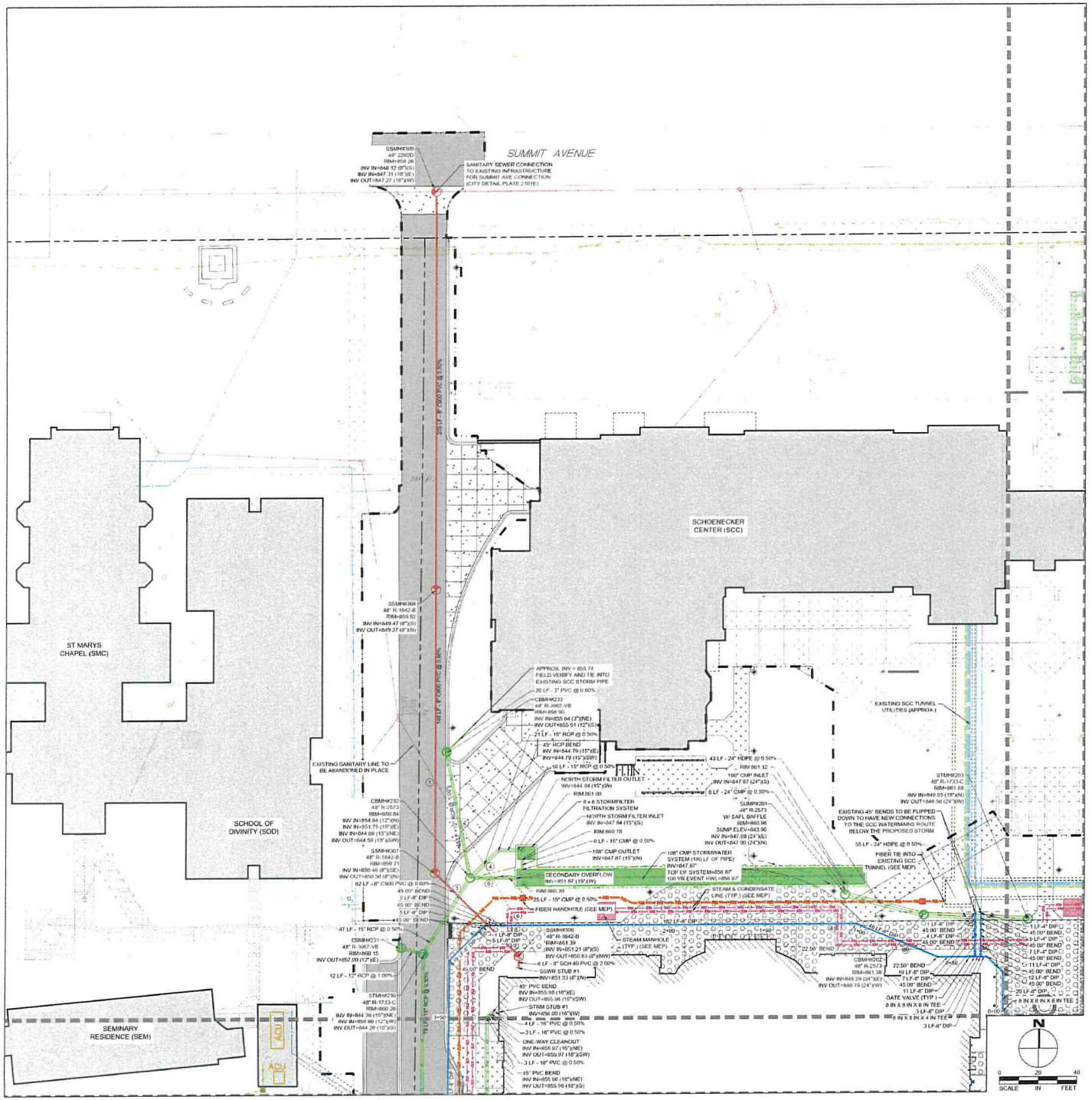

SHEET KEY:

NW	NE
SW	SE

UTILITY CROSSING SCHEDULE

UTILITY CROSSING NUMBER	STORM SEWER TOP/OUT OF PIPE ELEV	SANITARY SEWER TOP/OUT OF PIPE ELEV	WATERMAIN TOP/OUT OF PIPE ELEV	STEAM TOP/OUT OF PIPE ELEV	ELECTRIC TOP/OUT OF DUCT BANK ELEV	UTILITY TUNNELS TOP/OUT OF FLOORS	EXISTING UTILITIES TOP/OUT OF PIPE ELEV	UTILITY SEPARATION
1	--	850.98 (BOT)	--	--	--	--	844.42 (TOP)	1.64
2	854.57 (INT)	--	--	--	--	--	849.12 (TOP)	5.45
3	849.90 (TOP)	850.34 (BOT)	--	--	--	--	--	4.78
4	849.10 (TOP)	--	--	--	--	--	844.27 (BOT)	2.11
5	851.76 (BOT)	--	--	--	--	--	845.06 (TOP)	2.89
6	--	--	--	854.54 (BOT)	--	--	849.10 (TOP)	5.69
7	--	850.57 (BOT)	847.67 (TOP)	--	--	--	--	2.90**
8	--	--	852.24 (BOT)	856.04 (BOT)	--	--	849.74 (TOP)	2.47**
9	--	851.40 (TOP)	--	859.04 (BOT)	--	--	--	3.55
9A	--	--	853.27 (TOP)	854.35 (BOT)	--	--	--	0.87
9B	849.27 (BOT)	--	846.76 (TOP)	--	--	--	--	1.92**
9C	--	--	847.16 (TOP)	854.44 (BOT)	--	--	--	0.99
9 D	--	--	853.57 (TOP)	854.56 (BOT)	--	--	--	0.99

* CROSSING AT EXISTING UTILITY, FIELD VERIFY DEPTH
** 7 MINIMUM SEPARATION REQUIRED BETWEEN WATERMAIN AND SEWER. LOWER OR RAISE WATERMAIN AT CROSSING TO PROVIDE 7' OF SEPARATION. DR-XXX INSULATION IF 3' SEPARATION IS NOT ACHIEVABLE. (SEE DETAIL 7516D)

NOTE: UTILITY TUNNEL DEPTHS TO BE FIELD VERIFIED

LEGEND:

EXISTING	PROPOSED	
		STORM SEWER PIPE
		SOLID DRAINTILE
		PERFORATED DRAINTILE
		STORM INLET
		STORM MANHOLE
		STORM CLEANOUT
		SECONDARY OVERFLOW DRAIN
		SANITARY SEWER PIPE
		SANITARY SEWER MANHOLE
		SANITARY SEWER CLEANOUT
		WATER MAIN
		HYDRANT
		GATE VALVE
		FIRE DEPARTMENT CONNECTION
		WELL
		FIRE SPRINKLER
		IRRIGATION
		IRRIGATION CONTROL BOX
GAS	GAS	NATURAL GAS
EOH	EOH	ELECTRIC OVERHEAD
EUG	EUG	ELECTRIC UNDERGROUND
FUG	FUG	FIBER OPTIC UNDERGROUND
TOH	TOH	TELEPHONE OVERHEAD
TUG	TUG	TELEPHONE UNDERGROUND
STM	STM	STEAM
		CHILLED WATER
		ELECTRIC HANDHOLE
		ELECTRIC MANHOLE
		ELECTRIC METER
		TRANSFORMER
	GEN	GENERATOR
		LIGHT POLES
		POWER POLE
		GAS VALVE
		GAS METER
		FIBER OPTIC MANHOLE
		UTILITY TUNNEL
		INSULATION
		SAND WEDGE (1MC0501)

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CONSULTANTS

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PROJECT INFORMATION

LEE & PENNY ANDERSON MULTIPURPOSE ARENA

2260 SUMMIT AVE ST.
PAUL, MN 55105

I hereby certify that this plan, specification, or rep was prepared by me or under my direct supervisi and that I am a duly Licensed Professional Engin under the laws of the State of Minnesota.

JARED B OLSON

REGISTRATION NO.	DATE
42340	11/01/2022

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ZAR	ATA
JOB NO. 701480	DATE 01.19.2024

ISSUE RECORD

ISSUE #	DATE	DESCRIPTION
1	03/03/2023	CONCEPT DESIGN
2	06/22/2023	50% SCHEMATIC DESIG
3	09/01/2023	100% SCHEMATIC DESIG
4	11/03/2023	UI CD SET - BULL 1
5	11/17/2023	50% DESIGN DEVELOPMENT
6	12/15/2023	ARENA BID PKG-2
7	12/15/2023	ARENA BID PKG-2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

UTILITY PLAN - NW

C501

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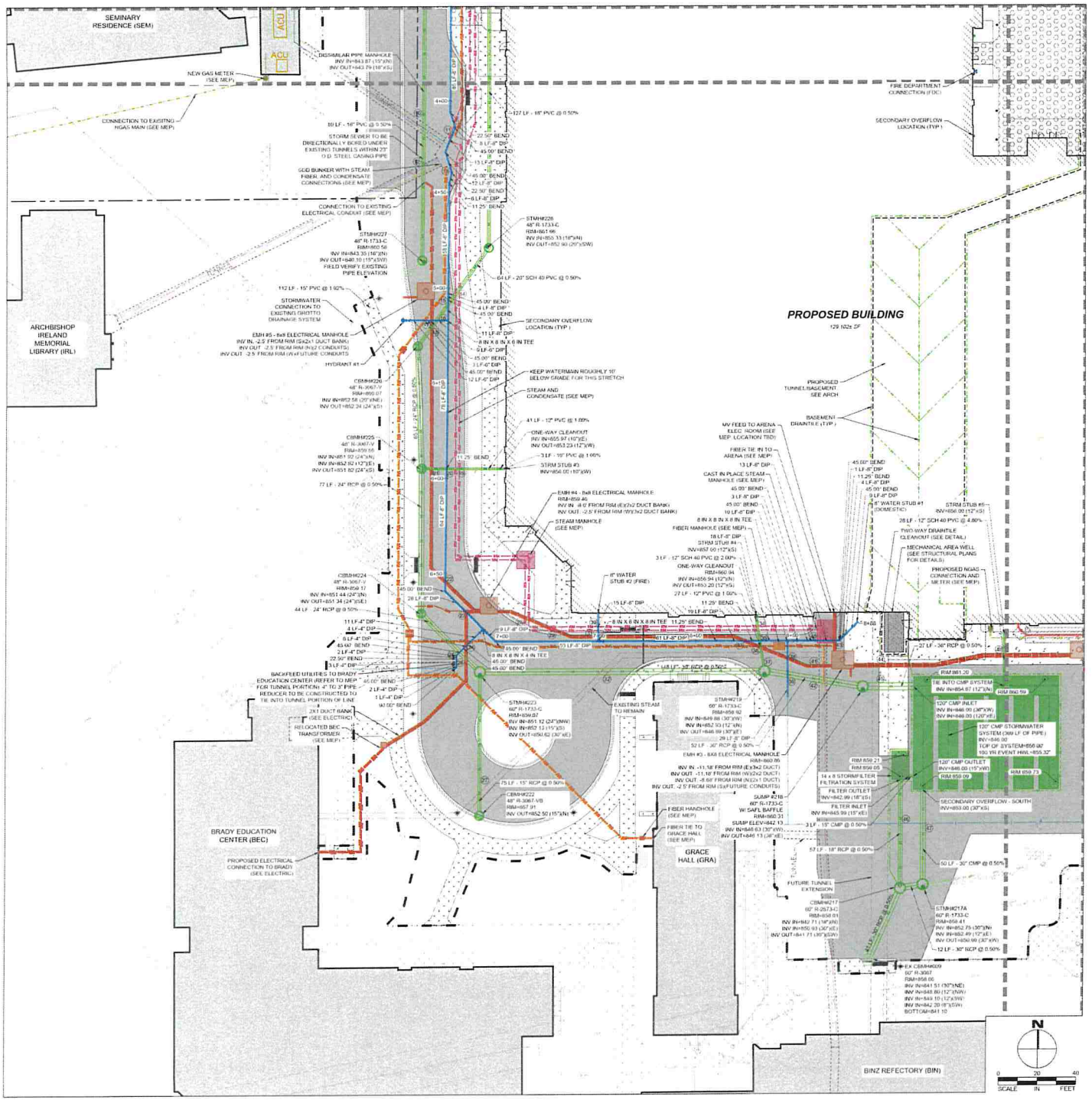

SHEET KEY:

NW	NE
SW	SE

UTILITY CROSSING SCHEDULE

UTILITY CROSSING NUMBER	STORM SEWER TOP/BOT OF PIPE ELEV	SANITARY SEWER TOP/BOT OF PIPE ELEV	WATERMAIN TOP/BOT OF PIPE ELEV	STEAM TOP/BOT OF PIPE ELEV	ELECTRIC TOP/BOT OF DUCT BANK ELEV	UTILITY TUNNELS TOP/BOT OF PIPE ELEV	EXISTING UTILITIES TOP/BOT OF PIPE ELEV	UTILITY SEPARATION
(1)	845.47 (TOP)	—	—	—	—	852.28 (BOT)	—	6.81'
(2)	—	—	852.67 (BOT)	856.28 (BOT)	—	852.10 (TOP)	—	0.58'
(3)	849.35 (TOP)	—	—	—	—	852.47 (BOT)	—	3.12'
(4)	—	—	852.10 (BOT)	—	—	852.10 (TOP)	—	0.00'
(5)	848.28 (TOP)	—	—	855.94 (BOT)	—	—	—	7.66'
(6)	850.67 (BOT)	—	849.68 (TOP)	—	—	—	—	2.01'
(7)	848.41 (BOT)	—	848.02 (TOP)	—	—	—	—	0.40'
(8)	—	—	849.62 (TOP)	—	856.60 (BOT)	—	—	7.00'
(9)	848.81 (TOP)	—	—	—	856.92 (BOT)	—	—	8.11'
(10)	848.02 (TOP)	—	—	855.78 (BOT)	—	—	—	7.76'
(11)	847.82 (BOT)	—	847.62 (TOP)	—	—	—	—	0.20'
(12)	851.61 (TOP)	—	—	—	856.47 (BOT)	—	—	4.86'
(13)	—	—	851.47 (TOP)	—	856.34 (BOT)	—	—	4.87'
(14)	—	—	851.28 (TOP)	—	856.15 (BOT)	—	—	4.87'
(15)	—	—	852.47 (TOP)	—	856.60 (BOT)	—	—	4.13'
(16)	853.61 (BOT)	—	853.28 (TOP)	—	—	—	—	0.33'
(17)	851.61 (TOP)	—	—	—	856.79 (BOT)	—	—	5.18'
(18)	851.74 (TOP)	—	—	—	—	—	858.74 (BOT)	7.00'
(19)	—	—	—	852.40 (BOT)	857.17 (TOP)	—	—	4.77'
(20)	—	—	—	856.40 (BOT)	860.34 (TOP)	—	—	3.94'
(21)	853.61 (TOP)	—	851.12 (TOP)	858.34 (BOT)	—	—	—	4.73'
(22)	—	—	852.28 (BOT)	—	856.79 (TOP)	—	—	3.51'
(23)	852.52 (BOT)	—	—	—	856.32 (TOP)	—	—	3.80'
(24)	854.04 (TOP)	—	—	—	—	—	858.53 (BOT)	4.49'
(25)	—	—	851.42 (BOT)	—	849.51 (TOP)	—	855.42 (BOT)	5.91'
(26)	849.62 (TOP)	—	850.44 (BOT)	—	—	—	—	1.82'
(27)	—	—	849.91 (TOP)	852.53	—	—	—	3.00'
(28)	—	—	—	—	849.74 (TOP)	852.50 (BOT)	—	2.76'
(29)	849.51 (TOP)	—	—	—	—	852.50 (BOT)	—	2.87'
(30)	—	—	849.50 (TOP)	—	854.87 (BOT)	—	—	5.37'
(31)	—	—	—	—	849.37 (TOP)	851.30 (BOT)	—	1.80'
(32)	844.44 (TOP)	—	—	—	—	851.30 (BOT)	—	6.86'
(33)	844.64 (TOP)	—	—	—	—	—	850.62 (BOT)	5.98'
(34)	852.67 (BOT)	—	—	—	—	—	854.41 (TOP)	1.74'
(35)	851.61 (BOT)	—	—	—	855.21 (TOP)	—	—	3.60'

1. NORMALLY AT EXISTING UTILITY ELEVATION IF POSSIBLE
2. 12" MINIMUM SEPARATION REQUIRED BETWEEN WATERMAIN AND SEWER. LOWER OR RAISE WATERMAIN AT CROSSING TO PROVIDE 12" OF SEPARATION. 6" OF SEPARATION IS NOT ACCEPTABLE (SEE DETAIL TYP.)

NOTE: UTILITY TUNNEL DEPTHS TO BE FIELD VERIFIED

LEGEND:

EXISTING / PROPOSED

- STORM SEWER PIPE
- SOLID DRAINTILE
- PERFORATED DRAINTILE
- STORM INLET
- STORM MANHOLE
- STORM CLEANOUT
- SECONDARY OVERFLOW DRAIN
- SANITARY SEWER PIPE
- SANITARY SEWER MANHOLE
- SANITARY SEWER CLEANOUT
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- SAND WEDGE (15H:0.5V)

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5	11/17/2023	50% DESIGN DEVELOPMENT
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7	12/18/2023	ARENA BID PKG-2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

UTILITY PLAN - SW

C503

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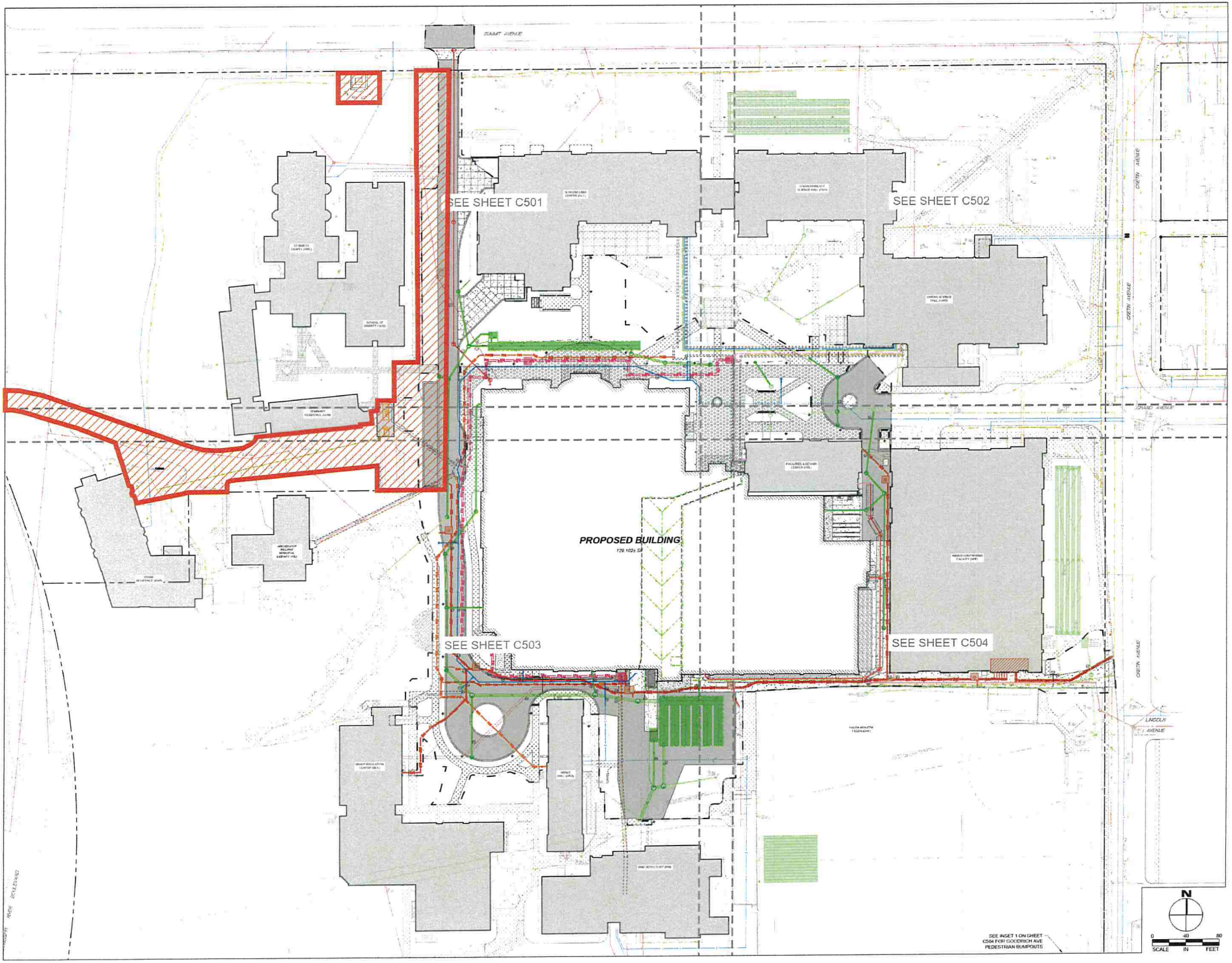
EXHIBIT D
TO TEMPORARY CONSTRUCTION LICENSE

DEPICTION OF LICENSE AREA



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REGISTRATION NO.	DATE
42349	1/19/2024

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701480	01.19.2024

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3	09/01/2023	100% SCHEMATIC DESIG
4	11/03/2023	LI CD SET - BULL 1
5	11/17/2023	90% DESIGN DEVELOPMENT
6	12/11/2023	ARENA BID PKG-2
7	12/15/2023	ARENA BID PKG-2
8	01/19/2024	100% DESIGN DEVELOPMENT

100% DESIGN DEVELOPMENT
01/19/2024

UTILITY PLAN - OVERALL - PH 2

C500B

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Document# 4090849
Recorded 04/14/2008 1600
County Recorder, Ramsey County, MN
1.1.6 377772

DEDICATION OF EASEMENT FOR RIGHT OF WAY PURPOSES

The University of Saint Thomas, incorporated as a non-profit,

for good and valuable consideration, to them in hand paid and the receipt of which is hereby acknowledged, does hereby grant, bargain, sell and convey to the City of Saint Paul, a municipal corporation of the State of Minnesota, its successors and assigns, as Grantee, a permanent easement for right-of-way purposes over, under and across the following tract of land being in the County of Ramsey, State of Minnesota, described as follows:

See attached map and legal description, Exhibit A,

to have and to hold the same forever. Grantor does covenant that it is well seized in fee of the land and premises aforesaid, and has good right to sell and convey the same free of all encumbrances.

That Grantor also covenants that the above granted easement is in the quiet and peaceable possession of the Grantee. Grantor will warrant and defend against all persons lawfully claiming the whole or any part thereof, subject to encumbrances, if any, hereinbefore mentioned. It is intended and agreed that this agreement shall be a covenant running with the land and shall be binding to the fullest extent of the law and equity for the benefit of the public. It is further intended and agreed that this agreement and covenant shall remain in effect without limitation as to time.

9-5

IN TESTIMONY WHEREOF, Grantor, The University of Saint Thomas, incorporated as a non-profit under the laws of the State of Minnesota, has caused this deed to be executed in its corporate name by its duly authorized officers, and attested to this 10th day of March, 2008.

By _____

Its Vice President for Business Affairs/Chief Financial Officer/Treasurer (Mark Vangsgard)

And Gerald M. Anderley

Its AVP for Facilities

STATE OF MINNESOTA }
COUNTY OF RAMSEY } ss

The foregoing was acknowledged before me this 10th day of March, 2008

by Mark Vangsgard and Gerald Anderley

the CFO and AVP

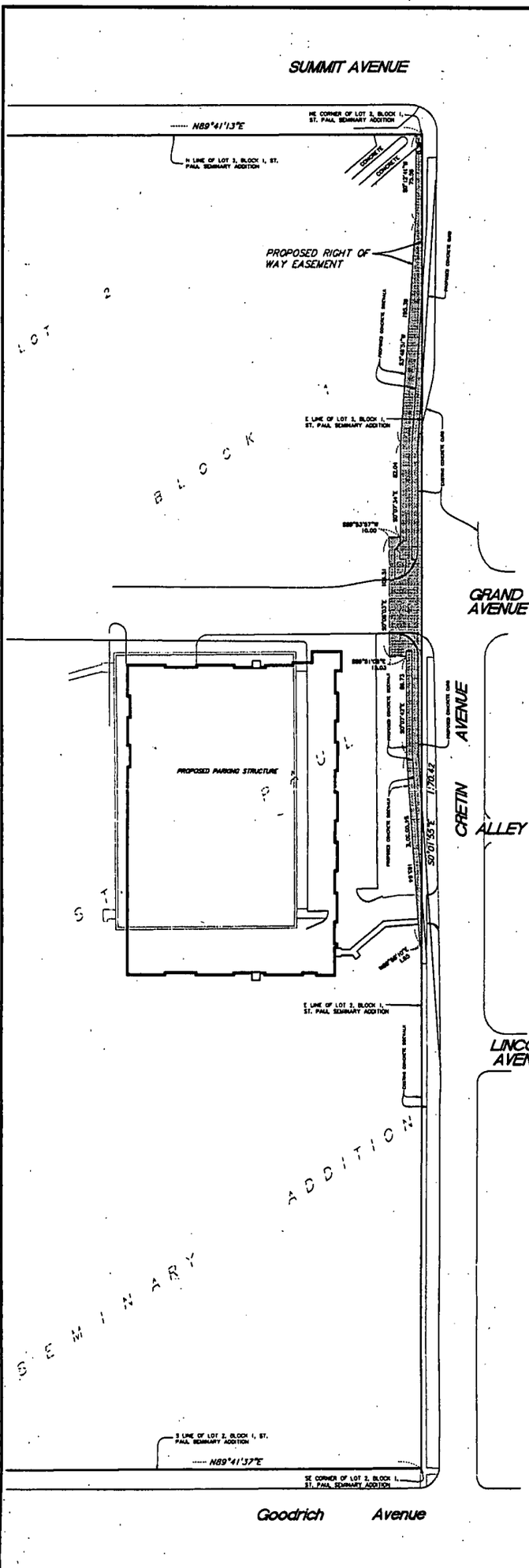
of University of St. Thomas

MARY L. MULCAHY
Notary Public
Minnesota
My Commission Expires January 31, 2009

Mary L. Mulcahy

This Instrument was drafted by:

Department of Public Works
Technical Services Division - Real Estate
Room 1000, City Hall Annex
25 W. 4th St.
St. Paul, MN 55102



DESCRIPTION OF PROPERTY SURVEYED

Part of Lot 2, Block 1, ST. PAUL SEMINARY ADDITION, according to the recorded plat thereof, Ramsey County, Minnesota.

DESCRIPTION OF PROPOSED RIGHT OF WAY EASEMENT

That part of Lot 2, Block 1, ST. PAUL SEMINARY ADDITION, according to the recorded plat thereof, Ramsey County, Minnesota, which lies easterly of a line described as commencing at the northeast corner of said Lot 2; thence South 89 degrees 41 minutes 13 seconds West, assumed bearing, along the north line of said Lot 2, a distance of 5.39 feet to the point of beginning of the line to be described; thence South 0 degrees 12 minutes 41 seconds West a distance of 78.56 feet; thence South 3 degrees 48 minutes 31 seconds West a distance of 195.38 feet; thence South 0 degrees 07 minutes 34 seconds East a distance of 82.04 feet; thence South 88 degrees 53 minutes 57 seconds West a distance of 10.00 feet; thence South 0 degrees 06 minutes 03 seconds East a distance of 104.51 feet; thence South 89 degrees 51 minutes 08 seconds East a distance of 15.03 feet; thence South 0 degrees 07 minutes 42 seconds East a distance of 88.73 feet; thence South 4 degrees 05 minutes 50 seconds East a distance of 165.64 feet; thence North 89 degrees 58 minutes 10 seconds East a distance of 1.65 feet to the east line of said Lot 2 and said line there terminating.

NOTES:

1.) This survey does not purport to show underground utilities; verify all utilities critical to construction or design.

2.) Contact GOPHER STATE ONE CALL at 651-454-0002 for precise onsite location of utilities prior to any excavation.

3.) This survey was prepared without the benefit of current title work. Easements, appurtenances, and encumbrances may exist in addition to those shown hereon. Easement information shown was provided by Comstock & Davis, inc. location. This survey is subject to revision upon receipt of a current title insurance commitment or attorney's title opinion. This survey does not purport to be a boundary survey.

4.) Survey coordinate basis: Ramsey County Coordinate System

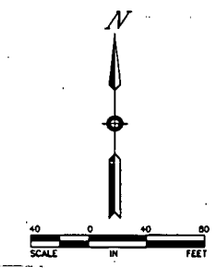
I hereby certify that this survey, plan, or report was prepared by me or under my direct supervision and that I am a duly Licensed Land Surveyor under the laws of the State of Minnesota.

Dated this 28th day of February, 2008

SUNDE LAND SURVEYING, LLC.

By _____

Aries J. Carlson, P.L.S. Minn. Lic. No. 44900



Add right of way easement	TLS	2/28/2008
Add new parking ramp	TLS	2/25/2008
Revision	By	Date
Original survey dated July 12, 2007	TLS	

Drawing Title:

DESCRIPTION SKETCH FOR:

RYAN COMPANIES
(UNIVERSITY OF ST. THOMAS)

SUNDE LAND SURVEYING
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Project: 2007-089-A	By/Dy: BM4/DJ/415/TLS/JJ/DJ
Township: 29 Range: 23 Section: 5	Date: 02/28/2008
File: 20070890004.dwg	Sheet: 1 of 1

Exhibit A

Exhibit A

DESCRIPTION OF PROPOSED RIGHT OF WAY EASEMENT

That part of Lot 2, Block 1, ST. PAUL SEMINARY ADDITION, according to the recorded plat thereof, Ramsey County, Minnesota, which lies easterly of a line described as commencing at the northeast corner of said Lot 2; thence South 89 degrees 41 minutes 13 seconds West, assumed bearing, along the north line of said Lot 2, a distance of 5.39 feet to the point of beginning of the line to be described; thence South 0 degrees 12 minutes 41 seconds West a distance of 75.56 feet; thence South 3 degrees 48 minutes 51 seconds West a distance of 195.38 feet; thence South 0 degrees 07 minutes 34 seconds East a distance of 82.04 feet; thence South 89 degrees 53 minutes 57 seconds West a distance of 10.00 feet; thence South 0 degrees 06 minutes 03 seconds East a distance of 104.51 feet; thence South 89 degrees 51 minutes 08 seconds East a distance of 15.03 feet; thence South 0 degrees 07 minutes 42 seconds East a distance of 86.73 feet; thence South 4 degrees 05 minutes 50 seconds East a distance of 165.64 feet; thence North 89 degrees 58 minutes 10 seconds East a distance of 1.65 feet to the east line of said Lot 2 and said line there terminating.

ADDENDUM

05.28.23.42.0005	Abstract
	ST. PAUL SEMINARY ADDITION EX PART DESC AS BEG ON WL OF LOT 2 BLK 1 & 30.97 FT S FROM SW COR OF LOT 1 BLK 1 TH N 89 DEG 15 MIN 24 SEC E FOR 196.48 FT TH N 0 DEG 27 MIN 49 SEC W FOR 138.16 FT TO LOT L BETWEEN SD LOTS 1 & 2; LOT 2 BLK 1

STORMWATER MANAGEMENT PLAN

Lee & Penny Anderson Multipurpose Arena
2260 Summit Ave
St. Paul, MN 55105

Prepared by:

Ryan A+E, Inc.
Project No. 701480

~~September 11, 2023~~
~~(October 30, 2023 Updated)~~
~~(November 17, 2023 Updated)~~
~~(December 5, 2023 Updated)~~
(January 19, 2024 Updated)

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

_____
Jared B. Olson, P.E., LEED AP
Minnesota License No. 42340

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INTRODUCTION

This stormwater management plan was prepared for the proposed Lee & Penny Anderson Multipurpose Arena project located at 2260 Summit Ave in St. Paul, Minnesota. Included in this plan are calculations for the existing and proposed discharge of stormwater from the site. The site is located within the Capitol Region Watershed District (CRWD) and is subject to the requirements of the CRWD and City of St. Paul (City) stormwater regulations.

The Lee & Penny Anderson Multipurpose Arena Project (Project) is a proposed redevelopment of an approximately six acre portion of the University of St. Thomas (St. Thomas) South Campus bordered by Summit Ave to the north, Cretin Ave to the east, Goodrich Ave to the south, and Mississippi River Blvd to the west. The Project will include a multipurpose competition venue for St. Thomas' hockey and basketball programs with capacity for approximately 4,000 to 5,500 spectators. The Project also includes practice facilities, coaching offices, locker rooms, and student athlete support services and will host other university events such as commencement ceremonies, academic convocations, speakers, and career fairs. Three existing buildings will be demolished, and six existing surface parking lots will be partially or wholly demolished to accommodate the redevelopment.

Included in this plan are calculations for the existing and proposed discharge of stormwater from the site.

DESIGN REQUIREMENTS

Runoff Control

CRWD Rules state the runoff rates for the proposed activity shall not exceed existing runoff rates for the 2-year, 10-year, and 100-year critical storm event using Atlas 14 precipitation depths and MSE-3 storm distributions. A hydrograph method based on sound hydrologic theory shall be used to analyze runoff for the design or analysis of flows and water levels. Reservoir routing procedures and critical duration storm events shall be used for design of detention basins and outlets.

City Stormwater Management Design Standards require the same runoff rates as CRWD.

Water Quality

CRWD Rules include water quality requirements for developments to incorporate effective non-point source pollution reduction BMPs to achieve 90% total suspended solids (TSS) removal from the disturbed area of the project on an

annual basis. Runoff volume reduction BMPs may be considered towards compliance with the 90% TSS removal requirements.

City Stormwater Management Design Standards require the same amount of total suspended solids removal as CRWD.

Volume Management

CRWD Rules state the stormwater runoff shall be retained onsite in the amount equivalent to 1.1 inches of runoff over the new and reconstructed impervious surfaces of the development. Infiltration, stormwater reuse, and other alternative compliance measures are allowed to meet the stormwater runoff requirements. Stormwater must be pretreated before discharging to infiltration or filtration areas.

City Stormwater Management Design Standards require the same amount of stormwater runoff be retained on site as CRWD and point to CRWD's rules for alternative compliance sequencing.

Flood Control

CRWD Rules state that no person or political subdivision shall alter or fill land below the 100-year flood elevation of any waterbody, public water, or public water wetland without first obtaining a permit from the District. Placement of fill within the 100-year floodplain is prohibited unless compensatory storage is provided. All habitable buildings, roads, and parking structures on or adjacent to a project site shall comply with District Freeboard requirements. For subsurface stormwater management BMPs, generally the low floor or low opening must be a minimum of 2 feet above the 100-year flood elevation or one foot above the emergency overflow elevation unless flood proofing measures are constructed with the building.

City Stormwater Management Design Standards require the same amount of flood control as CRWD.

Stormwater Conveyance

The stormwater pipes are designed to handle the flow rate from a 10-year rainfall event.

METHODOLOGY

Runoff Control

Stormwater modeling software HydroCAD 10.00 was used to model and analyze runoff for the existing and proposed site conditions. The SCS Runoff method was used to evaluate site conditions during each rain event for determining rate and quantity control.

Water Quality

Mass Loading Calculations provided by Contech are included in this report to show the appropriate TSS removal using enhanced filter media within the proposed filter cartridges.

Volume Management

Due to the site constraints of high bedrock and seasonal high groundwater lying within 3 feet of the bottom of any proposed infiltration area, the project is seeking to use the alternative compliance measure outlined in the CRWD Rules of filtration. Contech's StormFilter with PhosphoSorb filter media is proposed which equates to a 68% credit through CRWD's approved MTD List (See Figure 1). Sump manholes with SAFL Baffles will be utilized for pretreatment prior to the filtration systems.

Stormwater Conveyance

HydraFlow Storm Sewers Extension for AutoCAD Civil 3D was used to evaluate pipe sizes during the 10-year storm event.

Rainfall Depth and Intensity

An MSE-3 rainfall distribution is utilized per CRWD requirements. The following table identifies the storm frequencies and Atlas 14rainfall intensities that were used for the hydrologic analysis.

Table 1.1 –Rainfall Depth and Intensity

MSE-3 24-Hour Rainfall Event	Rainfall Depth (in)
2-yr	2.83
10-yr	4.23
100-yr	7.47

SITE CHARACTERISTICS

Existing Conditions

The University of St. Thomas South Campus parcel is bounded by Summit Ave to the north, Cretin Ave to the east, Goodrich Ave to the south, and both Mississippi River Blvd and the St. Paul Seminary parcel to the west. The approximately six acre redevelopment site sits near the center of the parcel with the newly constructed Schoenecker Center and quadrangle to the north, the Anderson Parking Facility to the east, the South Athletic Fields and Grace Residence Hall to the south, and St. Paul Seminary property to the west.

The existing geologic conditions of the site consist of:

Fill:	Fill was present in all soil borings at depths of 3-9.5' below surface elevation consisting of a mixture of sandy lean clays, lean clays, clayey sands, and silty sands with varying amounts of organics and gravel. Bituminous was found at the surface where existing parking lots exist.
Coarse Alluvium:	Coarse alluvial soils were found in three borings and consisted of silty sands with varying amounts of gravel.
Till:	Till soils were found in most borings and consisted of gravelly clayey sands.
Bedrock:	Bedrock from the Decorah Shale formation was found at depths 8-12' below surface elevation consisting of a green-gray calcareous shale with thinly bedded light gray limestone layers.
Groundwater:	Groundwater was found in three borings at depths of 10-12' below surface elevation. Based on previous project on the University campus (Anderson Parking Ramp, Service Center, McCarthy Gymnasium), there are two groundwater levels. The first level occurs within the overburden soils above the shale bedrock and is generally found 6-8' below the surface elevation. The second level occurs within the bedrock where limestone seams are present, generally 14-15' below the surface elevation. The two groundwater levels act independently of each other.

See Appendix A for the Arena Geotechnical Report.

There are six main subcatchment areas onsite including:

Subcatchment E-1:	Overland flow towards Summit Ave to the north
Subcatchment E-2:	Overland flow towards Cretin Ave to the east
Subcatchment E-3:	Piped discharge to an existing storm sewer tunnel that runs underneath the property starting from approximately the Cretin Ave/Lincoln Ave intersection and drains out to the Mississippi River. There are two storm tunnel connection points.
Subcatchment E-4:	Overland flow towards Goodrich Ave to the south
Subcatchment E-5:	Overland flow towards Mississippi River Blvd to the west
Subcatchment E-6:	Piped discharge to an existing linear aquatic feature that drains out to the Mississippi River

The existing drainage subcatchments along with pervious / impervious totals can be seen in the attached Existing Conditions Drainage Plan (Figure 2).

As the parcel is a developed site, there are existing stormwater treatment practices in place installed from previous development. The existing treatment systems were included within the HydroCAD analysis to provide the University a comprehensive stormwater treatment model and because there were overlapping drainage areas from those former projects. Stormwater and/or HydroCAD Reports from each respective project are included in Appendix B-D for reference. Those include the Schoenecker Center (SCC) System approved in 2022, the Anderson Parking Facility (APF) System approved in 2007, and the South Athletic Fields (SAF) System approved in 2013.

Schoenecker Center (SCC) System	Underground cistern (96” pipe gallery) with water reuse for irrigation purposes
Anderson Parking Facility (APF) System	Underground cistern (48” pipe gallery) with filter cartridges
South Athletic Fields (SAF) System	Surface filtration (sand and rock section below entirety of artificial turf system) with chambers for storage

Proposed Conditions

The proposed project will replace the existing surface parking lots and buildings with a new arena building, access drives and turnarounds, and plaza spaces. Proposed stormwater runoff conditions for this project will match the six existing subcatchments.

Subcatchment P-1:	Overland flow towards Summit Ave to the north
Subcatchment P-2:	Overland flow towards Cretin Ave to the east
Subcatchment P-3:	Piped discharge to an existing storm sewer tunnel that runs underneath the property starting from approximately the Cretin Ave/Lincoln Ave intersection and drains out to the Mississippi River. There are two storm tunnel connection points.
Subcatchment P-4:	Overland flow towards Goodrich Ave to the south
Subcatchment P-5:	Overland flow towards Mississippi River Blvd to the west
Subcatchment P-6:	Piped discharge to an existing linear aquatic feature that drains out to the Mississippi River

The proposed drainage subcatchments along with pervious / impervious totals can be seen in the attached Proposed Conditions Drainage Plan (Figure 3).

Existing subsurface soils are generally not conducive for infiltrating practices so filtration is utilized for water quality and volume management per CRWD and City requirements.

North Arena Treatment System	Underground cistern (108” pipe gallery) with filter cartridges
South Arena Treatment System	Underground cistern (120” pipe gallery) with filter cartridges

No changes are proposed to the existing SCC and SAF stormwater treatment systems. However, the existing outlet control structure for the APF system includes an existing low flow orifice, 20” in width by 3” in height according to the APF record drawings, that the project team is proposing to block/cover in order to retain the 1.1 inch rainfall event within the BayFilter treatment system to meet the volume management requirements and comply with the rate control requirements.

RESULTS

Runoff Control

Tables 3.1 to 3.3 below depict a comprehensive summary of the existing and proposed runoff conditions. All runoff rates are given in cubic feet per second (cfs). All drainage calculations can be found in the Arena HydroCAD Report provided as Appendix E.

It should be noted that while the runoff rates to the east are increasing slightly in the proposed conditions (due to the new access drive proposed out to Cretin Ave), the overall area and runoff volumes are reduced. The Project Team believes the increase in runoff to the east is negligible compared to the overall reduction in stormwater runoff across the South Campus.

Table 3.1 – Peak Runoff Rates, 2-Year Event

Discharge Point	Drainage Area	2-year, Atlas-14 (2.83" event)		
		Existing	Proposed	Change
N Offsite	1	0.72	0.72	0.00
E Offsite	2	2.12	2.22	0.10
Storm Tunnel	3	18.36	7.58	-10.78
S Offsite	4	7.20	6.31	-0.89
W Offsite	5	11.45	10.44	-1.01
Grotto Pipe	6	8.01	3.61	-4.40
Total		**47.86**	**30.88**	**-16.98**

Table 3.2 – Peak Runoff Rates, 10-Year Event

Discharge Point	Drainage Area	10-year, Atlas-14 (4.23" event)		
		Existing	Proposed	Change
N Offsite	1	1.20	1.20	0.00
E Offsite	2	3.81	3.93	0.12
Storm Tunnel	3	29.59	29.19	-0.40
S Offsite	4	13.34	11.69	-1.65
W Offsite	5	22.03	20.08	-1.95
Grotto Pipe	6	13.01	9.74	-3.27
Total		**82.98**	**75.83**	**-7.15**

Table 3.3 – Peak Runoff Rates, 100-Year Event

Discharge Point	Drainage Area	100-year, Atlas-14 (7.47" event)		
		Existing	Proposed	Change
N Offsite	1	18.30	18.30	0.00
E Offsite	2	7.79	7.90	0.11
Storm Tunnel	3	62.48	55.39	-7.09
S Offsite	4	28.02	24.55	-3.47
W Offsite	5	47.78	43.56	-4.22
Grotto Pipe	6	24.38	20.84	-3.54
Total		**188.75**	**170.54**	**-18.21**

Water Quality

Contech's StormFilter cartridge system is proposed to handle both the water quality and volume management requirements for the project. Mass Loading Calculations provided by Contech are included in this report to show the appropriate 90% TSS removal using enhanced filter media within the proposed filter cartridges. See Appendix F. Standard details for the StormFilter filtration systems are included as Figures 5.

Volume Management

The South Campus parcel includes stormwater treatment systems from previous projects that already treat impervious runoff from the site. The proposed arena project extents overlap with some of those previous projects that are already accounting for impervious area through an existing treatment system(s). Table 3.4 below shows the existing drainage conditions of the site and has broken up the impervious area into existing impervious and constructed impervious. Table 3.5 shows the proposed drainage conditions of the site and has broken the impervious area into existing impervious and reconstructed impervious. This nomenclature is used to quantify the true amount of impervious area that the arena project is responsible for versus impervious area already treated by an existing treatment system. The definitions of each are as follows:

Existing Impervious:	Existing impervious area that remains untouched by the arena project.
Constructed Impervious:	Existing impervious area that is touched/changed by the arena project, but the treatment is already accounted for through an existing University treatment system.
Reconstructed Impervious:	Proposed impervious area that is constructed by the arena project.

Table 3.4 – Existing Drainage Conditions

Discharge Point	Drainage Area	Pervious (sf)	Existing Imp (sf)	Constructed[1] Imp (sf)	Impervious (sf)	Total (sf)
N Offsite	E-1A	4,765	6,146	0	6,146	10,911
	E-1B	89,944	52,819	0	52,819	142,763
E Offsite	E-2	29,883	16,423	0	16,423	46,306
Storm Tunnel	E-3A	50,893	179,547	5,144	184,691	235,584
	E-3B	17,215	81,247	18,416	99,663	116,878
	E-3C	149,084	5,572	6,762	12,334	161,418
S Offsite	E-4	118,052	31,274	0	31,274	149,326
W Offsite	E-5	194,582	66,259	0	66,259	260,841
Grotto Pipe	E-6	40,484	64,980	9,839	74,819	115,303
Total		**694,902**	**504,267**	**40,161**	**544,428**	**1,239,330**

[1]Constructed impervious area is defined as existing impervious area that was constructed by another UST project (SCC, APF, SAF projects) and treatment has been accounted for within those respective stormwater treatment systems

Table 3.5 – Proposed Drainage Conditions

Discharge Point	Drainage Area	Pervious (sf)	Existing Imp (sf)	Reconstructed[1] Imp (sf)	Impervious (sf)	Total (sf)
N Offsite	P-1A	4,734	1,129	5,048	6,177	10,911
	P-1B	89,944	52,814	5	52,819	142,763
E Offsite	P-2	28,973	16,189	1,144	17,333	46,306
Storm Tunnel	P-3A	7,787	36,017	22,597	58,614	66,401
	P-3B	22,589	82,675	55,035	137,710	160,299
	P-3C	146,498	6,019	6,532	12,551	159,049
	P-3D	6,487	54	130,360	130,414	136,901
S Offsite	P-4	105,135	22,030	3,632	25,662	130,797
W Offsite	P-5	182,492	54,802	499	55,301	237,793
Grotto Pipe	P-6A	23,243	8,267	23,774	32,041	55,284
	P-6B	32,873	54,616	5,342	59,958	92,831
Total		**650,755**	**334,612**	**253,968**	**588,580**	**1,239,335**

[1]Reconstructed impervious area is defined as proposed impervious area to be constructed by the Arena project

Table 3.6 – Change in Drainage Conditions

Discharge Point	Drainage Area	Pervious (sf)	Existing Imp (sf)	Constructed Imp (sf)	Reconstructed Imp (sf)	Difference[1] of Imp (sf)	Impervious (sf)	Total (sf)
N Offsite	1	-31	-5,022	0	5,053	5,053	31	0
E Offsite	2	-910	-234	0	1,144	1,144	910	0
Storm Tunnel	3	-33,831	-141,601	30,322	214,524	184,202	42,601	8,770
S Offsite	4	-12,917	-9,244	0	3,632	3,632	-5,612	-18,529
W Offsite	5	-12,090	-11,457	0	499	499	-10,958	-23,048
Grotto Pipe	6	15,632	-2,097	9,839	29,116	19,277	17,180	32,812
Total		**-44,147**	**-169,655**	**40,161**	**253,968**	**213,807**	**44,152**	**5**

[1]Difference of impervious is SF that requires treatment of 1.1 inches of runoff

Based on geotechnical data and recommendations, the proposed volume management practice is filtration through enhanced media cartridges. Although not all of the proposed impervious areas drain to the proposed underground detention system, it is designed to provide for the detention of 1.1 inch of runoff from all proposed impervious surface within the limits of disturbance, or 1.62 inches based on CRWD's approved MTD list and respective removal efficiencies, except if the impervious runoff currently drains to another system on site and will continue to drain to that system.

The volume required to be stored within the underground detention systems is 40,959 cubic feet shown in the following calculations:

Existing Impervious
Existing Impervious to APF System: 99,663 sf
Existing Impervious to SAF System: 12,334 sf

Proposed Impervious
Proposed Impervious to APF System: 137,710 sf
Proposed Impervious to SAF System: 12,551 sf
Proposed Impervious to Arena Systems: 213,807 sf

Impervious Difference
Difference in Impervious Area to APF System: 38,047 sf
Difference in Impervious Area to SAF System: 217 sf
Difference in Impervious Area to Arena Systems: 213,807 sf – 38,047 sf – 217 sf = 175,543 sf

Volume Retention Required
APF System (Existing Impervious): 99,663 sf x 0.9 in x 1 ft/12 in = 7,475 cf
APF System (Added Impervious): 38,047 sf x 1.1 in x 1 ft/12 in = 3,488 cf
SAF System (Existing Impervious): 12,334 sf x 0.9 in x 1 ft/12 in = 925 cf
SAF System (Added Impervious): 217 sf x 1.1 in x 1 ft/12 in = 20 cf

Arena Systems (Added Impervious): 175,543 sf x 1.1 in x 1 ft/12 in = 16,091 cf
Total: 7,475 cf + 3,488 cf + 925 cf + 20 cf + 16,091 cf = 27,999 cf

Volume Retention Required Through Alternative Compliance
APF System Credit Factor Adjustment: 7,475 cf x 1.3 = 9,718 cf
APF System Credit Factor Adjustment: 3,488 cf x 1.82 = 6,348 cf
SAF System Credit Factor Adjustment: 925 cf x 1.3 = 1,203 cf
SAF System Credit Factor Adjustment: 20 cf x 1.82 = 36 cf
Arena System Credit Factor Adjustment: 16,091 cf x 1.47 = 23,654 cf
Total: 9,718 cf + 6,348 cf + 1,203 cf + 36 cf +23,654 cf = 40,959 cf

The volume provided within the underground detention systems is 41,824 cf cubic feet:

Table 3.7 – Proposed Volume Detention Through Filtration

Filtration Volume Required (ft^3)	BMP	Filtration Volume Provided below outlet (ft^3)	1.1-inch Runoff (ft^3)	2.5-inch Runoff (ft^3)
40,959	07-028 Bayfilter	1,444	**12,623***	28,690
	13-009 Athletic Field	27,834	1,151	**2,615**
	120" CMP & StormFilter with Phosphosorb	**21,668**	11,955	27,170
	108" CMP & StormFilter with Phosphosorb	**4,918**	5,496	12,491
	Total	**41,824 ft^3**		

*The APF system does not discharge to the secondary overflow in the 1.1 inch event with the proposed change to block/cover the existing orifice, so full capacity is assumed.

The proposed pipe storage material is corrugated metal pipe (CMP). The standard detail for the CMP pipe storage is included as Figure 6.

Flood Control

The proposed arena building as a basement/tunnel elevation of 848.00 and a main floor elevation of 862.00 with all low floor openings at 861.00 (doors near southwest building corner) or 862.00 (the remaining doors). With 100-year HWL of 856.87 for the north arena treatment system and 855.32 for the south arena treatment system, the flood control requirements are met. The City of St. Paul also required all building stub elevations to be at or above the height of the stormwater treatment system, so they are set at a height of 856.00 which is the top of the south arena treatment system.

The existing APF building has a basement elevation of 853.67 and a main floor elevation of 863.50 with all low floor openings generally at 863.50. With the modifications to the existing APF treatment system, the 100-year HWL is raised from 858.48 up to 858.51, which meets the flood control requirements under the assumption the existing building provided flood proofing measures.

Stormwater Conveyance

The proposed storm sewer design includes new storm services for the arena project, catch basin inlets for drainage of new roadways and sidewalk installed for the arena project, as well as connections of existing storm sewer networks within the South Campus site. The proposed drainage areas for storm sewer sizing are shown in Figure 7 and the storm sewer sizing HydraFlow results are included as Appendix G.

BEST MANAGEMENT PRACTICES

Best management practices (BMP's) will be implemented during construction per the project Stormwater Pollution Prevention Plan (SWPPP). The final SWPPP will be prepared as part of the construction documents as required and updated as the development occurs. A draft SWPPP narrative is included as Appendix I. Proposed BMP's will minimize erosion and manage sedimentation as required by the National Pollution Discharge Elimination System (NPDES). During construction, erosion control measures will include dust control, silt fencing and/or biorolls, inlet protection, temporary rock construction entrance(s), and a concrete wash-out area. Permanent BMP's will include the proposed arena treatment systems, sump manholes, StormFilter cartridge systems, surface pavements, and turf establishment of remaining disturbed areas.

CONCLUSION

The project is designed to satisfy the Capitol Region Watershed District and City of St. Paul stormwater requirements by using a new pipe gallery and cartridge filtration system. This series of BMPs has been designed to satisfy the runoff control, water quality, volume management, and flood control requirements. The storm sewer system is designed with capacity for the flow rate from a 10-year rainfall event.

APPENDIX A

APPENDIX B

Kimley»Horn

Stormwater Management Plan

Schoenecker Center
UST STEAM Academic Building
Saint Paul, MN

City of Saint Paul
Capital Region Watershed District

Prepared for:
BWBR Architects
380 St. Peter Street, Suite 600
Saint Paul, MN 55102

Prepared by:
Kimley-Horn
767 Eustis Street, Suite 100
St. Paul, MN 55114
Contact: Daniel Elenbaas, P.E.

Prepared on: April 6, 2022

Kimley»Horn

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Kimley»Horn

1.0. Introduction

BWBR is proposing to construct a new academic STEAM building on the University of St. Thomas Campus in Saint Paul, MN. The Site is located within the Capital Region Watershed District (CRWD) and is subject to the requirements of the CRWD and City of Saint Paul storm water rate control and water quality standards. The proposed site is approximately 4.51 acres and includes 2.51 acres of pervious surfaces and 2.00 acres of impervious surfaces (0.65 acres of existing impervious area, 1.35 acres of newly constructed or reconstructed impervious area). This report is designed to provide information on the pre-development drainage conditions, the post-development drainage conditions, and the stormwater management system designed to meet the City of Saint Paul and CRWD stormwater requirements for the proposed development.

Kimley-Horn has analyzed the drainage conditions of the Site and provides computations to meet the applicable CRWD and City of Saint Paul stormwater standards in this report. The analysis of the pre-development and post-development drainage models was completed using HydroCAD, Version 10.10, a computer-aided design system for modeling the hydrology and hydraulics of stormwater runoff. These calculations are largely based on the hydrology techniques developed by the Soil Conservation Service (SCS/NRCS), combined with other hydrology and hydraulics calculations. All calculations, hydrographs, and drainage area maps are provided in the appendix of this report. The HydroCAD model was expanded outside of the 4.51 acres of disturbed area to a total of 9.37 acres to include surrounding areas that drain adjacent to the proposed site through existing storm sewer.

2.0. Pre-development Conditions

The Site is generally comprised of the area west of the O'Shaughnessy and Owens Science Halls and south of Summit Avenue. The site currently contains Loras Hall, Lot M surface parking lot, and green space. Existing impervious area is approximately 1.52 acres. The Site has four main storm water discharge locations. They are listed as NW Offsite, SW Ravine, S Storm Sewer and SE Storm Sewer in the HydroCAD model. Water sheet flows to existing storm sewer inlets to the SW Ravine and SE Storm Sewer. Water sheet flows towards Summit Avenue and leaves the site via the NW Offsite route. Offsite flow does not enter the site and is generally contained within either the Summit Avenue or Cretin Avenue road cross-section and existing storm sewer. An existing low area is located north of the O'Shaugnessy Science Hall. This low area and single inlet to the storm system has been included in the HydroCAD model.

The **Exhibit 1** depicts the pre-development conditions. Time of concentrations were calculated for each drainage area using the standard NRCS/SCS segmental method including segments for Sheet Flow and Shallow Concentrated Flow. No areas of Channelized flow were used in the calculations. Runoff potential was calculated using the Curve Number (CN) method. The pervious and impervious areas were delineated for each drainage area. Impervious areas were given a CN of 98. Pervious areas were determined to be a CN of 80 due to previous construction and the built-up nature of the site and surrounding areas. See **Table 1** for a list of pre-development conditions time of concentrations and associated outflow reach.

Table 1: Pre-Development Hydrologic Parameters

Reach	Drainage Area	Time of Concentration (min)	Area (ac)	Impervious Area (%)
NW Offsite	EX-1A	6.4	0.355	44.23
	EX-1B	6.1	1.612	13.28
	EX-2D	8.7	0.046	69.57
	EX-2E	13.7	0.051	64.71
SW Ravine	EX-5A	2.8	1.432	65.64
	EX-5B	3.0	0.848	66.51
SE Storm Sewer	EX-4A	6.0	0.617	65.64
	EX-4B	1.2	0.258	50.78
S Storm Sewer	EX-2A	20.2	1.382	22.50
	EX-2B	10.2	0.667	58.77
	EX-2C	4.2	0.579	1.55
	EX-3A	5.0	0.977	100.00
	EX-3B	6.4	0.544	38.42

3.0. Post-development Conditions

The proposed improvements will consist of an approximate 30,600 square foot academic building. The development will also consist of underground tunnels, utilities, landscaping, paved walking paths, and a stormwater BMP. The proposed site conditions will include 2.00 acres of impervious, proposed and reconstructed, surfaces and 2.51 acres of pervious surfaces.

The proposed site will provide a stormwater management BMP to meet the applicable City and CRWD requirements. Where practicable, stormwater is directed to an underground cistern designed for water reuse via proposed storm sewer and is to be located north of the proposed STEAM building. The existing storm sewer north of the existing O'Shaughnessy Science Hall building will also be redirected to discharge to the underground cistern. Runoff that cannot be collected and directed to the reuse system will be routed to the existing storm system connections in Grand Avenue, south of the proposed site. Due to minor curve adjustments along Grand Avenue, one existing catch basin will be replaced with two proposed catch basins in the proposed curb line. The proposed STEAM building will be connected to other existing buildings on campus via an underground tunnel system. Surface inlets to the storm sewer south of the proposed STEAM building have been placed to capture the runoff and not interfere with the proposed tunnel system. Due to the connection of the proposed STEAM building to the existing academic building directly to the east, the northern portion of the existing storm sewer and surface inlets are rerouted from discharging through the south storm sewer to discharging into the proposed underground cistern.

The CRWD requires that the storm water treatment volume retained onsite shall be the equivalent to the volume of runoff from 1.1 inches of rainfall from the newly constructed and reconstructed impervious surfaces. The City of Saint Paul defines this impervious surface as newly constructed or disturbed impervious cover. Therefore, the proposed cistern BMP, which is further detailed in Section 6.0, will provide additional water quality volume to compensate for the portion of the drainage area that runs off to the south prior to treatment.

Exhibit 2 depicts the post-development conditions. Time of concentrations were calculated for each drainage area using the standard NRCS/SCS segmental method including segments for Sheet Flow and Shallow Concentrated Flow. No areas of Channelized flow were used in the calculations. Runoff potential was calculated using the Curve Number (CN) method. The pervious and impervious areas were delineated for each drainage area. Impervious areas were given a CN of 98. Pervious areas were determined to be a CN of 80 due to compaction during the proposed grading and construction activities.

Table 2: Post-Development Time of Concentrations

Reach	Drainage Area	Time of Concentration (min)	Area (ac)	Impervious Area (%)
NW Offsite	PR-1A	6.4	0.355	44.23
	PR-1B	3.2	0.314	47.45
	PR-2A	20.2	1.382	22.50
	PR-2B	4.1	1.611	47.92
	PR-2C	4.5	0.310	7.74
	PR-2D	8.7	0.046	69.57
	PR-2E	13.7	0.051	64.71
SW Ravine	PR-5A	2.8	1.432	66.90
	PR-5B	5.2	0.917	50.05
SE Storm Sewer	PR-4A	6.0	0.617	65.64
	PR-4B	0.9	0.244	55.74
S Storm Sewer	PR-3A	5.0	0.977	100.00
	PR-3B	9.7	1.106	35.08

4.0. Rate Attenuation Summary - *City of Saint Paul*

The City of Saint Paul requires that development projects over one quarter of an acre limit the peak discharge rate to 1.64 cfs/acre. Onsite drainage areas consist of areas PR-1B, PR-2B, PR-2C, PR-3B, PR-4B, and PR-5B. The proposed site disturbed area is approximately 4.51 acres resulting in a maximum peak cumulative allowable runoff rate of 7.4 cfs from the Site. The City requirement is based on a rainfall event of 5.9 inches using the SCS Type II rainfall distribution curve. The proposed site's final receiving water body is the Mississippi River. Due to proximity to the Mississippi River and precedence set at similar private development locations adjacent to the Mississippi River, the rate attenuation requirement by the City will not be a design requirement.

5.0. Rate Attenuation Summary - *CRWD*

In accordance with CRWD, the post-development discharge rates are to be less than or equal to the pre-development discharge rates for the 2-, 10-, and 100-year, 24-hour rainfall events. The rainfall events are based on Atlas-14 rainfall depths with the MSE Type-3 rainfall distribution curve. The 24-hour storm event was determined to be the critical storm event for the site as a whole. The 24-hour storm was used for each storm iteration.

The underground water reuse cistern collects all of the runoff from the north of the proposed STEAM building and stores the runoff for reuse in irrigation systems in the area. When the system is overcapacity, the excess runoff will backflow out of the inlets, pool in minor depressions in the grassed area, and then overflow and travel west down Summit Avenue. This overflow pattern is

similar to existing conditions during extreme rainfall events. A summary of the pre-development and post-development runoff rates for the 9.37-acre total drainage area is shown in **Table 3**. The HydroCAD model used for calculating storage and discharge rates is included in **Appendix 1**.

Table 3: UST STEAM Discharge Rate Summary (cfs)

Reach	2-Year		10-Year		100-Year (7.45")	
	Existing	Proposed	Existing	Proposed	Existing	Proposed
NW Offsite	5.04	2.27	9.18	3.80	19.38	*17.79*
SW Ravine	8.72	8.35	13.96	13.55	26.30	25.97
SE Storm Sewer	2.86	2.82	4.64	4.57	8.91	8.74
S Storm Sewer	9.73	6.50	16.26	10.39	32.11	19.69
Total Discharge	**26.35**	**19.94**	**44.04**	**32.31**	**86.70**	***72.19***

6.0. Volume Reduction Summary

Due to site constraints and maximizing usable green space on the Site, reuse techniques are proposed to achieve volume reduction. The CRWD requires a treatment volume equal to 1.1 inches of runoff over the newly constructed or reconstructed impervious surfaces. The total newly constructed and reconstructed impervious area on site is 84,763 square feet (1.95 acres). An underground cistern in being proposed and will be constructed of underground 96" CMP pipe. The Site expects approximately 0.01 cfs of baseflow from drain tile connections to enter the cistern. The irrigation rate averages out to be a constant outflow of 0.05 cfs over the irrigation season.

The total newly constructed and reconstructed impervious area is 84,763 square feet.

New Development required volume reduction = 1.1" x 84,763 sf x (1'/12") = 7,770 cubic feet

Total volume reduction required = ***7,770 cubic feet***

The RWMWD Water Reuse Calculator spreadsheet was used to size the underground cistern. The calculator export is included at the end of **Appendix 1**. The required runoff volume control is provided by on-site volume reduction through the underground cistern is detailed in ***Table 4.***

Table 4: UST STEAM Water Quality Summary

BMP	*Pipe Invert*	*Total Pipe Length (ft)*	*Volume Reduction Required (cf)*	*Volume Reduction Provided (cf)*	*100 YR HWL*
Undg. Cistern System (96" CMP DuroMaxx)	852.0'	689.5'	7,770	10,182	*860.23'*

Total volume reduction provided ***10,182 cubic feet***

Reduction Provided (10,182 cubic feet) > Reduction Required (7,770 cubic feet)

The CRWD requires BMPs to achieve 90% total suspended solids (TSS) removal. Per the Minnesota Pollution Control Agency, stormwater reuse provides 100% TSS removal for the reused portion, which is met in the proposed BMP volume reduction of 10,182 cubic feet.

7.0. Cistern Operation Plan

The cistern details are included in this section. The contributing watershed to the cistern is 3.3 acres, with an impervious area of 34% (1.12 acres). The hydrologic soil group of the contributing watershed

is assumed to be D. This matches the previous HydroCAD modeling and impacts from previous and proposed construction activities in the contributing watershed. The irrigation application area is 3.81 acres. The cistern will utilize 96" DIA Duromaxx pipe to supply the storage needed for the system. The underground cistern will be laid out using *four rows with a total length of 138'-9" of pipe in each row. The fifth row (furthest north) will be a total length of 75'-0". The shorter row is to provide a construction offset from the dripline of the existing large tree northeast of the cistern.* There will be one 36" DIA Duromaxx pipe header to allow flow between the pipe rows. The total storage capacity of the system is required to be *31,408* cubic feet to meet the design standards. The contributing watershed to the cistern and the irrigation area are shown in **Exhibit 3**.

A Rainwater Management System (RMS) filtration skid with a carbon filter will be used to further clean the runoff for reuse. The RMS system will utilize Model RWF 125 with a flow rate capacity of 125 gpm and a maximum pressure of 125 psi. The standard specification sheet is shown in **Appendix 3**. The cistern pump system will be located in the proposed STEAM building basement for ease of maintenance. The basement finished floor elevation is 847.9' and the cistern invert is *851.99'*. This setup allows for discharge of the entire runoff volume in the underground storage chambers during irrigation or drawdown. This setup is also beneficial when inspection is needed for the cistern, the water can be completely pumped out prior to inspection and maintenance activities. The 125-gpm (0.279 cfs) pumping rate will discharge the cistern-full volume of 31,408 cubic feet in 31.3 hours.

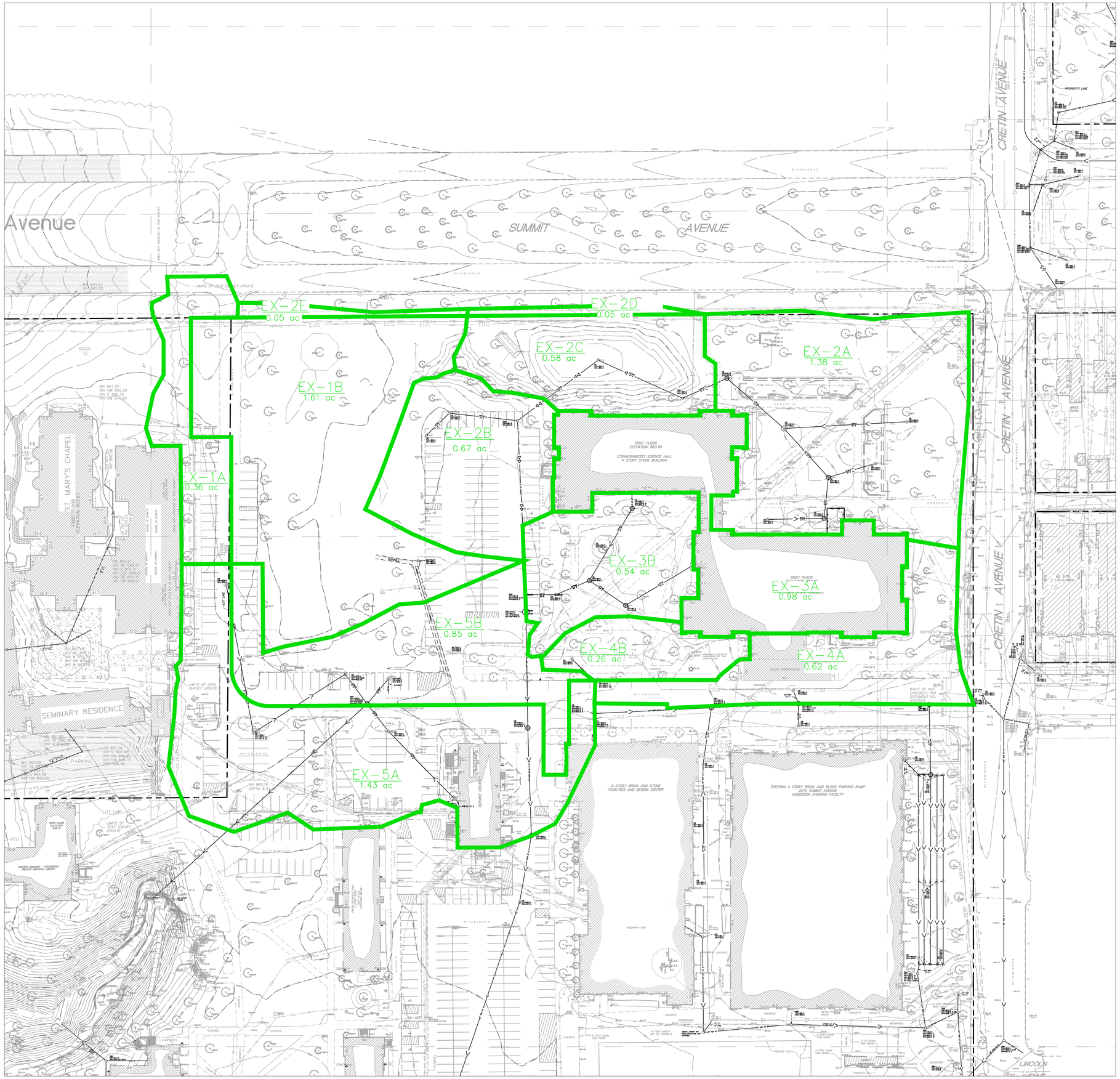
The cistern will not go offline at the end of the season and the water level will be monitored through predictive control. The predictive control will allow for pump down of the system prior to rainfall or snowmelt events. In the event that the cistern needs to be pumped down prior to a storm or snowmelt event, the system would be discharged to the existing storm sewer to the west of the proposed STEAM building (CB-115). The excess stormwater would be pumped to CB-115 through the irrigation system. The irrigation system will have a valve installed near the catchbasin that would be used to divert water from the irrigation system to the storm sewer. This section of the irrigation system would be on a separate zone to allow for isolation for the drawdown from the rest of the irrigation system.

In the event that the cistern overflows due to excess runoff volume, the runoff would back up in the storm sewer that drains to the cistern. The overflow from the system would occur in the northwest corner of the site through CBMH-105 (RE: 859.01'). The catchbasin at this location has the lowest rim elevation and would backflow first. The overflow would then flow to the northwest and enter Summit Avenue, where it would reenter the storm sewer and continue to the west. *The volume below the low outlet and above the pump off elevation is the entire cistern volume (31,408 cubic feet), this meets the design requirement of having a minimum of 8,418 cubic feet of volume below the low outlet and above the pump off elevation.*

Installation of the underground cistern shall be done during periods of dry weather and completed before a rainfall event. Placement of engineered soils shall be on dry native soil only. During construction, stormwater must be routed around the cistern excavation until all construction activity has ceased and tributary surfaces are cleaned of sediment. It is required that impervious area construction be completed, and pervious areas established with dense and healthy vegetation prior to introduction of stormwater into the underground cistern.

Exhibits

Exhibit 1. Pre-Development Drainage Exhibit



LEGEND

EXISTING	PROPOSED	
		STORM SEWER PIPE
		DRAIN TILE
		STORM INLET
		STORM MANHOLE
		PROPERTY LINE
928	928	EXISTING CONTOUR / PROPOSED CONTOUR
		EXISTING CONDITIONS DRAINAGE AREA

NORTH

GRAPHIC SCALE IN FEET
0 20 40 80

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DANIEL L. ELENBAAS

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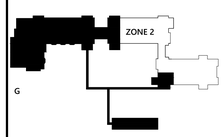
Keyplan



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Sheet Title

EXISTING CONDITIONS DRAINAGE MAP

Sheet No.

EX-1

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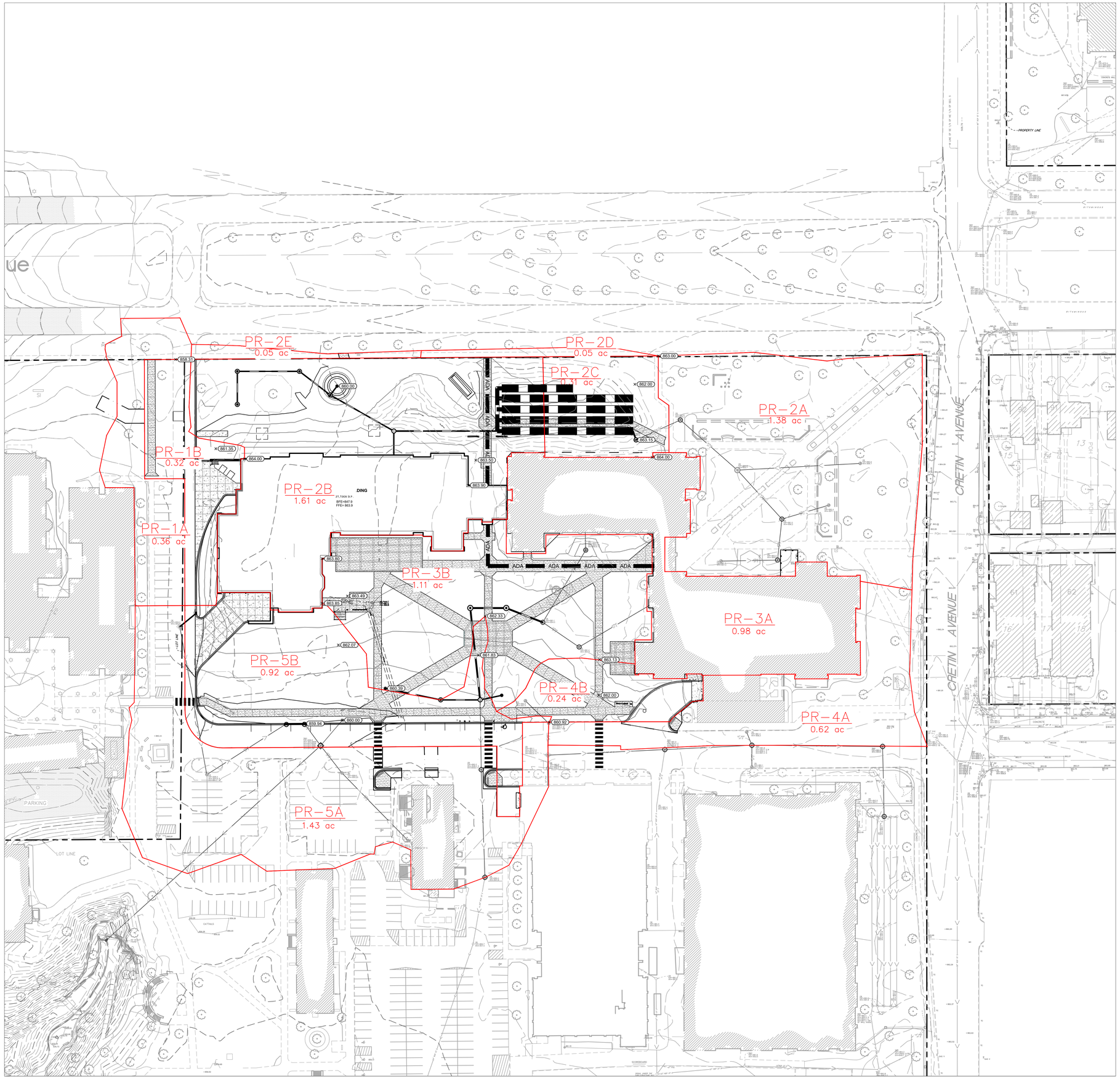
Exhibit 2. Post-Development Drainage Exhibit



LEGEND

EXISTING

PROPOSED

- STORM SEWER PIPE
- DRAIN TILE
- STORM INLET
- STORM MANHOLE
- PROPERTY LINE
- EXISTING CONTOUR
- PROPOSED CONTOUR
- PROPOSED CONDITIONS DRAINAGE AREA

NORTH

GRAPHIC SCALE IN FEET
0 20 40 80

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Sheet Title

PROPOSED CONDITIONS DRAINAGE MAP

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EX-2

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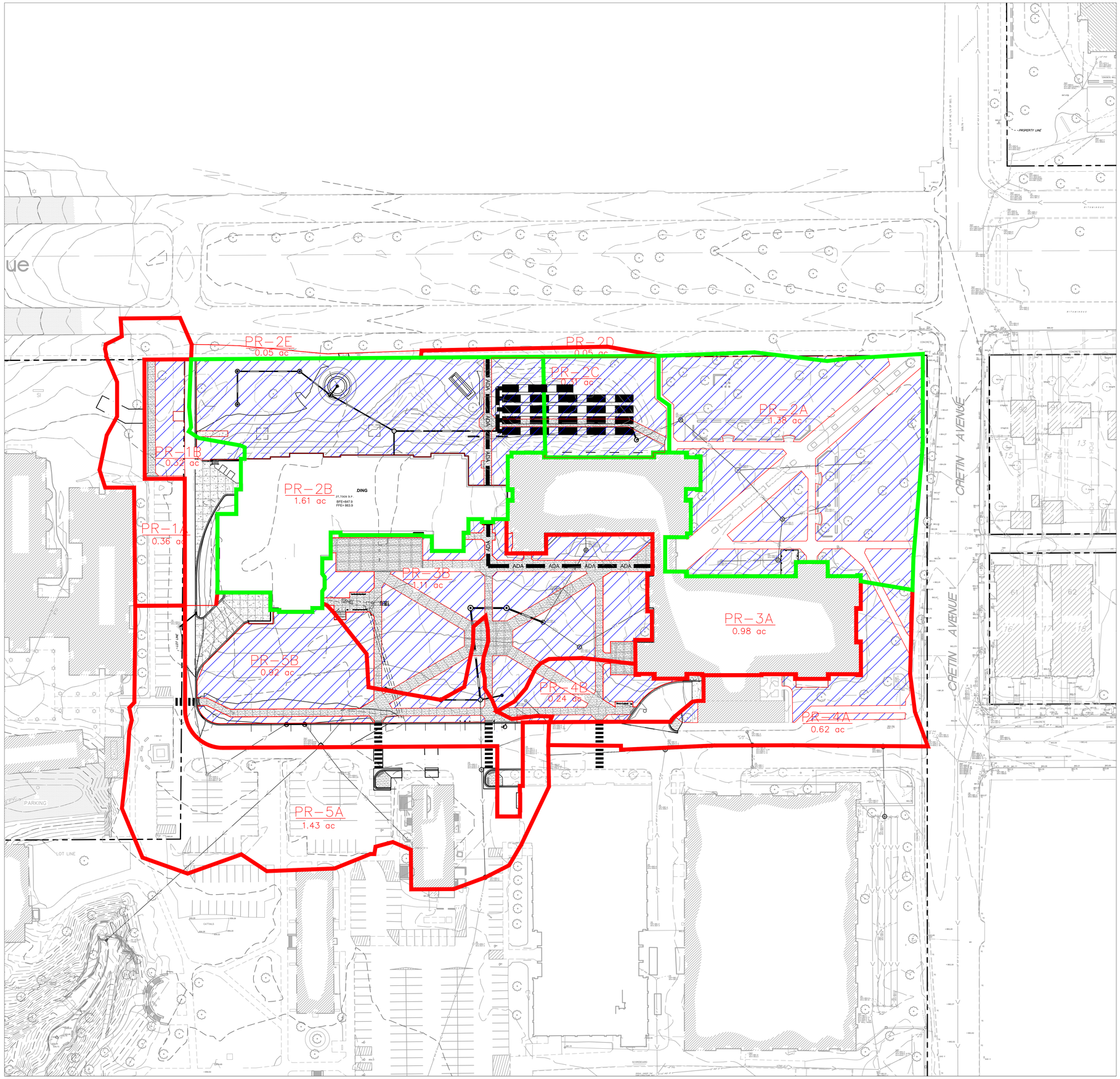
Exhibit 3. Irrigation Drainage Exhibit



LEGEND

EXISTING

PROPOSED

- STORM SEWER PIPE
- DRAIN TILE
- STORM INLET
- STORM MANHOLE
- PROPERTY LINE
- EXISTING CONTOUR
- PROPOSED CONTOUR
- PROPOSED CONDITIONS DRAINAGE AREA
- DRAINAGE AREA TO CISTERN
- IRRIGATED AREA

NORTH

GRAPHIC SCALE IN FEET
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Keyplan

NORTH

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IRRIGATION DRAINAGE MAP

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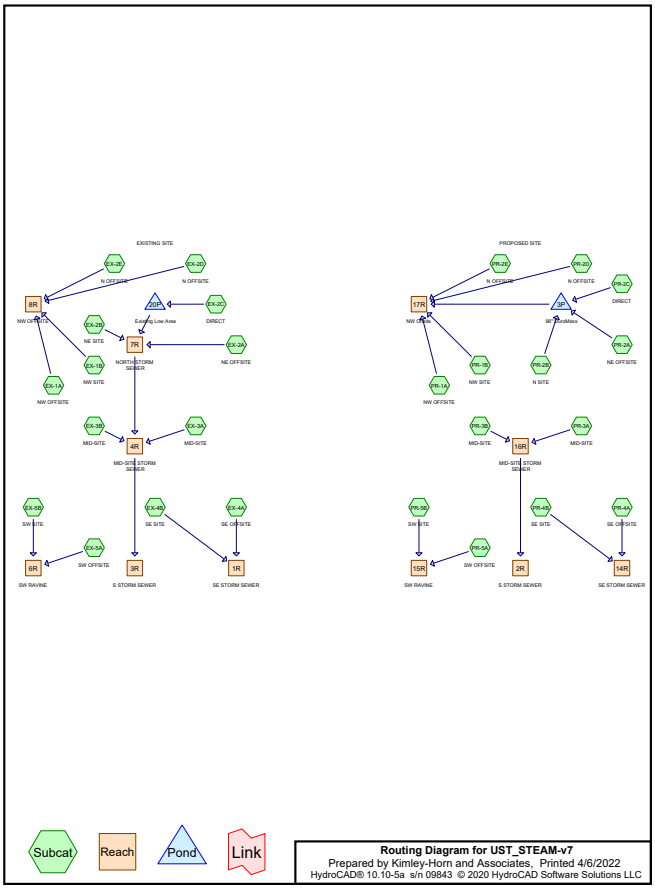
Appendices

Appendix 1. HydroCAD Model Analysis



Routing Diagram for UST_STEAM-v7
Prepared by Kimley-Horn and Associates, Printed 4/6/2022
HydroCAD® 10.10-5a s/n 09843 © 2020 HydroCAD Software Solutions LLC

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2YR-MSE3	MSE 24-hr	3	Default	24.00	1	2.81	2
2	10YR-MSE3	MSE 24-hr	3	Default	24.00	1	4.20	2
3	100YR-MSE3	MSE 24-hr	3	Default	24.00	1	7.45	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.557	80	>75% Grass cover, Good, HSG D (EX-1A, EX-1B, EX-2A, EX-2B, EX-2C, EX-2D, EX-2E, EX-3B, EX-4A, EX-4B, EX-5A, EX-5B, PR-1A, PR-1B, PR-2A, PR-2B, PR-2C, PR-2D, PR-2E, PR-3B, PR-4A, PR-4B, PR-5A, PR-5B)
9.176	98	Impervious (EX-1A, EX-1B, EX-2A, EX-2B, EX-2C, EX-2D, EX-2E, EX-3A, EX-3B, EX-4A, EX-4B, EX-5A, EX-5B, PR-1A, PR-1B, PR-2A, PR-2B, PR-2C, PR-2D, PR-2E, PR-3A, PR-3B, PR-4A, PR-4B, PR-5A, PR-5B)
18.733	**89**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
9.557	HSG D	EX-1A, EX-1B, EX-2A, EX-2B, EX-2C, EX-2D, EX-2E, EX-3B, EX-4A, EX-4B, EX-5A, EX-5B, PR-1A, PR-1B, PR-2A, PR-2B, PR-2C, PR-2D, PR-2E, PR-3B, PR-4A, PR-4B, PR-5A, PR-5B
9.176	Other	EX-1A, EX-1B, EX-2A, EX-2B, EX-2C, EX-2D, EX-2E, EX-3A, EX-3B, EX-4A, EX-4B, EX-5A, EX-5B, PR-1A, PR-1B, PR-2A, PR-2B, PR-2C, PR-2D, PR-2E, PR-3A, PR-3B, PR-4A, PR-4B, PR-5A, PR-5B
18.733		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	9.557	0.000	9.557	>75% Grass cover, Good	EX-1A, EX-1B, EX-2A, EX-2B, EX-2C, EX-2D, EX-2E, EX-3B, EX-4A, EX-4B, EX-5A, EX-5B, PR-1A, PR-1B, PR-2A, PR-2B, PR-2C, PR-2D, PR-2E, PR-3B, PR-4A, PR-4B, PR-5A, PR-5B
0.000	0.000	0.000	0.000	9.176	9.176	Impervious	EX-1A, EX-1B, EX-2A, EX-2B, EX-2C, EX-2D, EX-2E, EX-3A, EX-3B, EX-4A, EX-4B, EX-5A, EX-5B, PR-1A, PR-1B, PR-2A, PR-2B, PR-2C, PR-2D, PR-2E, PR-3A, PR-3B.

Ground Covers (all nodes) (continued)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	**0.000**	**0.000**	**9.557**	**9.176**	**18.733**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	EX-2B	0.00	0.00	217.0	0.0106	0.013	0.0	18.0	0.0

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentEX-1A: NW OFFSITE Runoff Area=0.355 ac 44.23% Impervious Runoff Depth>1.76"
Flow Length=174' Tc=6.4 min CN=WQ Runoff=1.04 cfs 0.052 af

SubcatchmentEX-1B: NW SITE Runoff Area=1.612 ac 13.28% Impervious Runoff Depth>1.30"
Flow Length=466' Tc=6.1 min CN=WQ Runoff=3.75 cfs 0.175 af

SubcatchmentEX-2A: NE OFFSITE Runoff Area=1.382 ac 22.50% Impervious Runoff Depth>1.44"
Flow Length=352' Tc=20.2 min CN=WQ Runoff=2.10 cfs 0.166 af

SubcatchmentEX-2B: NE SITE Runoff Area=0.667 ac 58.77% Impervious Runoff Depth>1.97"
Flow Length=290' Tc=10.2 min CN=WQ Runoff=1.85 cfs 0.110 af

SubcatchmentEX-2C: DIRECT Runoff Area=0.579 ac 1.55% Impervious Runoff Depth>1.13"
Flow Length=131' Tc=4.2 min CN=WQ Runoff=1.32 cfs 0.055 af

SubcatchmentEX-2D: N OFFSITE Runoff Area=0.046 ac 69.57% Impervious Runoff Depth>2.13"
Flow Length=250' Tc=8.7 min CN=WQ Runoff=0.14 cfs 0.008 af

SubcatchmentEX-2E: N OFFSITE Runoff Area=0.051 ac 64.71% Impervious Runoff Depth>2.06"
Flow Length=262' Tc=13.7 min CN=WQ Runoff=0.13 cfs 0.009 af

SubcatchmentEX-3A: MID-SITE Runoff Area=0.977 ac 100.00% Impervious Runoff Depth>2.58"
Flow Length=234' Slope=0.0025 '/' Tc=5.0 min CN=WQ Runoff=4.21 cfs 0.210 af

SubcatchmentEX-3B: MID-SITE Runoff Area=0.544 ac 38.42% Impervious Runoff Depth>1.67"
Flow Length=222' Tc=6.4 min CN=WQ Runoff=1.53 cfs 0.076 af

SubcatchmentEX-4A: SE OFFSITE Runoff Area=0.617 ac 65.64% Impervious Runoff Depth>2.07"
Flow Length=233' Tc=6.0 min CN=WQ Runoff=2.11 cfs 0.107 af

SubcatchmentEX-4B: SE SITE Runoff Area=0.258 ac 50.78% Impervious Runoff Depth>1.86"
Flow Length=125' Tc=1.2 min CN=WQ Runoff=0.92 cfs 0.040 af

SubcatchmentEX-5A: SW OFFSITE Runoff Area=1.432 ac 65.64% Impervious Runoff Depth>2.07"
Flow Length=215' Tc=2.8 min CN=WQ Runoff=5.47 cfs 0.247 af

SubcatchmentEX-5B: SW SITE Runoff Area=0.848 ac 66.51% Impervious Runoff Depth>2.09"
Flow Length=269' Tc=3.0 min CN=WQ Runoff=3.25 cfs 0.147 af

SubcatchmentPR-1A: NW OFFSITE Runoff Area=0.355 ac 44.23% Impervious Runoff Depth>1.76"
Flow Length=174' Tc=6.4 min CN=WQ Runoff=1.04 cfs 0.052 af

SubcatchmentPR-1B: NW SITE Runoff Area=0.314 ac 47.45% Impervious Runoff Depth>1.81"
Flow Length=164' Tc=3.2 min CN=WQ Runoff=1.06 cfs 0.047 af

SubcatchmentPR-2A: NE OFFSITE Runoff Area=1.382 ac 22.50% Impervious Runoff Depth>1.44"
Flow Length=352' Tc=20.2 min CN=WQ Runoff=2.10 cfs 0.166 af

SubcatchmentPR-2B: N SITE Runoff Area=1.611 ac 47.92% Impervious Runoff Depth>1.81"
Flow Length=208' Slope=0.0050 '/' Tc=4.1 min CN=WQ Runoff=5.33 cfs 0.243 af

SubcatchmentPR-2C: DIRECT Runoff Area=0.310 ac 7.74% Impervious Runoff Depth>1.22"
Flow Length=39' Slope=0.0260 '/' Tc=4.5 min CN=WQ Runoff=0.74 cfs 0.032 af

SubcatchmentPR-2D: N OFFSITE Runoff Area=0.046 ac 69.57% Impervious Runoff Depth>2.13"
Flow Length=250' Tc=8.7 min CN=WQ Runoff=0.14 cfs 0.008 af

SubcatchmentPR-2E: N OFFSITE Runoff Area=0.051 ac 64.71% Impervious Runoff Depth>2.06"
Flow Length=262' Tc=13.7 min CN=WQ Runoff=0.13 cfs 0.009 af

SubcatchmentPR-3A: MID-SITE Runoff Area=0.977 ac 100.00% Impervious Runoff Depth>2.58"
Flow Length=234' Slope=0.0025 '/' Tc=5.0 min CN=98 Runoff=4.21 cfs 0.210 af

SubcatchmentPR-3B: MID-SITE Runoff Area=1.109 ac 35.08% Impervious Runoff Depth>1.62"
Flow Length=135' Tc=9.7 min CN=WQ Runoff=2.64 cfs 0.150 af

SubcatchmentPR-4A: SE OFFSITE Runoff Area=0.617 ac 65.64% Impervious Runoff Depth>2.07"
Flow Length=233' Tc=6.0 min CN=WQ Runoff=2.11 cfs 0.107 af

SubcatchmentPR-4B: SE SITE Runoff Area=0.244 ac 55.74% Impervious Runoff Depth>1.93"
Flow Length=101' Tc=0.9 min CN=WQ Runoff=0.90 cfs 0.039 af

SubcatchmentPR-5A: SW OFFSITE Runoff Area=1.432 ac 66.90% Impervious Runoff Depth>2.09"
Flow Length=215' Tc=2.8 min CN=WQ Runoff=5.51 cfs 0.250 af

SubcatchmentPR-5B: SW SITE Runoff Area=0.917 ac 50.05% Impervious Runoff Depth>1.84"
Flow Length=141' Tc=5.2 min CN=WQ Runoff=2.95 cfs 0.141 af

Reach 1R: SE STORM SEWER Inflow=2.86 cfs 0.147 af
Outflow=2.86 cfs 0.147 af

Reach 2R: S STORM SEWER Inflow=6.50 cfs 0.360 af
Outflow=6.50 cfs 0.360 af

Reach 3R: S STORM SEWER Inflow=9.73 cfs 0.616 af
Outflow=9.73 cfs 0.616 af

Reach 4R: MID-SITE STORM SEWER Inflow=9.73 cfs 0.616 af
Outflow=9.73 cfs 0.616 af

Reach 6R: SW RAVINE Inflow=8.72 cfs 0.395 af
Outflow=8.72 cfs 0.395 af

Reach 7R: NORTH STORM SEWER Inflow=4.20 cfs 0.330 af
Outflow=4.20 cfs 0.330 af

Reach 8R: NW OFFSITE Inflow=5.04 cfs 0.244 af
Outflow=5.04 cfs 0.244 af

Reach 14R: SE STORM SEWER Inflow=2.82 cfs 0.146 af
Outflow=2.82 cfs 0.146 af

Reach 15R: SW RAVINE Inflow=8.35 cfs 0.391 af
Outflow=8.35 cfs 0.391 af

Reach 16R: MID-SITE STORM SEWER Inflow=6.50 cfs 0.360 af
Outflow=6.50 cfs 0.360 af

Reach 17R: NW Offsite Inflow=2.27 cfs 0.116 af
Outflow=2.27 cfs 0.116 af

Pond 3P: 96" DuroMaxx Peak Elev=856.56' Storage=19,194 cf Inflow=7.09 cfs 0.441 af
Outflow=0.00 cfs 0.000 af

Pond 20P: Existing Low Area Peak Elev=855.35' Storage=32 cf Inflow=1.32 cfs 0.055 af
Outflow=1.31 cfs 0.055 af

Total Runoff Area = 18.733 ac Runoff Volume = 2.855 af Average Runoff Depth = 1.83"
51.02% Pervious = 9.557 ac 48.98% Impervious = 9.176 ac

Summary for Subcatchment EX-1A: NW OFFSITE

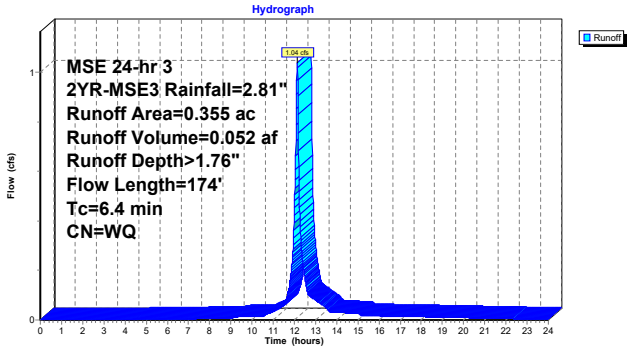
Runoff = 1.04 cfs @ 12.14 hrs, Volume= 0.052 af, Depth> 1.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

	Area (ac)	CN	Description
*	0.157	98	Impervious
	0.198	80	>75% Grass cover, Good, HSG D
	0.355		Weighted Average
	0.198		55.77% Pervious Area
	0.157		44.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	58	0.0343	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
0.9	116	0.0172	2.11		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.4	174	Total			

Subcatchment EX-1A: NW OFFSITE



Summary for Subcatchment EX-1B: NW SITE

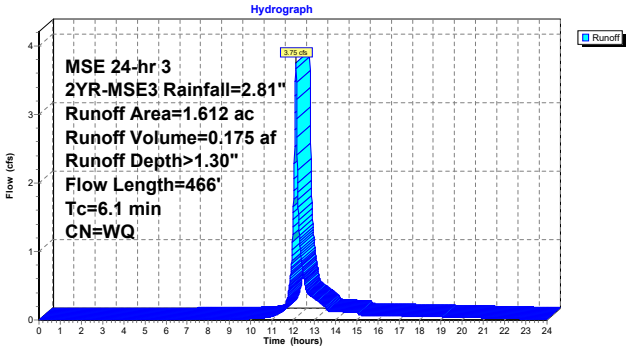
Runoff = 3.75 cfs @ 12.14 hrs, Volume= 0.175 af, Depth> 1.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

	Area (ac)	CN	Description
*	0.214	98	Impervious
	1.398	80	>75% Grass cover, Good, HSG D
	1.612		Weighted Average
	1.398		86.72% Pervious Area
	0.214		13.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	79	0.1280	2.56		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
5.6	387	0.0051	1.15		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.1	466	Total			

Subcatchment EX-1B: NW SITE



Summary for Subcatchment EX-2A: NE OFFSITE

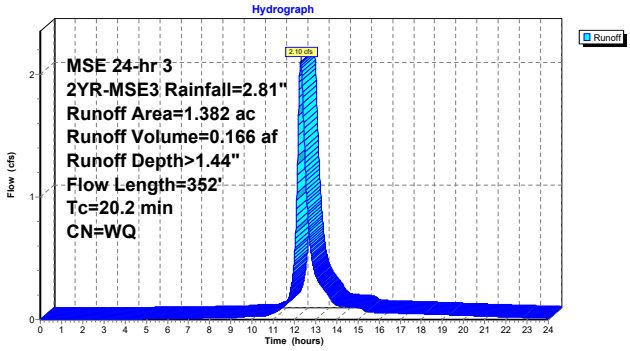
Runoff = 2.10 cfs @ 12.30 hrs, Volume= 0.166 af, Depth> 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

Area (ac)	CN	Description
* 0.311	98	Impervious
1.071	80	>75% Grass cover, Good, HSG D
1.382		Weighted Average
1.071		77.50% Pervious Area
0.311		22.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.4	66	0.0029	0.07		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
3.8	286	0.0061	1.26		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
20.2	352	Total			

Subcatchment EX-2A: NE OFFSITE



Summary for Subcatchment EX-2B: NE SITE

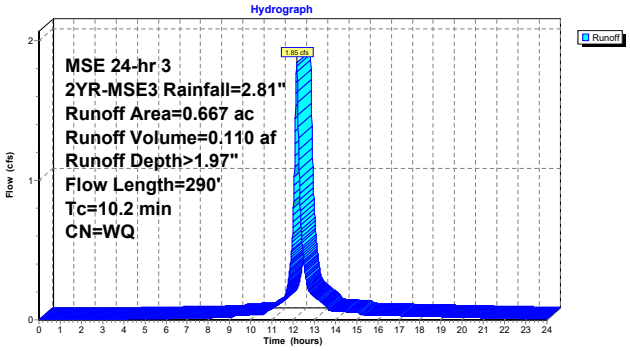
Runoff = 1.85 cfs @ 12.18 hrs, Volume= 0.110 af, Depth> 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

Area (ac)	CN	Description
* 0.392	98	Impervious
0.275	80	>75% Grass cover, Good, HSG D
0.667		Weighted Average
0.275		41.23% Pervious Area
0.392		58.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	217	0.0106	6.12	10.81	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Concrete pipe, bends & connections
9.6	73	0.0137	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
10.2	290	Total			

Subcatchment EX-2B: NE SITE



Summary for Subcatchment EX-2C: DIRECT

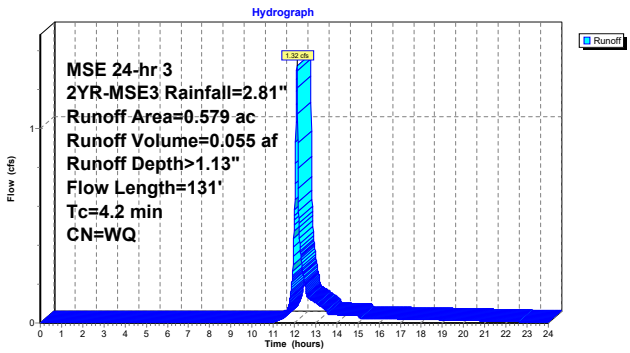
Runoff = 1.32 cfs @ 12.12 hrs, Volume= 0.055 af, Depth> 1.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

Area (ac)	CN	Description
* 0.009	98	Impervious
0.570	80	>75% Grass cover, Good, HSG D
0.579		Weighted Average
0.570		98.45% Pervious Area
0.009		1.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	98	0.0620	4.01		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.8	33	0.0273	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
4.2	131	Total			

Subcatchment EX-2C: DIRECT



Summary for Subcatchment EX-2D: N OFFSITE

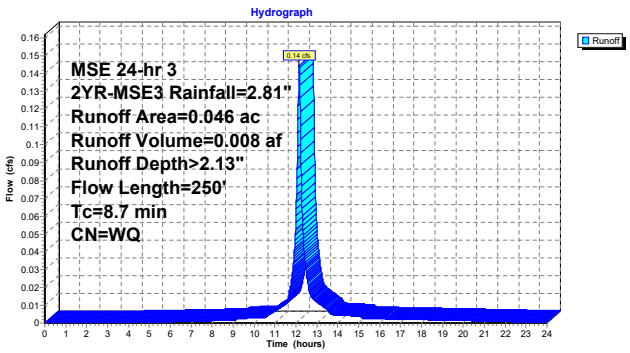
Runoff = 0.14 cfs @ 12.16 hrs, Volume= 0.008 af, Depth> 2.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

Area (ac)	CN	Description
* 0.032	98	Impervious
0.014	80	>75% Grass cover, Good, HSG D
0.046		Weighted Average
0.014		30.43% Pervious Area
0.032		69.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	52	0.0189	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
2.3	198	0.0052	1.46		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.7	250	Total			

Subcatchment EX-2D: N OFFSITE



Summary for Subcatchment EX-2E: N OFFSITE

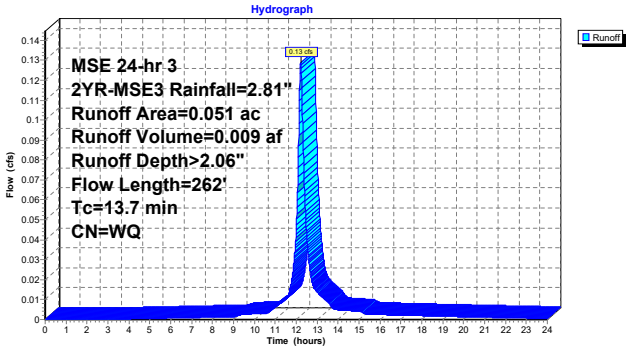
Runoff = 0.13 cfs @ 12.22 hrs, Volume= 0.009 af, Depth> 2.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

	Area (ac)	CN	Description
*	0.033	98	Impervious
	0.018	80	>75% Grass cover, Good, HSG D
	0.051		Weighted Average
	0.018		35.29% Pervious Area
	0.033		64.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.1	87	0.0109	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
1.6	175	0.0080	1.82		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
13.7	262	Total			

Subcatchment EX-2E: N OFFSITE



Summary for Subcatchment EX-3A: MID-SITE

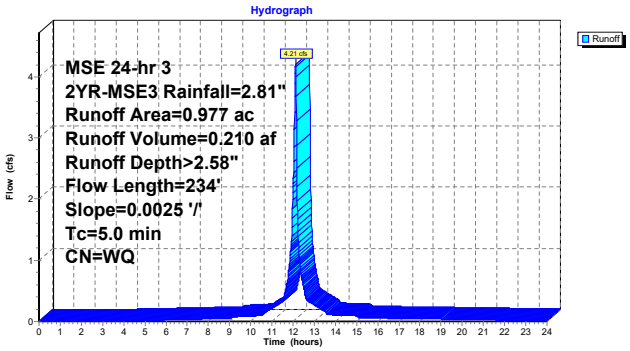
Runoff = 4.21 cfs @ 12.12 hrs, Volume= 0.210 af, Depth> 2.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

	Area (ac)	CN	Description
*	0.977	98	Impervious
	0.000	80	>75% Grass cover, Good, HSG D
	0.977		Weighted Average
	0.977		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	76	0.0025	0.53		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
2.6	158	0.0025	1.02		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
5.0	234	Total			

Subcatchment EX-3A: MID-SITE



Summary for Subcatchment EX-3B: MID-SITE

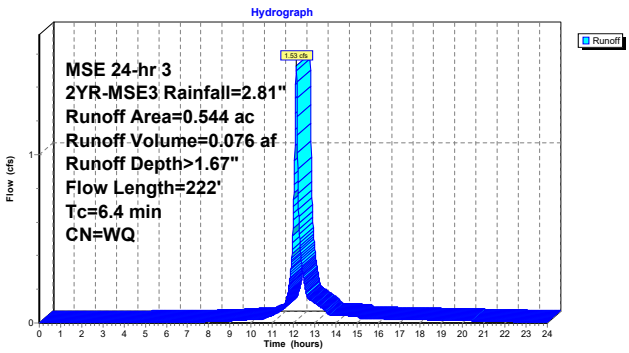
Runoff = 1.53 cfs @ 12.14 hrs, Volume= 0.076 af, Depth> 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

	Area (ac)	CN	Description
*	0.209	98	Impervious
	0.335	80	>75% Grass cover, Good, HSG D
	0.544		Weighted Average
	0.335		61.58% Pervious Area
	0.209		38.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	34	0.0174	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
1.7	188	0.0085	1.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.4	222	Total			

Subcatchment EX-3B: MID-SITE



Summary for Subcatchment EX-4A: SE OFFSITE

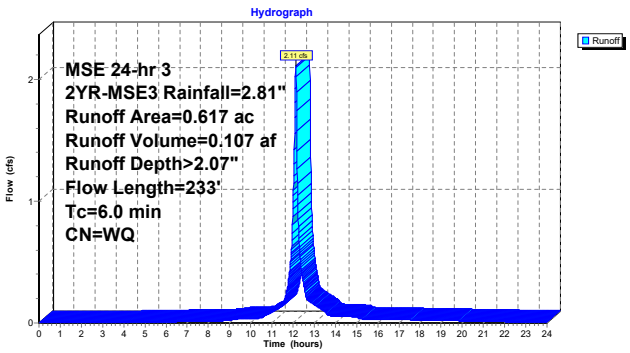
Runoff = 2.11 cfs @ 12.13 hrs, Volume= 0.107 af, Depth> 2.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

	Area (ac)	CN	Description
*	0.405	98	Impervious
	0.212	80	>75% Grass cover, Good, HSG D
	0.617		Weighted Average
	0.212		34.36% Pervious Area
	0.405		65.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	88	0.0216	1.28		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
4.9	145	0.0006	0.50		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.0	233	Total			

Subcatchment EX-4A: SE OFFSITE



Summary for Subcatchment EX-4B: SE SITE

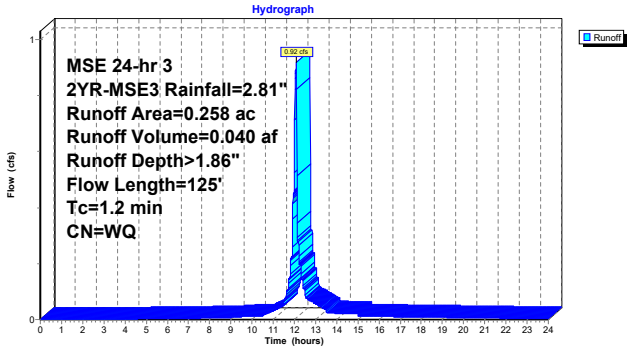
Runoff = 0.92 cfs @ 12.10 hrs, Volume= 0.040 af, Depth> 1.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

	Area (ac)	CN	Description
*	0.131	98	Impervious
	0.127	80	>75% Grass cover, Good, HSG D
	0.258		Weighted Average
	0.127		49.22% Pervious Area
	0.131		50.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	31	0.0468	1.42		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
0.8	94	0.0134	1.86		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.2	125	Total			

Subcatchment EX-4B: SE SITE



Summary for Subcatchment EX-5A: SW OFFSITE

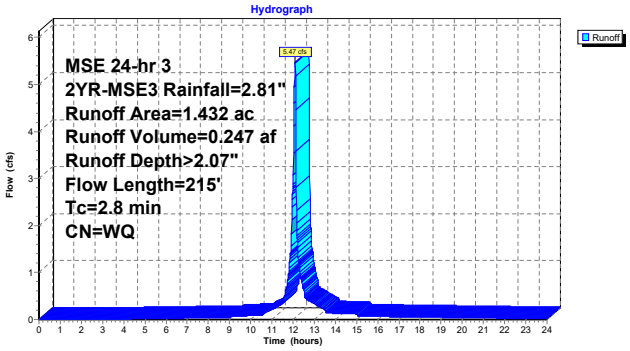
Runoff = 5.47 cfs @ 12.11 hrs, Volume= 0.247 af, Depth> 2.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

	Area (ac)	CN	Description
*	0.940	98	Impervious
	0.492	80	>75% Grass cover, Good, HSG D
	1.432		Weighted Average
	0.492		34.36% Pervious Area
	0.940		65.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	21	0.0595	1.44		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
2.6	194	0.0039	1.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.8	215	Total			

Subcatchment EX-5A: SW OFFSITE



Summary for Subcatchment EX-5B: SW SITE

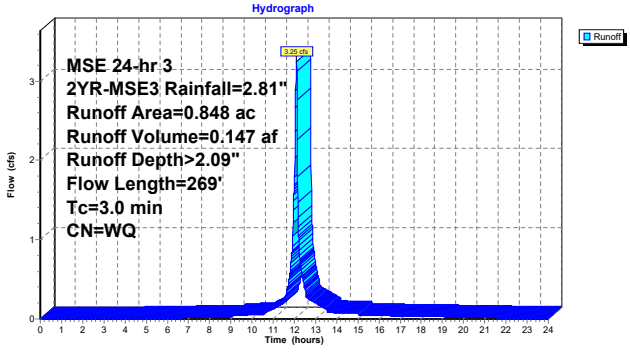
Runoff = 3.25 cfs @ 12.11 hrs, Volume= 0.147 af, Depth> 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

	Area (ac)	CN	Description
*	0.564	98	Impervious
	0.284	80	>75% Grass cover, Good, HSG D
	0.848		Weighted Average
	0.284		33.49% Pervious Area
	0.564		66.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	78	0.0101	0.92		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
1.6	191	0.0099	2.02		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.0	269	Total			

Subcatchment EX-5B: SW SITE



Summary for Subcatchment PR-1A: NW OFFSITE

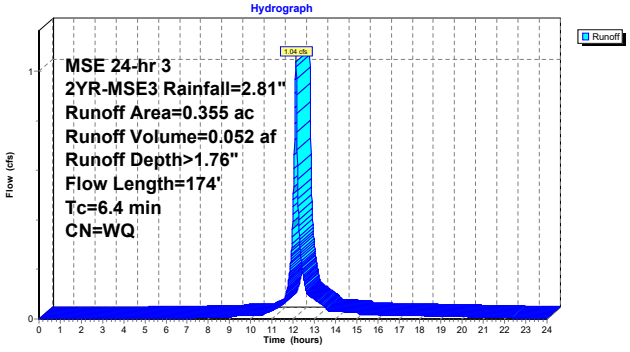
Runoff = 1.04 cfs @ 12.14 hrs, Volume= 0.052 af, Depth> 1.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

	Area (ac)	CN	Description
*	0.157	98	Impervious
	0.198	80	>75% Grass cover, Good, HSG D
	0.355		Weighted Average
	0.198		55.77% Pervious Area
	0.157		44.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	58	0.0343	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
0.9	116	0.0172	2.11		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.4	174	Total			

Subcatchment PR-1A: NW OFFSITE



Summary for Subcatchment PR-1B: NW SITE

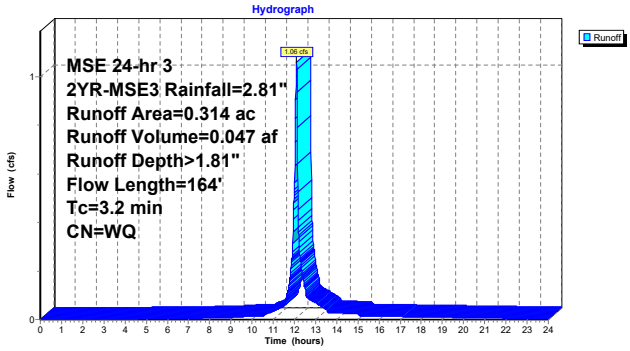
Runoff = 1.06 cfs @ 12.11 hrs, Volume= 0.047 af, Depth> 1.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

	Area (ac)	CN	Description
*	0.149	98	Impervious
	0.165	80	>75% Grass cover, Good, HSG D
	0.314		Weighted Average
	0.165		52.55% Pervious Area
	0.149		47.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	33	0.0803	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
0.7	131	0.0232	3.09		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.2	164	Total			

Subcatchment PR-1B: NW SITE



Summary for Subcatchment PR-2A: NE OFFSITE

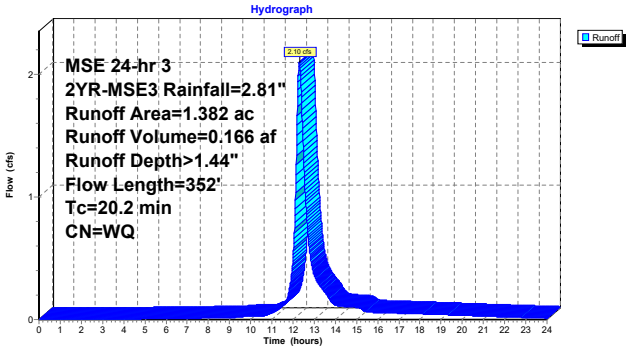
Runoff = 2.10 cfs @ 12.30 hrs, Volume= 0.166 af, Depth> 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

	Area (ac)	CN	Description
*	0.311	98	Impervious
	1.071	80	>75% Grass cover, Good, HSG D
	1.382		Weighted Average
	1.071		77.50% Pervious Area
	0.311		22.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.4	66	0.0029	0.07		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
3.8	286	0.0061	1.26		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
20.2	352	Total			

Subcatchment PR-2A: NE OFFSITE



Summary for Subcatchment PR-2B: N SITE

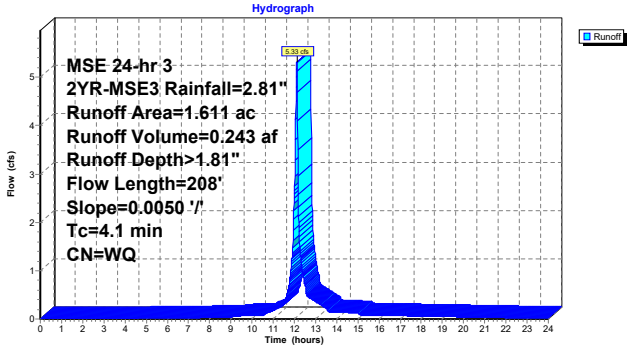
Runoff = 5.33 cfs @ 12.12 hrs, Volume= 0.243 af, Depth> 1.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

	Area (ac)	CN	Description
*	0.772	98	Impervious
	0.839	80	>75% Grass cover, Good, HSG D
	1.611		Weighted Average
	0.839		52.08% Pervious Area
	0.772		47.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	208	0.0050	0.85		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"

Subcatchment PR-2B: N SITE



Summary for Subcatchment PR-2C: DIRECT

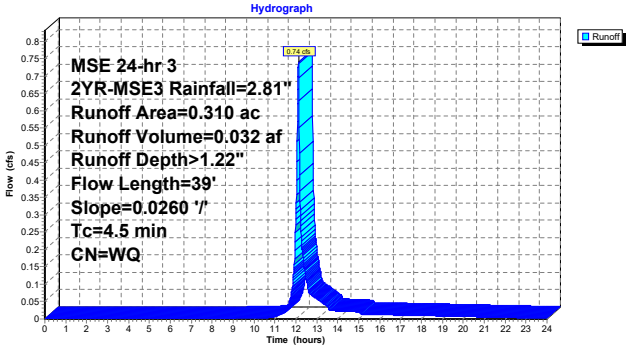
Runoff = 0.74 cfs @ 12.12 hrs, Volume= 0.032 af, Depth> 1.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

	Area (ac)	CN	Description
*	0.024	98	Impervious
	0.286	80	>75% Grass cover, Good, HSG D
	0.310		Weighted Average
	0.286		92.26% Pervious Area
	0.024		7.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	39	0.0260	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"

Subcatchment PR-2C: DIRECT



Summary for Subcatchment PR-2D: N OFFSITE

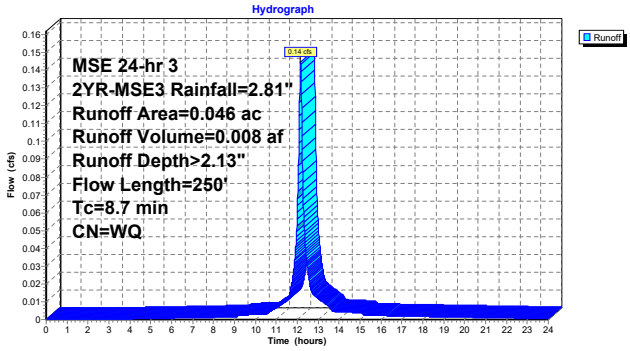
Runoff = 0.14 cfs @ 12.16 hrs, Volume= 0.008 af, Depth> 2.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

Area (ac)	CN	Description
* 0.032	98	Impervious
0.014	80	>75% Grass cover, Good, HSG D
0.046		Weighted Average
0.014		30.43% Pervious Area
0.032		69.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	52	0.0189	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
2.3	198	0.0052	1.46		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.7	250	Total			

Subcatchment PR-2D: N OFFSITE



Summary for Subcatchment PR-2E: N OFFSITE

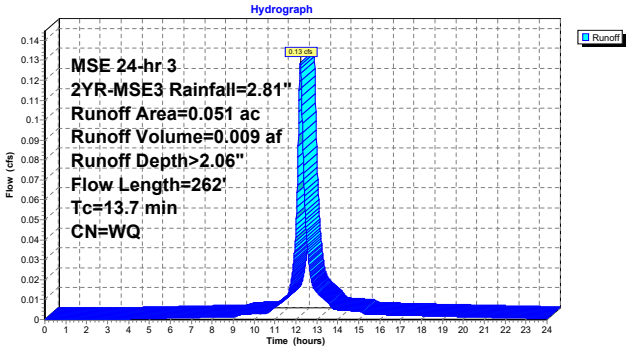
Runoff = 0.13 cfs @ 12.22 hrs, Volume= 0.009 af, Depth> 2.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

Area (ac)	CN	Description
* 0.033	98	Impervious
0.018	80	>75% Grass cover, Good, HSG D
0.051		Weighted Average
0.018		35.29% Pervious Area
0.033		64.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.1	87	0.0109	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
1.6	175	0.0080	1.82		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
13.7	262	Total			

Subcatchment PR-2E: N OFFSITE



Summary for Subcatchment PR-3A: MID-SITE

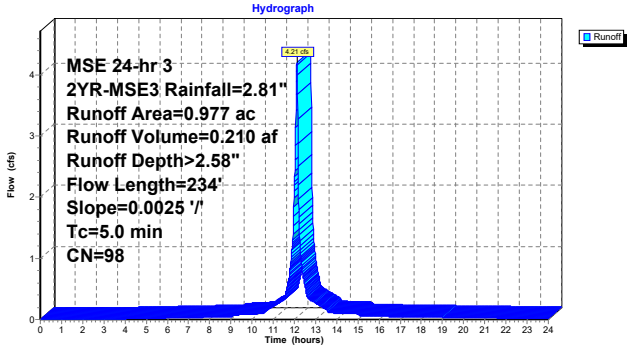
Runoff = 4.21 cfs @ 12.12 hrs, Volume= 0.210 af, Depth> 2.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

Area (ac)	CN	Description
* 0.977	98	Impervious
0.977		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	76	0.0025	0.53		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
2.6	158	0.0025	1.02		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
5.0	234	Total			

Subcatchment PR-3A: MID-SITE



Summary for Subcatchment PR-3B: MID-SITE

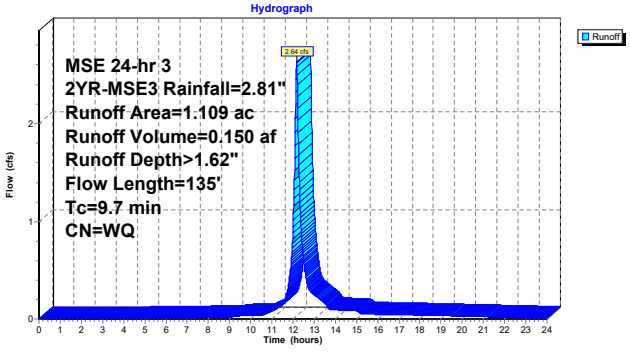
Runoff = 2.64 cfs @ 12.17 hrs, Volume= 0.150 af, Depth> 1.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

Area (ac)	CN	Description
* 0.389	98	Impervious
0.720	80	>75% Grass cover, Good, HSG D
1.109		Weighted Average
0.720		64.92% Pervious Area
0.389		35.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	48	0.0065	0.09		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
0.5	87	0.0189	2.79		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
9.7	135	Total			

Subcatchment PR-3B: MID-SITE



Summary for Subcatchment PR-4A: SE OFFSITE

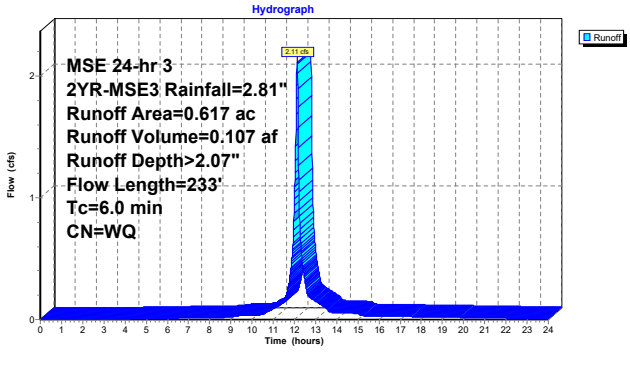
Runoff = 2.11 cfs @ 12.13 hrs, Volume= 0.107 af, Depth> 2.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

	Area (ac)	CN	Description
*	0.405	98	Impervious
	0.212	80	>75% Grass cover, Good, HSG D
	0.617		Weighted Average
	0.212		34.36% Pervious Area
	0.405		65.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	88	0.0216	1.28		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
4.9	145	0.0006	0.50		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.0	233	Total			

Subcatchment PR-4A: SE OFFSITE



Summary for Subcatchment PR-4B: SE SITE

[49] Hint: Tc<2dt may require smaller dt

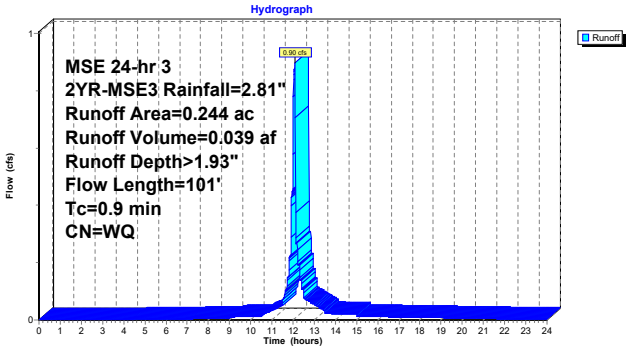
Runoff = 0.90 cfs @ 12.10 hrs, Volume= 0.039 af, Depth> 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

	Area (ac)	CN	Description
*	0.136	98	Impervious
	0.108	80	>75% Grass cover, Good, HSG D
	0.244		Weighted Average
	0.108		44.26% Pervious Area
	0.136		55.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	38	0.0297	1.23		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
0.4	63	0.0171	2.65		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	101	Total			

Subcatchment PR-4B: SE SITE



Summary for Subcatchment PR-5A: SW OFFSITE

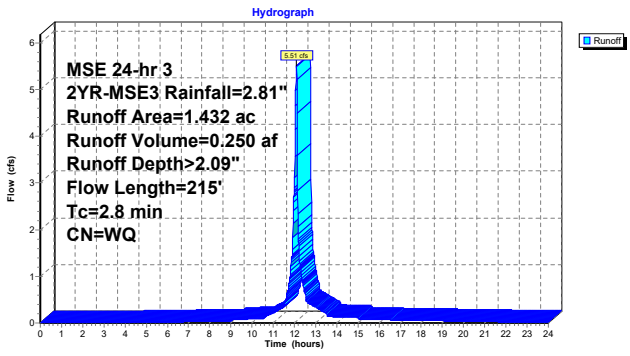
Runoff = 5.51 cfs @ 12.11 hrs, Volume= 0.250 af, Depth> 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

	Area (ac)	CN	Description
*	0.958	98	Impervious
	0.474	80	>75% Grass cover, Good, HSG D
	1.432		Weighted Average
	0.474		33.10% Pervious Area
	0.958		66.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	21	0.0595	1.44		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
2.6	194	0.0039	1.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.8	215	Total			

Subcatchment PR-5A: SW OFFSITE



Summary for Subcatchment PR-5B: SW SITE

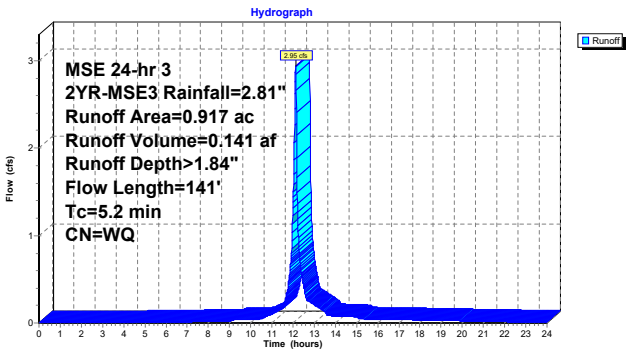
Runoff = 2.95 cfs @ 12.13 hrs, Volume= 0.141 af, Depth> 1.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2YR-MSE3 Rainfall=2.81"

	Area (ac)	CN	Description
*	0.459	98	Impervious
	0.458	80	>75% Grass cover, Good, HSG D
	0.917		Weighted Average
	0.458		49.95% Pervious Area
	0.459		50.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	48	0.0371	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
0.6	93	0.0230	2.44		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
5.2	141	Total			

Subcatchment PR-5B: SW SITE



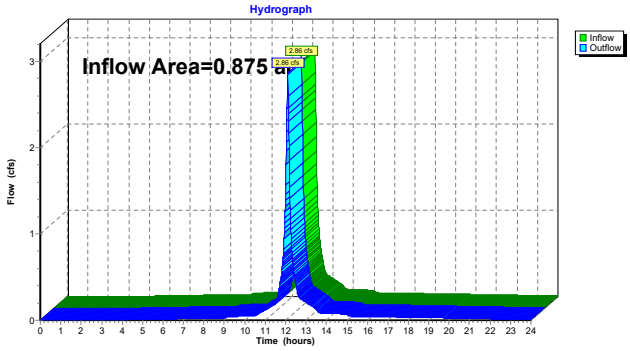
Summary for Reach 1R: SE STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.875 ac, 61.26% Impervious, Inflow Depth > 2.01" for 2YR-MSE3 event
Inflow = 2.86 cfs @ 12.10 hrs, Volume= 0.147 af
Outflow = 2.86 cfs @ 12.10 hrs, Volume= 0.147 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 1R: SE STORM SEWER



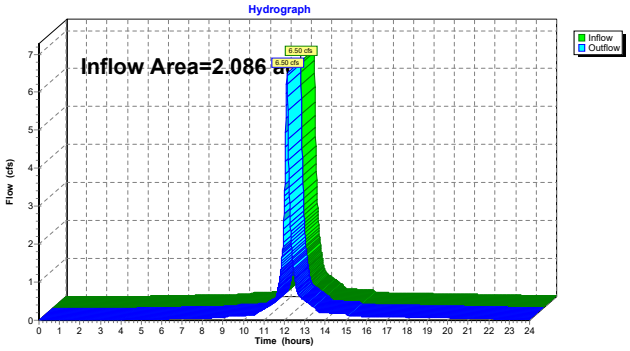
Summary for Reach 2R: S STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.086 ac, 65.48% Impervious, Inflow Depth > 2.07" for 2YR-MSE3 event
Inflow = 6.50 cfs @ 12.13 hrs, Volume= 0.360 af
Outflow = 6.50 cfs @ 12.13 hrs, Volume= 0.360 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 2R: S STORM SEWER



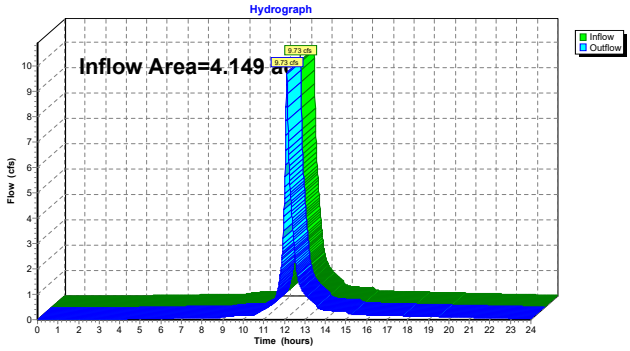
Summary for Reach 3R: S STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.149 ac, 45.75% Impervious, Inflow Depth > 1.78" for 2YR-MSE3 event
Inflow = 9.73 cfs @ 12.13 hrs, Volume= 0.616 af
Outflow = 9.73 cfs @ 12.13 hrs, Volume= 0.616 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 3R: S STORM SEWER



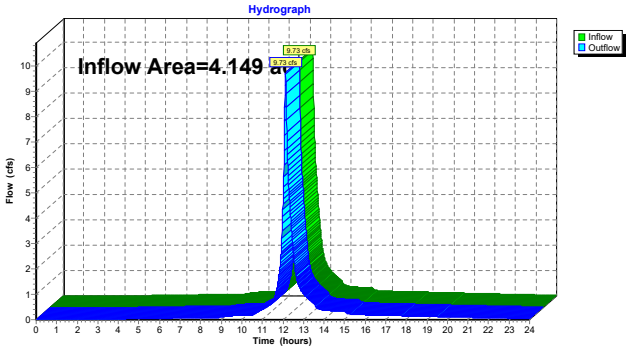
Summary for Reach 4R: MID-SITE STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.149 ac, 45.75% Impervious, Inflow Depth > 1.78" for 2YR-MSE3 event
Inflow = 9.73 cfs @ 12.13 hrs, Volume= 0.616 af
Outflow = 9.73 cfs @ 12.13 hrs, Volume= 0.616 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 4R: MID-SITE STORM SEWER



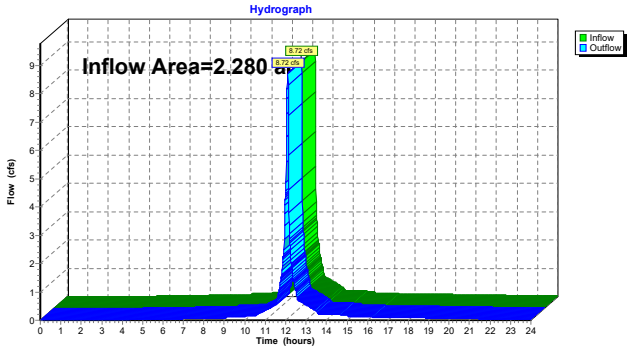
Summary for Reach 6R: SW RAVINE

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.280 ac, 65.96% Impervious, Inflow Depth > 2.08" for 2YR-MSE3 event
Inflow = 8.72 cfs @ 12.11 hrs, Volume= 0.395 af
Outflow = 8.72 cfs @ 12.11 hrs, Volume= 0.395 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 6R: SW RAVINE



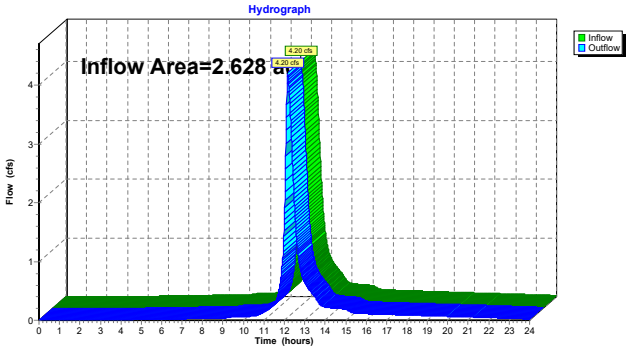
Summary for Reach 7R: NORTH STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.628 ac, 27.09% Impervious, Inflow Depth > 1.51" for 2YR-MSE3 event
Inflow = 4.20 cfs @ 12.16 hrs, Volume= 0.330 af
Outflow = 4.20 cfs @ 12.16 hrs, Volume= 0.330 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 7R: NORTH STORM SEWER



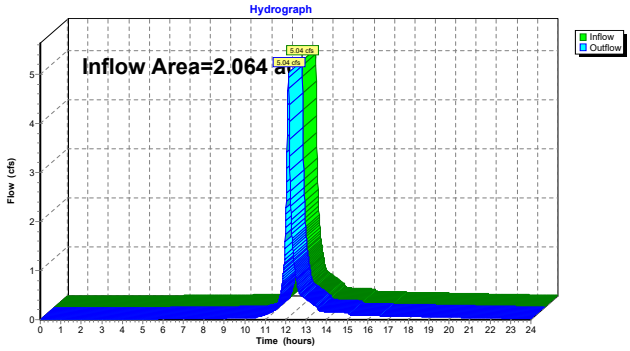
Summary for Reach 8R: NW OFFSITE

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.064 ac, 21.12% Impervious, Inflow Depth > 1.42" for 2YR-MSE3 event
Inflow = 5.04 cfs @ 12.14 hrs, Volume= 0.244 af
Outflow = 5.04 cfs @ 12.14 hrs, Volume= 0.244 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 8R: NW OFFSITE



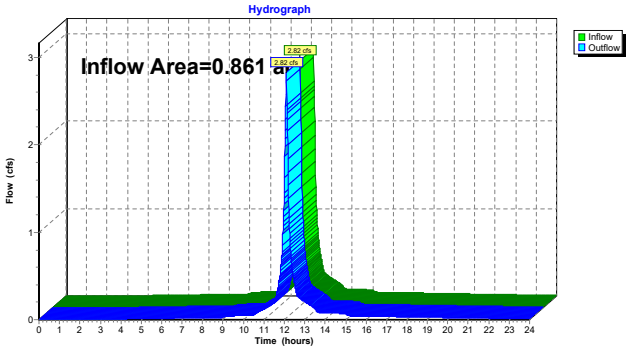
Summary for Reach 14R: SE STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.861 ac, 62.83% Impervious, Inflow Depth > 2.03" for 2YR-MSE3 event
Inflow = 2.82 cfs @ 12.10 hrs, Volume= 0.146 af
Outflow = 2.82 cfs @ 12.10 hrs, Volume= 0.146 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 14R: SE STORM SEWER



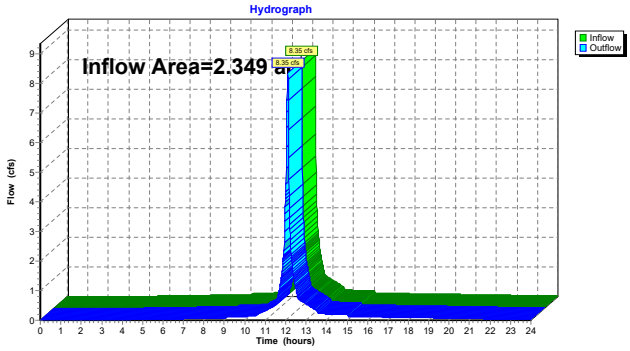
Summary for Reach 15R: SW RAVINE

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.349 ac, 60.32% Impervious, Inflow Depth > 2.00" for 2YR-MSE3 event
Inflow = 8.35 cfs @ 12.11 hrs, Volume= 0.391 af
Outflow = 8.35 cfs @ 12.11 hrs, Volume= 0.391 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 15R: SW RAVINE



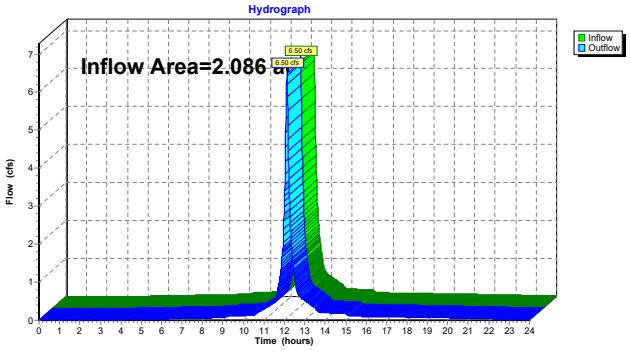
Summary for Reach 16R: MID-SITE STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.086 ac, 65.48% Impervious, Inflow Depth > 2.07" for 2YR-MSE3 event
Inflow = 6.50 cfs @ 12.13 hrs, Volume= 0.360 af
Outflow = 6.50 cfs @ 12.13 hrs, Volume= 0.360 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 16R: MID-SITE STORM SEWER



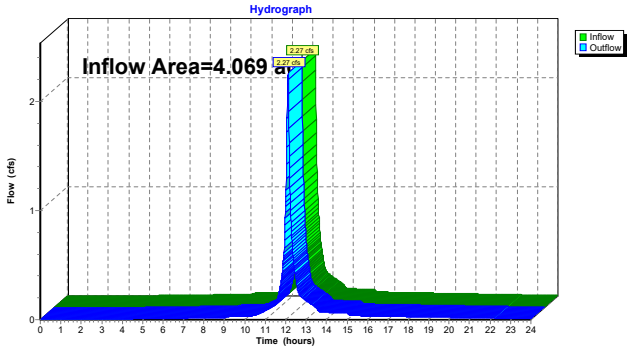
Summary for Reach 17R: NW Offsite

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.069 ac, 36.32% Impervious, Inflow Depth > 0.34" for 2YR-MSE3 event
Inflow = 2.27 cfs @ 12.12 hrs, Volume= 0.116 af
Outflow = 2.27 cfs @ 12.12 hrs, Volume= 0.116 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 17R: NW Offsite



Summary for Pond 3P: 96" DuroMaxx

Inflow Area = 3.303 ac, 33.51% Impervious, Inflow Depth > 1.60" for 2YR-MSE3 event
Inflow = 7.09 cfs @ 12.12 hrs, Volume= 0.441 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 856.56' @ 24.00 hrs Surf.Area= 4,897 sf Storage= 19,194 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

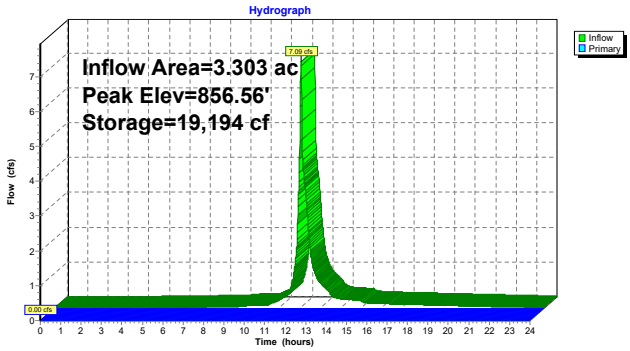
Volume	Invert	Avail.Storage	Storage Description
#1	859.00'	2,130 cf	**Above Ground - Overflow (Prismatic)**Listed below (Recalc)
#2	851.99'	321 cf	**35.4" Round CMP_Round 35.4" Header Row** L= 47.0'
#3	851.99'	402 cf	**35.4" Round CMP_Round 35.4" Header Connecters** L= 58.8'
#4	851.99'	30,685 cf	**94.5" Round CMP_Round 94.5"** L= 630.0'
		33,538 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
859.00	100	0	0
860.00	229	165	165
860.50	1,880	527	692
861.00	3,871	1,438	2,130

Device	Routing	Invert	Outlet Devices
#1	Primary	859.01'	**4.0' long x 5.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.35 2.51 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.69 2.73 2.77 2.86

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=851.99' TW=0.00' (Dynamic Tailwater)
↑**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: 96" DuroMaxx



Summary for Pond 20P: Existing Low Area

Inflow Area = 0.579 ac, 1.55% Impervious, Inflow Depth > 1.13" for 2YR-MSE3 event
Inflow = 1.32 cfs @ 12.12 hrs, Volume= 0.055 af
Outflow = 1.31 cfs @ 12.13 hrs, Volume= 0.055 af, Atten= 1%, Lag= 0.4 min
Primary = 1.31 cfs @ 12.13 hrs, Volume= 0.055 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 855.35' @ 12.13 hrs Surf.Area= 429 sf Storage= 32 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.2 min (815.3 - 815.1)

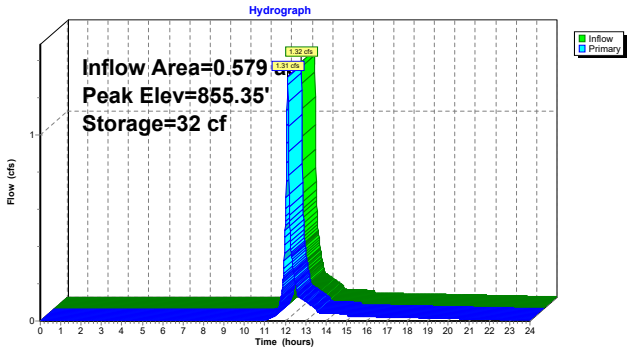
Volume	Invert	Avail.Storage	Storage Description
#1	855.20'	17,712 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
855.20	1	0	0
856.00	2,323	930	930
857.00	4,837	3,580	4,510
858.00	6,555	5,696	10,206
859.00	8,458	7,507	17,712

Device	Routing	Invert	Outlet Devices
#1	Primary	855.20'	**27.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.30 cfs @ 12.13 hrs HW=855.35' TW=0.00' (Dynamic Tailwater)
↑**1=Orifice/Grate** (Weir Controls 1.30 cfs @ 1.25 fps)

Pond 20P: Existing Low Area



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentEX-1A: NW OFFSITE Runoff Area=0.355 ac 44.23% Impervious Runoff Depth>2.98"
Flow Length=174' Tc=6.4 min CN=WQ Runoff=1.76 cfs 0.088 af

SubcatchmentEX-1B: NW SITE Runoff Area=1.612 ac 13.28% Impervious Runoff Depth>2.44"
Flow Length=466' Tc=6.1 min CN=WQ Runoff=7.03 cfs 0.328 af

SubcatchmentEX-2A: NE OFFSITE Runoff Area=1.382 ac 22.50% Impervious Runoff Depth>2.60"
Flow Length=352' Tc=20.2 min CN=WQ Runoff=3.84 cfs 0.299 af

SubcatchmentEX-2B: NE SITE Runoff Area=0.667 ac 58.77% Impervious Runoff Depth>3.24"
Flow Length=290' Tc=10.2 min CN=WQ Runoff=3.02 cfs 0.180 af

SubcatchmentEX-2C: DIRECT Runoff Area=0.579 ac 1.55% Impervious Runoff Depth>2.23"
Flow Length=131' Tc=4.2 min CN=WQ Runoff=2.59 cfs 0.108 af

SubcatchmentEX-2D: N OFFSITE Runoff Area=0.046 ac 69.57% Impervious Runoff Depth>3.43"
Flow Length=250' Tc=8.7 min CN=WQ Runoff=0.23 cfs 0.013 af

SubcatchmentEX-2E: N OFFSITE Runoff Area=0.051 ac 64.71% Impervious Runoff Depth>3.34"
Flow Length=262' Tc=13.7 min CN=WQ Runoff=0.21 cfs 0.014 af

SubcatchmentEX-3A: MID-SITE Runoff Area=0.977 ac 100.00% Impervious Runoff Depth>3.96"
Flow Length=234' Slope=0.0025 '/' Tc=5.0 min CN=WQ Runoff=6.34 cfs 0.323 af

SubcatchmentEX-3B: MID-SITE Runoff Area=0.544 ac 38.42% Impervious Runoff Depth>2.88"
Flow Length=222' Tc=6.4 min CN=WQ Runoff=2.63 cfs 0.131 af

SubcatchmentEX-4A: SE OFFSITE Runoff Area=0.617 ac 65.64% Impervious Runoff Depth>3.36"
Flow Length=233' Tc=6.0 min CN=WQ Runoff=3.40 cfs 0.173 af

SubcatchmentEX-4B: SE SITE Runoff Area=0.258 ac 50.78% Impervious Runoff Depth>3.10"
Flow Length=125' Tc=1.2 min CN=WQ Runoff=1.52 cfs 0.067 af

SubcatchmentEX-5A: SW OFFSITE Runoff Area=1.432 ac 65.64% Impervious Runoff Depth>3.36"
Flow Length=215' Tc=2.8 min CN=WQ Runoff=8.73 cfs 0.401 af

SubcatchmentEX-5B: SW SITE Runoff Area=0.848 ac 66.51% Impervious Runoff Depth>3.38"
Flow Length=269' Tc=3.0 min CN=WQ Runoff=5.19 cfs 0.239 af

SubcatchmentPR-1A: NW OFFSITE Runoff Area=0.355 ac 44.23% Impervious Runoff Depth>2.98"
Flow Length=174' Tc=6.4 min CN=WQ Runoff=1.76 cfs 0.088 af

SubcatchmentPR-1B: NW SITE Runoff Area=0.314 ac 47.45% Impervious Runoff Depth>3.04"
Flow Length=164' Tc=3.2 min CN=WQ Runoff=1.78 cfs 0.080 af

SubcatchmentPR-2A: NE OFFSITE Runoff Area=1.382 ac 22.50% Impervious Runoff Depth>2.60"
Flow Length=352' Tc=20.2 min CN=WQ Runoff=3.84 cfs 0.299 af

SubcatchmentPR-2B: N SITE Runoff Area=1.611 ac 47.92% Impervious Runoff Depth>3.05"
Flow Length=208' Slope=0.0050 '/' Tc=4.1 min CN=WQ Runoff=8.91 cfs 0.409 af

SubcatchmentPR-2C: DIRECT Runoff Area=0.310 ac 7.74% Impervious Runoff Depth>2.34"
Flow Length=39' Slope=0.0260 '/' Tc=4.5 min CN=WQ Runoff=1.42 cfs 0.061 af

SubcatchmentPR-2D: N OFFSITE Runoff Area=0.046 ac 69.57% Impervious Runoff Depth>3.43"
Flow Length=250' Tc=8.7 min CN=WQ Runoff=0.23 cfs 0.013 af

SubcatchmentPR-2E: N OFFSITE Runoff Area=0.051 ac 64.71% Impervious Runoff Depth>3.34"
Flow Length=262' Tc=13.7 min CN=WQ Runoff=0.21 cfs 0.014 af

SubcatchmentPR-3A: MID-SITE Runoff Area=0.977 ac 100.00% Impervious Runoff Depth>3.96"
Flow Length=234' Slope=0.0025 '/' Tc=5.0 min CN=98 Runoff=6.34 cfs 0.323 af

SubcatchmentPR-3B: MID-SITE Runoff Area=1.109 ac 35.08% Impervious Runoff Depth>2.82"
Flow Length=135' Tc=9.7 min CN=WQ Runoff=4.60 cfs 0.261 af

SubcatchmentPR-4A: SE OFFSITE Runoff Area=0.617 ac 65.64% Impervious Runoff Depth>3.36"
Flow Length=233' Tc=6.0 min CN=WQ Runoff=3.40 cfs 0.173 af

SubcatchmentPR-4B: SE SITE Runoff Area=0.244 ac 55.74% Impervious Runoff Depth>3.19"
Flow Length=101' Tc=0.9 min CN=WQ Runoff=1.46 cfs 0.065 af

SubcatchmentPR-5A: SW OFFSITE Runoff Area=1.432 ac 66.90% Impervious Runoff Depth>3.38"
Flow Length=215' Tc=2.8 min CN=WQ Runoff=8.77 cfs 0.404 af

SubcatchmentPR-5B: SW SITE Runoff Area=0.917 ac 50.05% Impervious Runoff Depth>3.09"
Flow Length=141' Tc=5.2 min CN=WQ Runoff=4.90 cfs 0.236 af

Reach 1R: SE STORM SEWER Inflow=4.64 cfs 0.239 af
Outflow=4.64 cfs 0.239 af

Reach 2R: S STORM SEWER Inflow=10.39 cfs 0.584 af
Outflow=10.39 cfs 0.584 af

Reach 3R: S STORM SEWER Inflow=16.26 cfs 1.041 af
Outflow=16.26 cfs 1.041 af

Reach 4R: MID-SITE STORM SEWER Inflow=16.26 cfs 1.041 af
Outflow=16.26 cfs 1.041 af

Reach 6R: SW RAVINE Inflow=13.96 cfs 0.640 af
Outflow=13.96 cfs 0.640 af

Reach 7R: NORTH STORM SEWER Inflow=7.60 cfs 0.587 af
Outflow=7.60 cfs 0.587 af

Reach 8R: NW OFFSITE Inflow=9.18 cfs 0.443 af
Outflow=9.18 cfs 0.443 af

Reach 14R: SE STORM SEWER Inflow=4.57 cfs 0.238 af
Outflow=4.57 cfs 0.238 af

Reach 15R: SW RAVINE Inflow=13.55 cfs 0.640 af
Outflow=13.55 cfs 0.640 af

Reach 16R: MID-SITE STORM SEWER Inflow=10.39 cfs 0.584 af
Outflow=10.39 cfs 0.584 af

Reach 17R: NW Offsite Inflow=3.80 cfs 0.283 af
Outflow=3.80 cfs 0.283 af

Pond 3P: 96" DuroMaxx Peak Elev=859.09' Storage=29,855 cf Inflow=12.29 cfs 0.769 af
Outflow=0.21 cfs 0.088 af

Pond 20P: Existing Low Area Peak Elev=855.43' Storage=77 cf Inflow=2.59 cfs 0.108 af
Outflow=2.55 cfs 0.108 af

Total Runoff Area = 18.733 ac Runoff Volume = 4.788 af Average Runoff Depth = 3.07"
51.02% Pervious = 9.557 ac 48.98% Impervious = 9.176 ac

Summary for Subcatchment EX-1A: NW OFFSITE

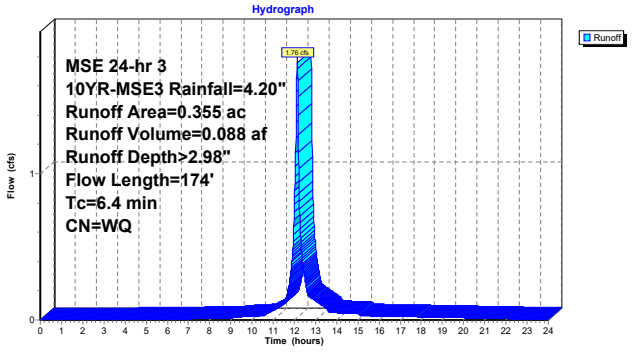
Runoff = 1.76 cfs @ 12.14 hrs, Volume= 0.088 af, Depth> 2.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

	Area (ac)	CN	Description
*	0.157	98	Impervious
	0.198	80	>75% Grass cover, Good, HSG D
	0.355		Weighted Average
	0.198		55.77% Pervious Area
	0.157		44.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	58	0.0343	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
0.9	116	0.0172	2.11		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.4	174	Total			

Subcatchment EX-1A: NW OFFSITE



Summary for Subcatchment EX-1B: NW SITE

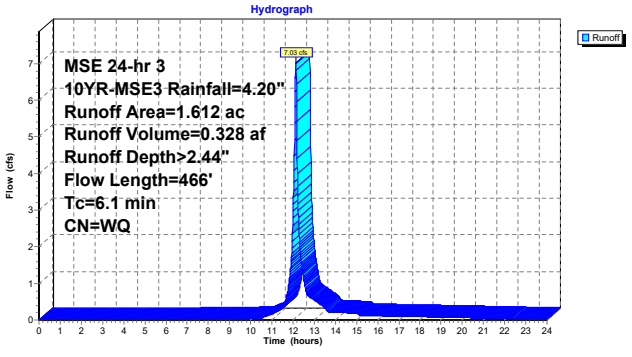
Runoff = 7.03 cfs @ 12.13 hrs, Volume= 0.328 af, Depth> 2.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

	Area (ac)	CN	Description
*	0.214	98	Impervious
	1.398	80	>75% Grass cover, Good, HSG D
	1.612		Weighted Average
	1.398		86.72% Pervious Area
	0.214		13.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	79	0.1280	2.56		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
5.6	387	0.0051	1.15		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.1	466	Total			

Subcatchment EX-1B: NW SITE



Summary for Subcatchment EX-2A: NE OFFSITE

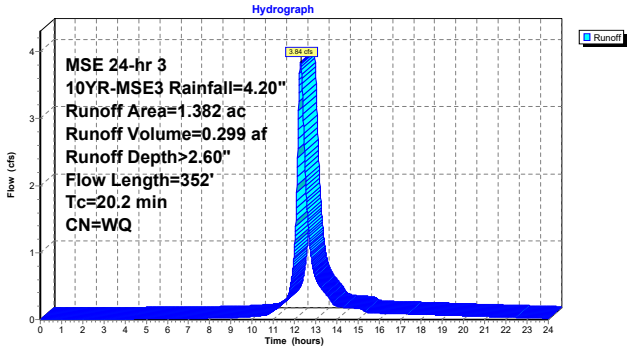
Runoff = 3.84 cfs @ 12.30 hrs, Volume= 0.299 af, Depth> 2.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

Area (ac)	CN	Description
* 0.311	98	Impervious
1.071	80	>75% Grass cover, Good, HSG D
1.382		Weighted Average
1.071		77.50% Pervious Area
0.311		22.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.4	66	0.0029	0.07		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
3.8	286	0.0061	1.26		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
20.2	352	Total			

Subcatchment EX-2A: NE OFFSITE



Summary for Subcatchment EX-2B: NE SITE

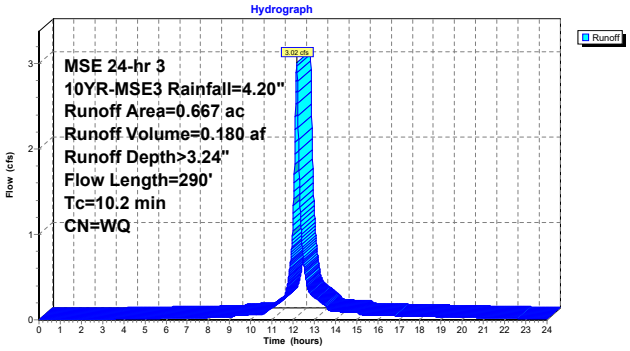
Runoff = 3.02 cfs @ 12.18 hrs, Volume= 0.180 af, Depth> 3.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

Area (ac)	CN	Description
* 0.392	98	Impervious
0.275	80	>75% Grass cover, Good, HSG D
0.667		Weighted Average
0.275		41.23% Pervious Area
0.392		58.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	217	0.0106	6.12	10.81	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Concrete pipe, bends & connections
9.6	73	0.0137	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
10.2	290	Total			

Subcatchment EX-2B: NE SITE



Summary for Subcatchment EX-2C: DIRECT

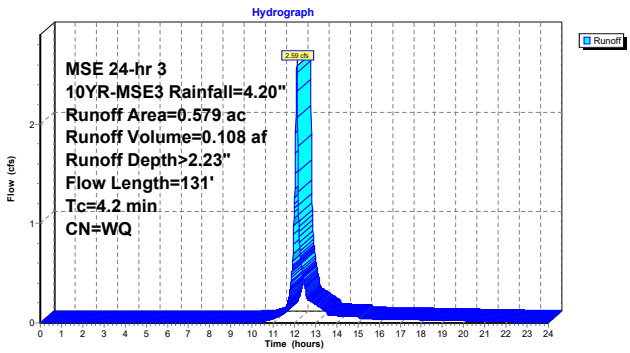
Runoff = 2.59 cfs @ 12.12 hrs, Volume= 0.108 af, Depth> 2.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

Area (ac)	CN	Description
* 0.009	98	Impervious
0.570	80	>75% Grass cover, Good, HSG D
0.579		Weighted Average
0.570		98.45% Pervious Area
0.009		1.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	98	0.0620	4.01		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.8	33	0.0273	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
4.2	131	Total			

Subcatchment EX-2C: DIRECT



Summary for Subcatchment EX-2D: N OFFSITE

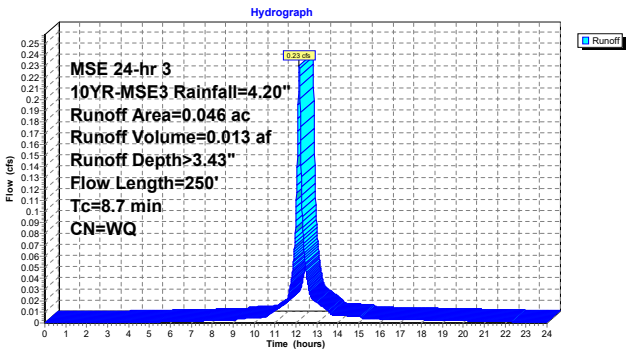
Runoff = 0.23 cfs @ 12.16 hrs, Volume= 0.013 af, Depth> 3.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

Area (ac)	CN	Description
* 0.032	98	Impervious
0.014	80	>75% Grass cover, Good, HSG D
0.046		Weighted Average
0.014		30.43% Pervious Area
0.032		69.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	52	0.0189	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
2.3	198	0.0052	1.46		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.7	250	Total			

Subcatchment EX-2D: N OFFSITE



Summary for Subcatchment EX-2E: N OFFSITE

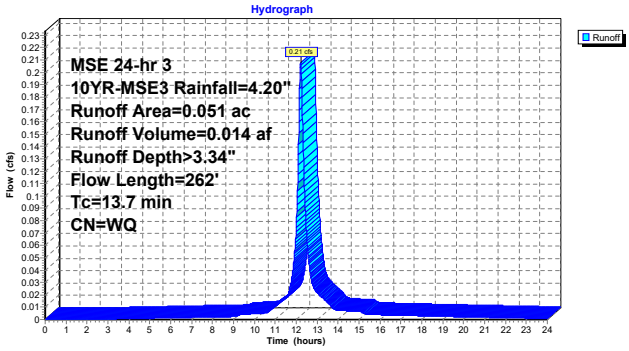
Runoff = 0.21 cfs @ 12.21 hrs, Volume= 0.014 af, Depth> 3.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

Area (ac)	CN	Description
* 0.033	98	Impervious
0.018	80	>75% Grass cover, Good, HSG D
0.051		Weighted Average
0.018		35.29% Pervious Area
0.033		64.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.1	87	0.0109	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
1.6	175	0.0080	1.82		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
13.7	262	Total			

Subcatchment EX-2E: N OFFSITE



Summary for Subcatchment EX-3A: MID-SITE

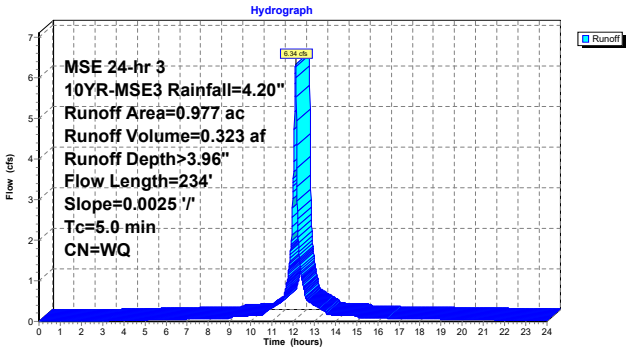
Runoff = 6.34 cfs @ 12.12 hrs, Volume= 0.323 af, Depth> 3.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

Area (ac)	CN	Description
* 0.977	98	Impervious
0.000	80	>75% Grass cover, Good, HSG D
0.977		Weighted Average
0.977		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	76	0.0025	0.53		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
2.6	158	0.0025	1.02		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
5.0	234	Total			

Subcatchment EX-3A: MID-SITE



Summary for Subcatchment EX-3B: MID-SITE

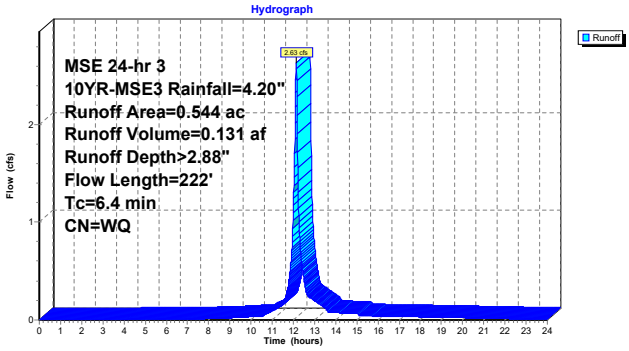
Runoff = 2.63 cfs @ 12.14 hrs, Volume= 0.131 af, Depth> 2.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

Area (ac)	CN	Description
* 0.209	98	Impervious
0.335	80	>75% Grass cover, Good, HSG D
0.544		Weighted Average
0.335		61.58% Pervious Area
0.209		38.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	34	0.0174	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
1.7	188	0.0085	1.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.4	222	Total			

Subcatchment EX-3B: MID-SITE



Summary for Subcatchment EX-4A: SE OFFSITE

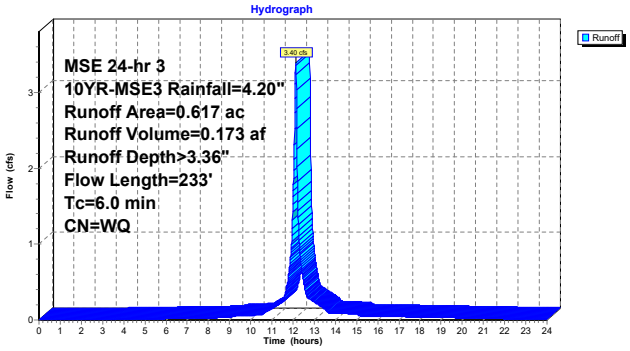
Runoff = 3.40 cfs @ 12.13 hrs, Volume= 0.173 af, Depth> 3.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

Area (ac)	CN	Description
* 0.405	98	Impervious
0.212	80	>75% Grass cover, Good, HSG D
0.617		Weighted Average
0.212		34.36% Pervious Area
0.405		65.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	88	0.0216	1.28		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
4.9	145	0.0006	0.50		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.0	233	Total			

Subcatchment EX-4A: SE OFFSITE



Summary for Subcatchment EX-4B: SE SITE

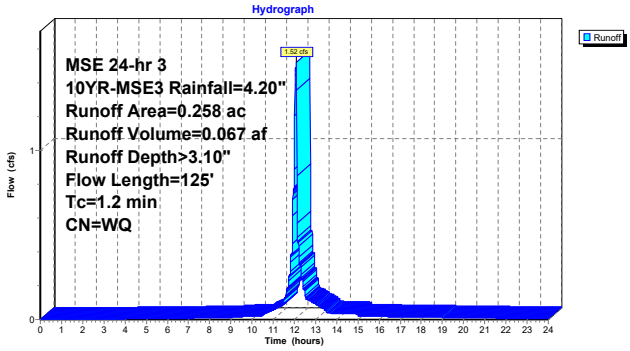
Runoff = 1.52 cfs @ 12.10 hrs, Volume= 0.067 af, Depth> 3.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

Area (ac)	CN	Description
* 0.131	98	Impervious
0.127	80	>75% Grass cover, Good, HSG D
0.258		Weighted Average
0.127		49.22% Pervious Area
0.131		50.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	31	0.0468	1.42		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
0.8	94	0.0134	1.86		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.2	125	Total			

Subcatchment EX-4B: SE SITE



Summary for Subcatchment EX-5A: SW OFFSITE

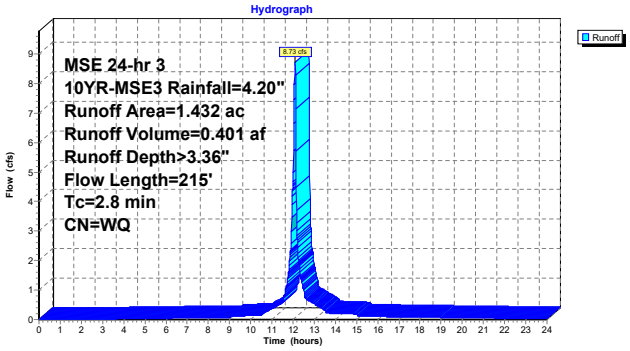
Runoff = 8.73 cfs @ 12.10 hrs, Volume= 0.401 af, Depth> 3.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

Area (ac)	CN	Description
* 0.940	98	Impervious
0.492	80	>75% Grass cover, Good, HSG D
1.432		Weighted Average
0.492		34.36% Pervious Area
0.940		65.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	21	0.0595	1.44		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
2.6	194	0.0039	1.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.8	215	Total			

Subcatchment EX-5A: SW OFFSITE



Summary for Subcatchment EX-5B: SW SITE

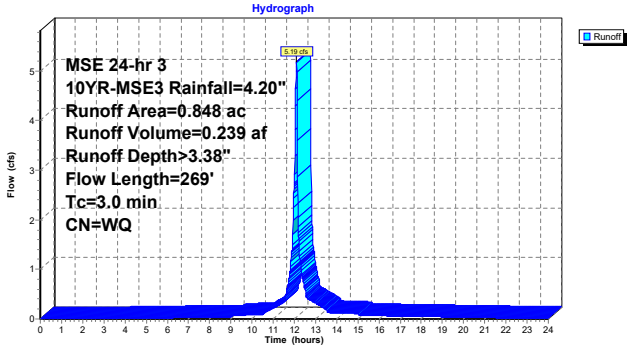
Runoff = 5.19 cfs @ 12.11 hrs, Volume= 0.239 af, Depth> 3.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

Area (ac)	CN	Description
* 0.564	98	Impervious
0.284	80	>75% Grass cover, Good, HSG D
0.848		Weighted Average
0.284		33.49% Pervious Area
0.564		66.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	78	0.0101	0.92		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
1.6	191	0.0099	2.02		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.0	269	Total			

Subcatchment EX-5B: SW SITE



Summary for Subcatchment PR-1A: NW OFFSITE

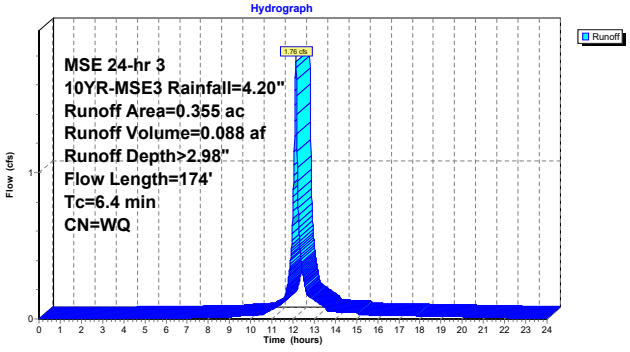
Runoff = 1.76 cfs @ 12.14 hrs, Volume= 0.088 af, Depth> 2.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

Area (ac)	CN	Description
* 0.157	98	Impervious
0.198	80	>75% Grass cover, Good, HSG D
0.355		Weighted Average
0.198		55.77% Pervious Area
0.157		44.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	58	0.0343	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
0.9	116	0.0172	2.11		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.4	174	Total			

Subcatchment PR-1A: NW OFFSITE



Summary for Subcatchment PR-1B: NW SITE

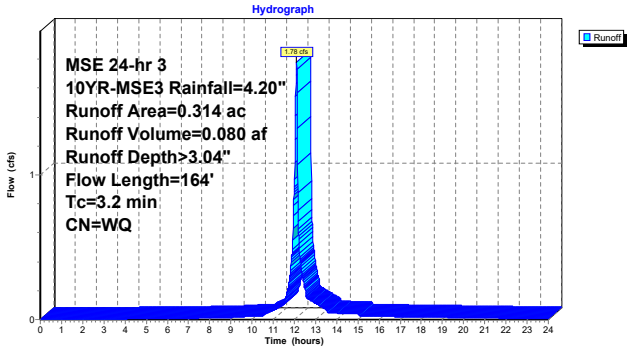
Runoff = 1.78 cfs @ 12.11 hrs, Volume= 0.080 af, Depth> 3.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

	Area (ac)	CN	Description
*	0.149	98	Impervious
	0.165	80	>75% Grass cover, Good, HSG D
	0.314		Weighted Average
	0.165		52.55% Pervious Area
	0.149		47.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	33	0.0803	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
0.7	131	0.0232	3.09		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.2	164	Total			

Subcatchment PR-1B: NW SITE



Summary for Subcatchment PR-2A: NE OFFSITE

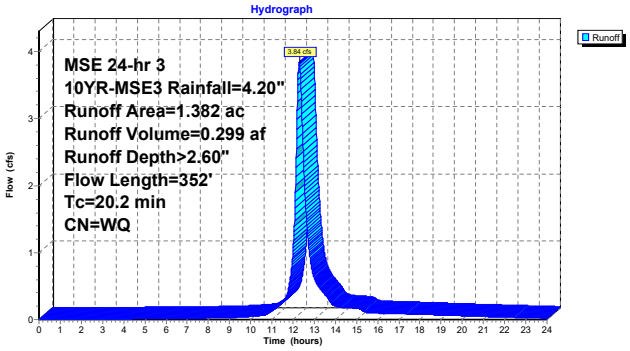
Runoff = 3.84 cfs @ 12.30 hrs, Volume= 0.299 af, Depth> 2.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

	Area (ac)	CN	Description
*	0.311	98	Impervious
	1.071	80	>75% Grass cover, Good, HSG D
	1.382		Weighted Average
	1.071		77.50% Pervious Area
	0.311		22.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.4	66	0.0029	0.07		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
3.8	286	0.0061	1.26		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
20.2	352	Total			

Subcatchment PR-2A: NE OFFSITE



Summary for Subcatchment PR-2B: N SITE

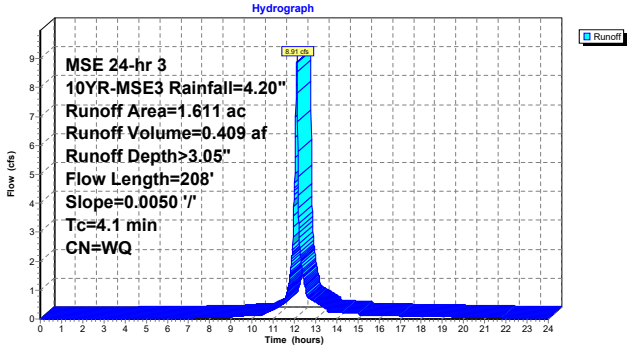
Runoff = 8.91 cfs @ 12.12 hrs, Volume= 0.409 af, Depth> 3.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

	Area (ac)	CN	Description
*	0.772	98	Impervious
	0.839	80	>75% Grass cover, Good, HSG D
	1.611		Weighted Average
	0.839		52.08% Pervious Area
	0.772		47.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	208	0.0050	0.85		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"

Subcatchment PR-2B: N SITE



Summary for Subcatchment PR-2C: DIRECT

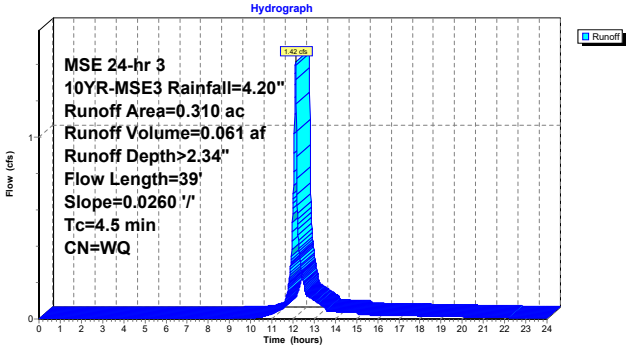
Runoff = 1.42 cfs @ 12.12 hrs, Volume= 0.061 af, Depth> 2.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

	Area (ac)	CN	Description
*	0.024	98	Impervious
	0.286	80	>75% Grass cover, Good, HSG D
	0.310		Weighted Average
	0.286		92.26% Pervious Area
	0.024		7.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	39	0.0260	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"

Subcatchment PR-2C: DIRECT



Summary for Subcatchment PR-2D: N OFFSITE

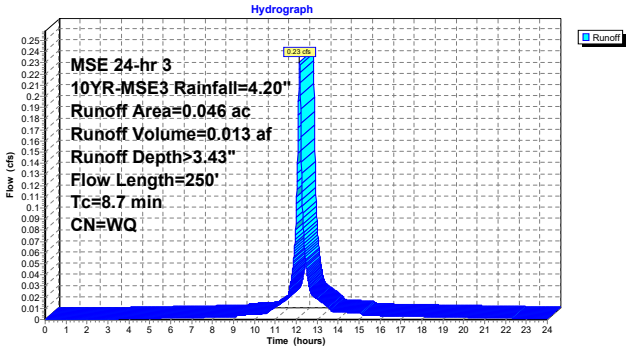
Runoff = 0.23 cfs @ 12.16 hrs, Volume= 0.013 af, Depth> 3.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

Area (ac)	CN	Description
* 0.032	98	Impervious
0.014	80	>75% Grass cover, Good, HSG D
0.046		Weighted Average
0.014		30.43% Pervious Area
0.032		69.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	52	0.0189	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
2.3	198	0.0052	1.46		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.7	250	Total			

Subcatchment PR-2D: N OFFSITE



Summary for Subcatchment PR-2E: N OFFSITE

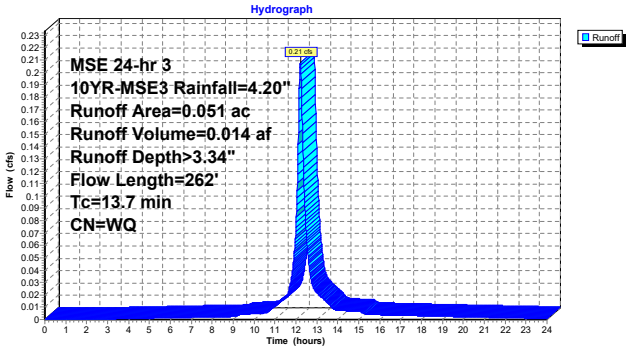
Runoff = 0.21 cfs @ 12.21 hrs, Volume= 0.014 af, Depth> 3.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

Area (ac)	CN	Description
* 0.033	98	Impervious
0.018	80	>75% Grass cover, Good, HSG D
0.051		Weighted Average
0.018		35.29% Pervious Area
0.033		64.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.1	87	0.0109	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
1.6	175	0.0080	1.82		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
13.7	262	Total			

Subcatchment PR-2E: N OFFSITE



Summary for Subcatchment PR-3A: MID-SITE

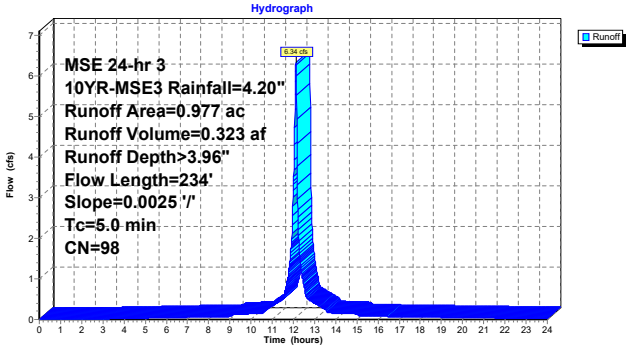
Runoff = 6.34 cfs @ 12.12 hrs, Volume= 0.323 af, Depth> 3.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

Area (ac)	CN	Description
* 0.977	98	Impervious
0.977		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	76	0.0025	0.53		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
2.6	158	0.0025	1.02		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
5.0	234	Total			

Subcatchment PR-3A: MID-SITE



Summary for Subcatchment PR-3B: MID-SITE

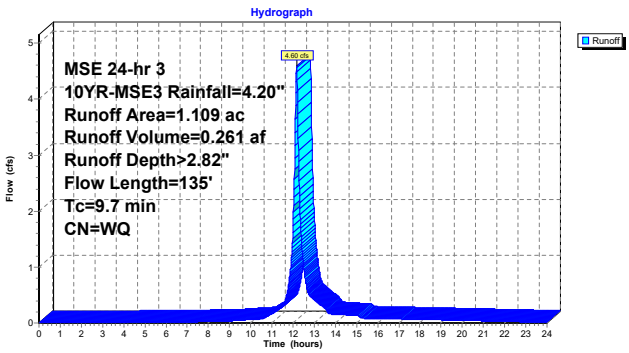
Runoff = 4.60 cfs @ 12.17 hrs, Volume= 0.261 af, Depth> 2.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

Area (ac)	CN	Description
* 0.389	98	Impervious
0.720	80	>75% Grass cover, Good, HSG D
1.109		Weighted Average
0.720		64.92% Pervious Area
0.389		35.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	48	0.0065	0.09		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
0.5	87	0.0189	2.79		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
9.7	135	Total			

Subcatchment PR-3B: MID-SITE



Summary for Subcatchment PR-4A: SE OFFSITE

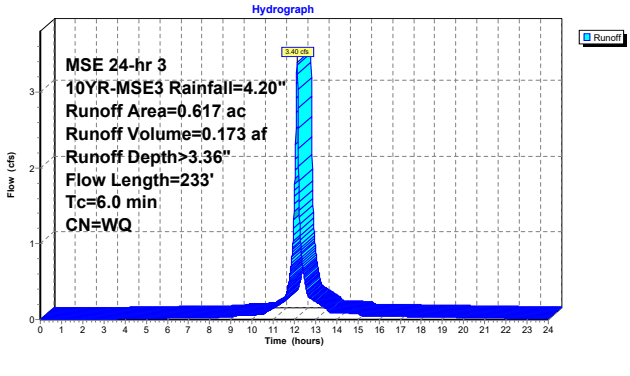
Runoff = 3.40 cfs @ 12.13 hrs, Volume= 0.173 af, Depth> 3.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

	Area (ac)	CN	Description
*	0.405	98	Impervious
	0.212	80	>75% Grass cover, Good, HSG D
	0.617		Weighted Average
	0.212		34.36% Pervious Area
	0.405		65.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	88	0.0216	1.28		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
4.9	145	0.0006	0.50		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.0	233	Total			

Subcatchment PR-4A: SE OFFSITE



Summary for Subcatchment PR-4B: SE SITE

[49] Hint: Tc<2dt may require smaller dt

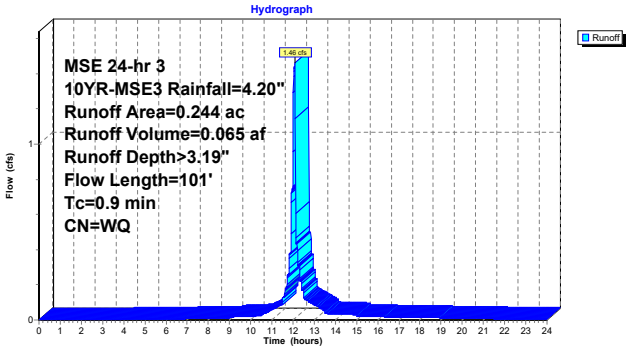
Runoff = 1.46 cfs @ 12.10 hrs, Volume= 0.065 af, Depth> 3.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

	Area (ac)	CN	Description
*	0.136	98	Impervious
	0.108	80	>75% Grass cover, Good, HSG D
	0.244		Weighted Average
	0.108		44.26% Pervious Area
	0.136		55.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	38	0.0297	1.23		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
0.4	63	0.0171	2.65		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	101	Total			

Subcatchment PR-4B: SE SITE



Summary for Subcatchment PR-5A: SW OFFSITE

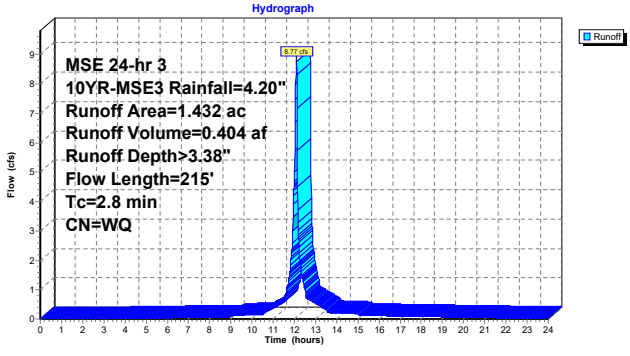
Runoff = 8.77 cfs @ 12.10 hrs, Volume= 0.404 af, Depth> 3.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

	Area (ac)	CN	Description
*	0.958	98	Impervious
	0.474	80	>75% Grass cover, Good, HSG D
	1.432		Weighted Average
	0.474		33.10% Pervious Area
	0.958		66.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	21	0.0595	1.44		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
2.6	194	0.0039	1.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.8	215	Total			

Subcatchment PR-5A: SW OFFSITE



Summary for Subcatchment PR-5B: SW SITE

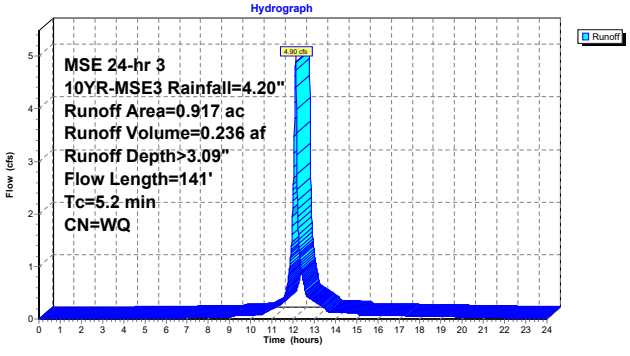
Runoff = 4.90 cfs @ 12.12 hrs, Volume= 0.236 af, Depth> 3.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10YR-MSE3 Rainfall=4.20"

	Area (ac)	CN	Description
*	0.459	98	Impervious
	0.458	80	>75% Grass cover, Good, HSG D
	0.917		Weighted Average
	0.458		49.95% Pervious Area
	0.459		50.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	48	0.0371	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
0.6	93	0.0230	2.44		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
5.2	141	Total			

Subcatchment PR-5B: SW SITE



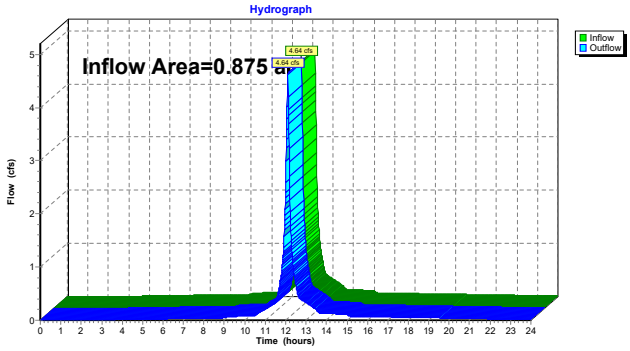
Summary for Reach 1R: SE STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.875 ac, 61.26% Impervious, Inflow Depth > 3.28" for 10YR-MSE3 event
Inflow = 4.64 cfs @ 12.10 hrs, Volume= 0.239 af
Outflow = 4.64 cfs @ 12.10 hrs, Volume= 0.239 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 1R: SE STORM SEWER



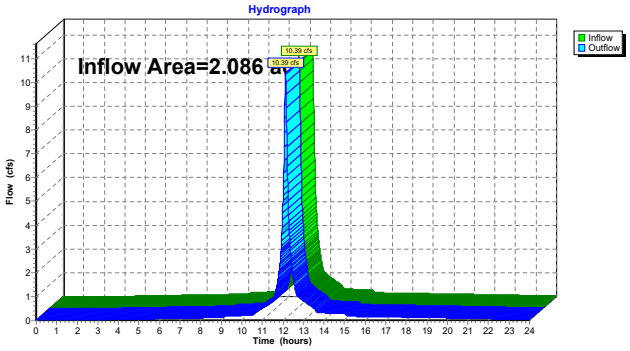
Summary for Reach 2R: S STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.086 ac, 65.48% Impervious, Inflow Depth > 3.36" for 10YR-MSE3 event
Inflow = 10.39 cfs @ 12.13 hrs, Volume= 0.584 af
Outflow = 10.39 cfs @ 12.13 hrs, Volume= 0.584 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 2R: S STORM SEWER



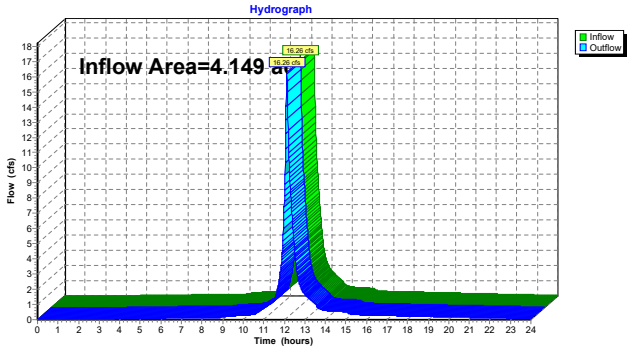
Summary for Reach 3R: S STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.149 ac, 45.75% Impervious, Inflow Depth > 3.01" for 10YR-MSE3 event
Inflow = 16.26 cfs @ 12.13 hrs, Volume= 1.041 af
Outflow = 16.26 cfs @ 12.13 hrs, Volume= 1.041 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 3R: S STORM SEWER



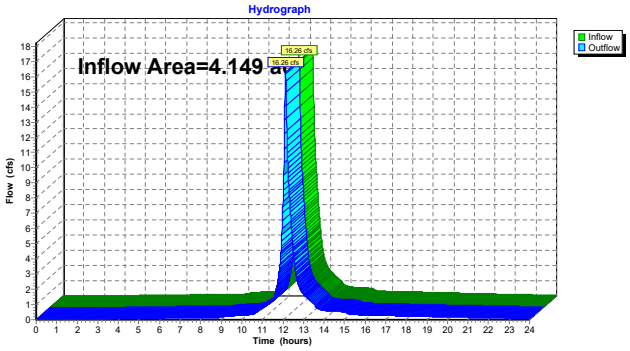
Summary for Reach 4R: MID-SITE STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.149 ac, 45.75% Impervious, Inflow Depth > 3.01" for 10YR-MSE3 event
Inflow = 16.26 cfs @ 12.13 hrs, Volume= 1.041 af
Outflow = 16.26 cfs @ 12.13 hrs, Volume= 1.041 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 4R: MID-SITE STORM SEWER



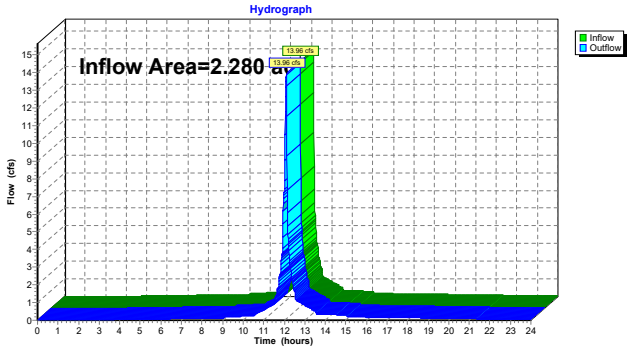
Summary for Reach 6R: SW RAVINE

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.280 ac, 65.96% Impervious, Inflow Depth > 3.37" for 10YR-MSE3 event
Inflow = 13.96 cfs @ 12.11 hrs, Volume= 0.640 af
Outflow = 13.96 cfs @ 12.11 hrs, Volume= 0.640 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 6R: SW RAVINE



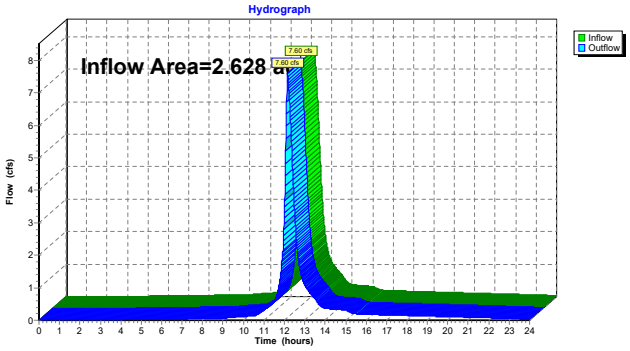
Summary for Reach 7R: NORTH STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.628 ac, 27.09% Impervious, Inflow Depth > 2.68" for 10YR-MSE3 event
Inflow = 7.60 cfs @ 12.15 hrs, Volume= 0.587 af
Outflow = 7.60 cfs @ 12.15 hrs, Volume= 0.587 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 7R: NORTH STORM SEWER



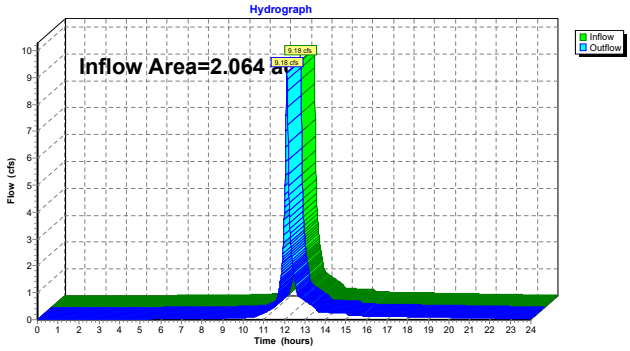
Summary for Reach 8R: NW OFFSITE

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.064 ac, 21.12% Impervious, Inflow Depth > 2.58" for 10YR-MSE3 event
Inflow = 9.18 cfs @ 12.14 hrs, Volume= 0.443 af
Outflow = 9.18 cfs @ 12.14 hrs, Volume= 0.443 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 8R: NW OFFSITE



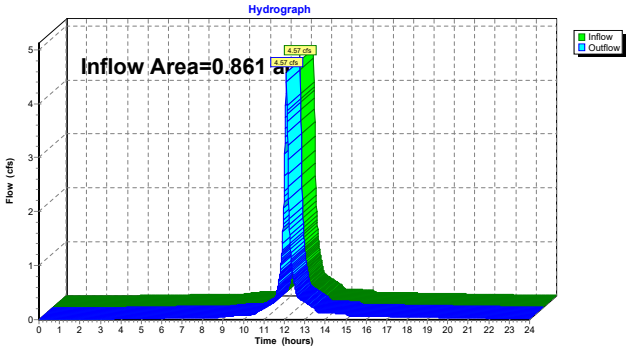
Summary for Reach 14R: SE STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.861 ac, 62.83% Impervious, Inflow Depth > 3.31" for 10YR-MSE3 event
Inflow = 4.57 cfs @ 12.10 hrs, Volume= 0.238 af
Outflow = 4.57 cfs @ 12.10 hrs, Volume= 0.238 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 14R: SE STORM SEWER



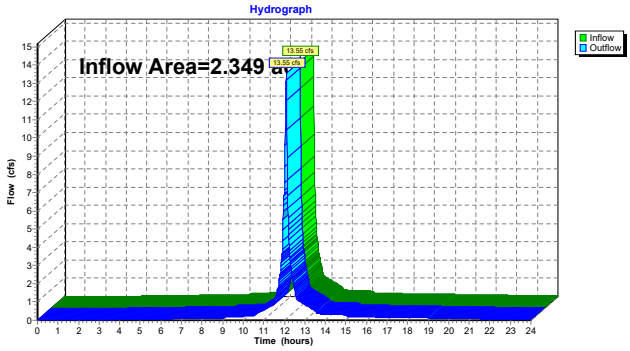
Summary for Reach 15R: SW RAVINE

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.349 ac, 60.32% Impervious, Inflow Depth > 3.27" for 10YR-MSE3 event
Inflow = 13.55 cfs @ 12.11 hrs, Volume= 0.640 af
Outflow = 13.55 cfs @ 12.11 hrs, Volume= 0.640 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 15R: SW RAVINE



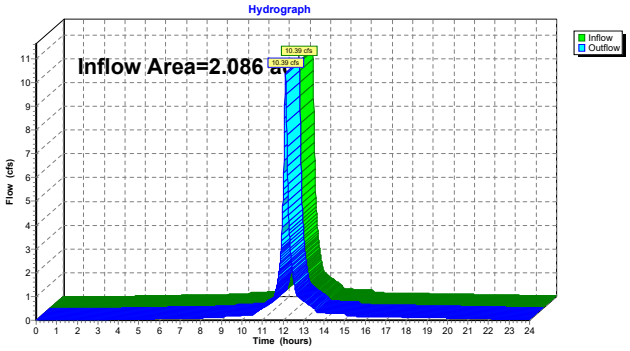
Summary for Reach 16R: MID-SITE STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.086 ac, 65.48% Impervious, Inflow Depth > 3.36" for 10YR-MSE3 event
Inflow = 10.39 cfs @ 12.13 hrs, Volume= 0.584 af
Outflow = 10.39 cfs @ 12.13 hrs, Volume= 0.584 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 16R: MID-SITE STORM SEWER



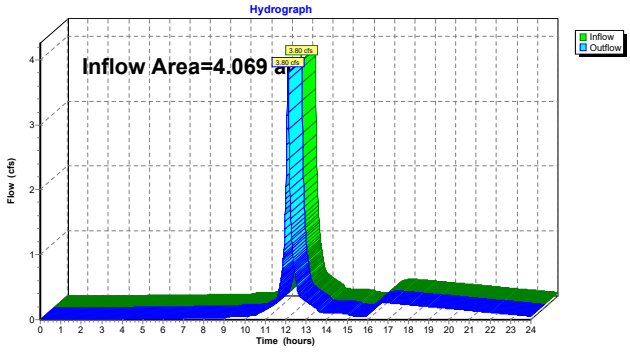
Summary for Reach 17R: NW Offsite

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.069 ac, 36.32% Impervious, Inflow Depth > 0.83" for 10YR-MSE3 event
Inflow = 3.80 cfs @ 12.12 hrs, Volume= 0.283 af
Outflow = 3.80 cfs @ 12.12 hrs, Volume= 0.283 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 17R: NW Offsite



Summary for Pond 3P: 96" DuroMaxx

Inflow Area = 3.303 ac, 33.51% Impervious, Inflow Depth > 2.80" for 10YR-MSE3 event
Inflow = 12.29 cfs @ 12.12 hrs, Volume= 0.769 af
Outflow = 0.21 cfs @ 16.90 hrs, Volume= 0.088 af, Atten= 98%, Lag= 286.8 min
Primary = 0.21 cfs @ 16.90 hrs, Volume= 0.088 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 859.09' @ 16.90 hrs Surf.Area= 3,069 sf Storage= 29,855 cf

Plug-Flow detention time= 571.7 min calculated for 0.088 af (11% of inflow)
Center-of-Mass det. time= 373.6 min (1,155.0 - 781.4)

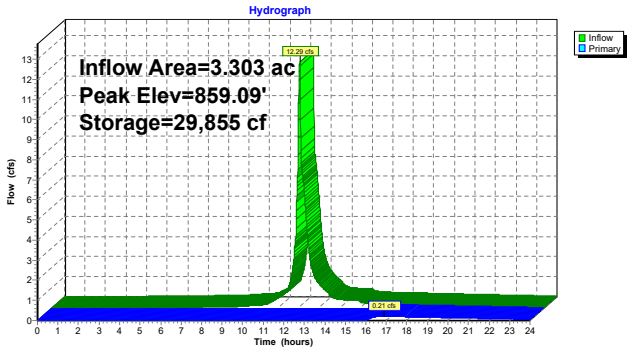
Volume	Invert	Avail.Storage	Storage Description
#1	859.00'	2,130 cf	**Above Ground - Overflow (Prismatic)**Listed below (Recalc)
#2	851.99'	321 cf	**35.4" Round CMP_Round 35.4" Header Row** L= 47.0'
#3	851.99'	402 cf	**35.4" Round CMP_Round 35.4" Header Connecters** L= 58.8'
#4	851.99'	30,685 cf	**94.5" Round CMP_Round 94.5"** L= 630.0'
		33,538 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
859.00	100	0	0
860.00	229	165	165
860.50	1,880	527	692
861.00	3,871	1,438	2,130

Device	Routing	Invert	Outlet Devices
#1	Primary	859.01'	**4.0' long x 5.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.35 2.51 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.69 2.73 2.77 2.86

Primary OutFlow Max=0.21 cfs @ 16.90 hrs HW=859.09' TW=0.00' (Dynamic Tailwater)
↑**1=Broad-Crested Rectangular Weir** (Weir Controls 0.21 cfs @ 0.66 fps)

Pond 3P: 96" DuroMaxx



Summary for Pond 20P: Existing Low Area

Inflow Area = 0.579 ac, 1.55% Impervious, Inflow Depth > 2.23" for 10YR-MSE3 event
Inflow = 2.59 cfs @ 12.12 hrs, Volume= 0.108 af
Outflow = 2.55 cfs @ 12.13 hrs, Volume= 0.108 af, Atten= 1%, Lag= 0.5 min
Primary = 2.55 cfs @ 12.13 hrs, Volume= 0.108 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 855.43' @ 12.13 hrs Surf.Area= 669 sf Storage= 77 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.3 min (801.8 - 801.5)

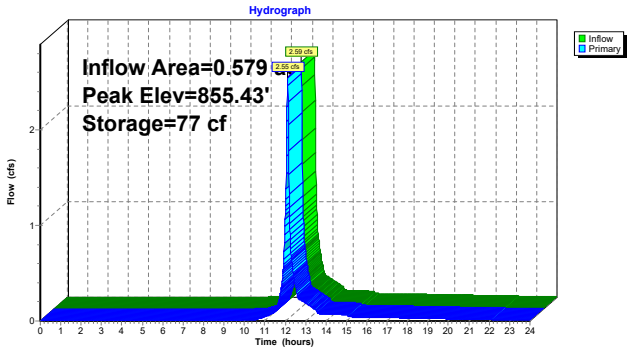
Volume	Invert	Avail.Storage	Storage Description
#1	855.20'	17,712 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
855.20	1	0	0
856.00	2,323	930	930
857.00	4,837	3,580	4,510
858.00	6,555	5,696	10,206
859.00	8,458	7,507	17,712

Device	Routing	Invert	Outlet Devices
#1	Primary	855.20'	**27.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.54 cfs @ 12.13 hrs HW=855.43' TW=0.00' (Dynamic Tailwater)
└**1=Orifice/Grate** (Weir Controls 2.54 cfs @ 1.57 fps)

Pond 20P: Existing Low Area



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentEX-1A: NW OFFSITE Runoff Area=0.355 ac 44.23% Impervious Runoff Depth>6.04"
Flow Length=174' Tc=6.4 min CN=WQ Runoff=3.51 cfs 0.179 af

SubcatchmentEX-1B: NW SITE Runoff Area=1.612 ac 13.28% Impervious Runoff Depth>5.39"
Flow Length=466' Tc=6.1 min CN=WQ Runoff=15.15 cfs 0.724 af

SubcatchmentEX-2A: NE OFFSITE Runoff Area=1.382 ac 22.50% Impervious Runoff Depth>5.58"
Flow Length=352' Tc=20.2 min CN=WQ Runoff=8.20 cfs 0.642 af

SubcatchmentEX-2B: NE SITE Runoff Area=0.667 ac 58.77% Impervious Runoff Depth>6.34"
Flow Length=290' Tc=10.2 min CN=WQ Runoff=5.83 cfs 0.353 af

SubcatchmentEX-2C: DIRECT Runoff Area=0.579 ac 1.55% Impervious Runoff Depth>5.14"
Flow Length=131' Tc=4.2 min CN=WQ Runoff=5.73 cfs 0.248 af

SubcatchmentEX-2D: N OFFSITE Runoff Area=0.046 ac 69.57% Impervious Runoff Depth>6.57"
Flow Length=250' Tc=8.7 min CN=WQ Runoff=0.44 cfs 0.025 af

SubcatchmentEX-2E: N OFFSITE Runoff Area=0.051 ac 64.71% Impervious Runoff Depth>6.47"
Flow Length=262' Tc=13.7 min CN=WQ Runoff=0.40 cfs 0.027 af

SubcatchmentEX-3A: MID-SITE Runoff Area=0.977 ac 100.00% Impervious Runoff Depth>7.21"
Flow Length=234' Slope=0.0025 '/' Tc=5.0 min CN=WQ Runoff=11.30 cfs 0.587 af

SubcatchmentEX-3B: MID-SITE Runoff Area=0.544 ac 38.42% Impervious Runoff Depth>5.92"
Flow Length=222' Tc=6.4 min CN=WQ Runoff=5.32 cfs 0.268 af

SubcatchmentEX-4A: SE OFFSITE Runoff Area=0.617 ac 65.64% Impervious Runoff Depth>6.49"
Flow Length=233' Tc=6.0 min CN=WQ Runoff=6.45 cfs 0.334 af

SubcatchmentEX-4B: SE SITE Runoff Area=0.258 ac 50.78% Impervious Runoff Depth>6.18"
Flow Length=125' Tc=1.2 min CN=WQ Runoff=2.95 cfs 0.133 af

SubcatchmentEX-5A: SW OFFSITE Runoff Area=1.432 ac 65.64% Impervious Runoff Depth>6.49"
Flow Length=215' Tc=2.8 min CN=WQ Runoff=16.53 cfs 0.774 af

SubcatchmentEX-5B: SW SITE Runoff Area=0.848 ac 66.51% Impervious Runoff Depth>6.51"
Flow Length=269' Tc=3.0 min CN=WQ Runoff=9.82 cfs 0.460 af

SubcatchmentPR-1A: NW OFFSITE Runoff Area=0.355 ac 44.23% Impervious Runoff Depth>6.04"
Flow Length=174' Tc=6.4 min CN=WQ Runoff=3.51 cfs 0.179 af

SubcatchmentPR-1B: NW SITE Runoff Area=0.314 ac 47.45% Impervious Runoff Depth>6.11"
Flow Length=164' Tc=3.2 min CN=WQ Runoff=3.49 cfs 0.160 af

SubcatchmentPR-2A: NE OFFSITE Runoff Area=1.382 ac 22.50% Impervious Runoff Depth>5.58"
Flow Length=352' Tc=20.2 min CN=WQ Runoff=8.20 cfs 0.642 af

SubcatchmentPR-2B: N SITE Runoff Area=1.611 ac 47.92% Impervious Runoff Depth>6.12"
Flow Length=208' Slope=0.0050 '/' Tc=4.1 min CN=WQ Runoff=17.49 cfs 0.821 af

SubcatchmentPR-2C: DIRECT Runoff Area=0.310 ac 7.74% Impervious Runoff Depth>5.27"
Flow Length=39' Slope=0.0260 '/' Tc=4.5 min CN=WQ Runoff=3.08 cfs 0.136 af

SubcatchmentPR-2D: N OFFSITE Runoff Area=0.046 ac 69.57% Impervious Runoff Depth>6.57"
Flow Length=250' Tc=8.7 min CN=WQ Runoff=0.44 cfs 0.025 af

SubcatchmentPR-2E: N OFFSITE Runoff Area=0.051 ac 64.71% Impervious Runoff Depth>6.47"
Flow Length=262' Tc=13.7 min CN=WQ Runoff=0.40 cfs 0.027 af

SubcatchmentPR-3A: MID-SITE Runoff Area=0.977 ac 100.00% Impervious Runoff Depth>7.21"
Flow Length=234' Slope=0.0025 '/' Tc=5.0 min CN=98 Runoff=11.30 cfs 0.587 af

SubcatchmentPR-3B: MID-SITE Runoff Area=1.109 ac 35.08% Impervious Runoff Depth>5.84"
Flow Length=135' Tc=9.7 min CN=WQ Runoff=9.41 cfs 0.540 af

SubcatchmentPR-4A: SE OFFSITE Runoff Area=0.617 ac 65.64% Impervious Runoff Depth>6.49"
Flow Length=233' Tc=6.0 min CN=WQ Runoff=6.45 cfs 0.334 af

SubcatchmentPR-4B: SE SITE Runoff Area=0.244 ac 55.74% Impervious Runoff Depth>6.28"
Flow Length=101' Tc=0.9 min CN=WQ Runoff=2.81 cfs 0.128 af

SubcatchmentPR-5A: SW OFFSITE Runoff Area=1.432 ac 66.90% Impervious Runoff Depth>6.51"
Flow Length=215' Tc=2.8 min CN=WQ Runoff=16.56 cfs 0.777 af

SubcatchmentPR-5B: SW SITE Runoff Area=0.917 ac 50.05% Impervious Runoff Depth>6.16"
Flow Length=141' Tc=5.2 min CN=WQ Runoff=9.61 cfs 0.471 af

Reach 1R: SE STORM SEWER Inflow=8.91 cfs 0.466 af
Outflow=8.91 cfs 0.466 af

Reach 2R: S STORM SEWER Inflow=19.69 cfs 1.127 af
Outflow=19.69 cfs 1.127 af

Reach 3R: S STORM SEWER Inflow=32.11 cfs 2.098 af
Outflow=32.11 cfs 2.098 af

Reach 4R: MID-SITE STORM SEWER Inflow=32.11 cfs 2.098 af
Outflow=32.11 cfs 2.098 af

Reach 6R: SW RAVINE Inflow=26.30 cfs 1.234 af
Outflow=26.30 cfs 1.234 af

Reach 7R: NORTH STORM SEWER Inflow=16.09 cfs 1.243 af
Outflow=16.09 cfs 1.243 af

Reach 8R: NW OFFSITE Inflow=19.38 cfs 0.955 af
Outflow=19.38 cfs 0.955 af

Reach 14R: SE STORM SEWER Inflow=8.74 cfs 0.461 af
Outflow=8.74 cfs 0.461 af

Reach 15R: SW RAVINE Inflow=25.97 cfs 1.248 af
Outflow=25.97 cfs 1.248 af

Reach 16R: MID-SITE STORM SEWER Inflow=19.69 cfs 1.127 af
Outflow=19.69 cfs 1.127 af

Reach 17R: NW Offsite Inflow=17.79 cfs 1.308 af
Outflow=17.79 cfs 1.308 af

Pond 3P: 96" DuroMaxx Peak Elev=860.23' Storage=31,711 cf Inflow=25.04 cfs 1.600 af
Outflow=14.30 cfs 0.917 af

Pond 20P: Existing Low Area Peak Elev=855.59' Storage=220 cf Inflow=5.73 cfs 0.248 af
Outflow=5.61 cfs 0.248 af

Total Runoff Area = 18.733 ac Runoff Volume = 9.581 af Average Runoff Depth = 6.14"
51.02% Pervious = 9.557 ac 48.98% Impervious = 9.176 ac

Summary for Subcatchment EX-1A: NW OFFSITE

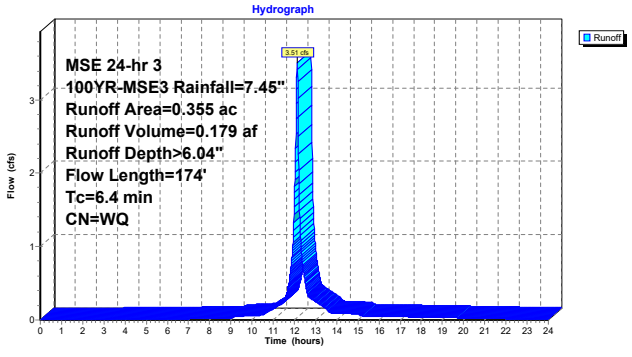
Runoff = 3.51 cfs @ 12.13 hrs, Volume= 0.179 af, Depth> 6.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.157	98	Impervious
	0.198	80	>75% Grass cover, Good, HSG D
	0.355		Weighted Average
	0.198		55.77% Pervious Area
	0.157		44.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	58	0.0343	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
0.9	116	0.0172	2.11		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.4	174	Total			

Subcatchment EX-1A: NW OFFSITE



Summary for Subcatchment EX-1B: NW SITE

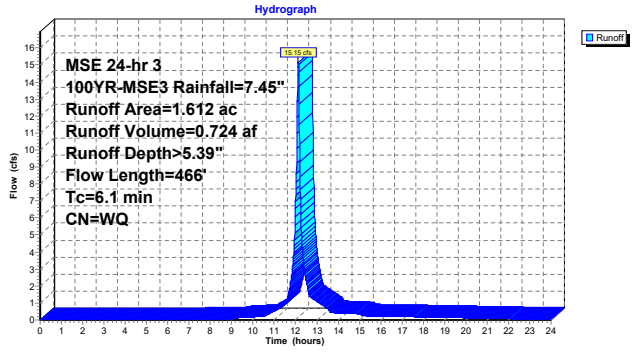
Runoff = 15.15 cfs @ 12.13 hrs, Volume= 0.724 af, Depth> 5.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.214	98	Impervious
	1.398	80	>75% Grass cover, Good, HSG D
	1.612		Weighted Average
	1.398		86.72% Pervious Area
	0.214		13.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	79	0.1280	2.56		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
5.6	387	0.0051	1.15		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.1	466	Total			

Subcatchment EX-1B: NW SITE



Summary for Subcatchment EX-2A: NE OFFSITE

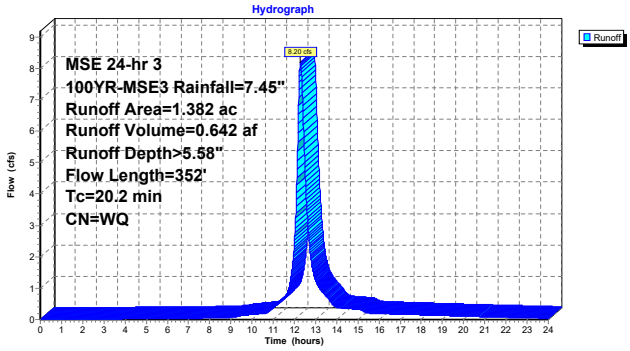
Runoff = 8.20 cfs @ 12.28 hrs, Volume= 0.642 af, Depth> 5.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.311	98	Impervious
	1.071	80	>75% Grass cover, Good, HSG D
	1.382		Weighted Average
	1.071		77.50% Pervious Area
	0.311		22.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.4	66	0.0029	0.07		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
3.8	286	0.0061	1.26		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
20.2	352	Total			

Subcatchment EX-2A: NE OFFSITE



Summary for Subcatchment EX-2B: NE SITE

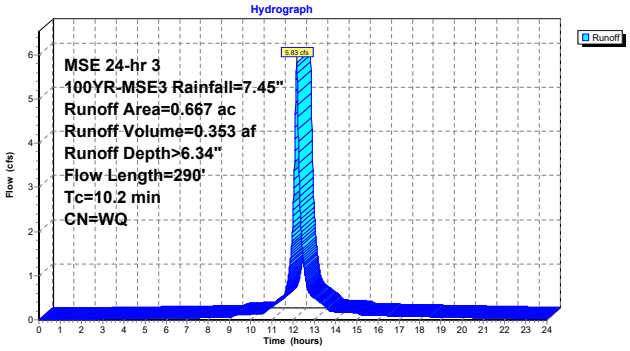
Runoff = 5.83 cfs @ 12.17 hrs, Volume= 0.353 af, Depth> 6.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.392	98	Impervious
	0.275	80	>75% Grass cover, Good, HSG D
	0.667		Weighted Average
	0.275		41.23% Pervious Area
	0.392		58.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	217	0.0106	6.12	10.81	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Concrete pipe, bends & connections
9.6	73	0.0137	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
10.2	290	Total			

Subcatchment EX-2B: NE SITE



Summary for Subcatchment EX-2C: DIRECT

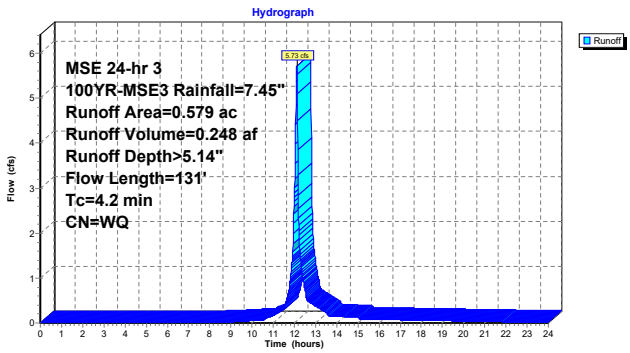
Runoff = 5.73 cfs @ 12.12 hrs, Volume= 0.248 af, Depth> 5.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.009	98	Impervious
	0.570	80	>75% Grass cover, Good, HSG D
	0.579		Weighted Average
	0.570		98.45% Pervious Area
	0.009		1.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	98	0.0620	4.01		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
3.8	33	0.0273	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
4.2	131	Total			

Subcatchment EX-2C: DIRECT



Summary for Subcatchment EX-2D: N OFFSITE

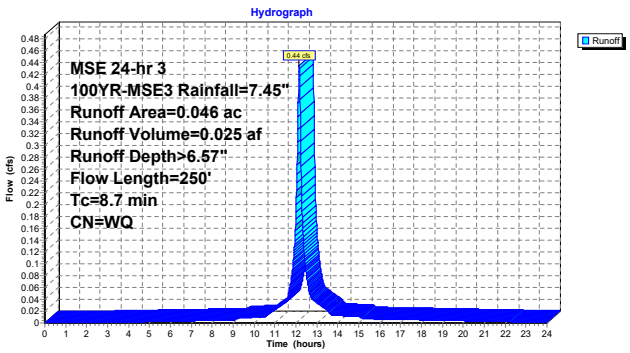
Runoff = 0.44 cfs @ 12.16 hrs, Volume= 0.025 af, Depth> 6.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.032	98	Impervious
	0.014	80	>75% Grass cover, Good, HSG D
	0.046		Weighted Average
	0.014		30.43% Pervious Area
	0.032		69.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	52	0.0189	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
2.3	198	0.0052	1.46		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.7	250	Total			

Subcatchment EX-2D: N OFFSITE



Summary for Subcatchment EX-2E: N OFFSITE

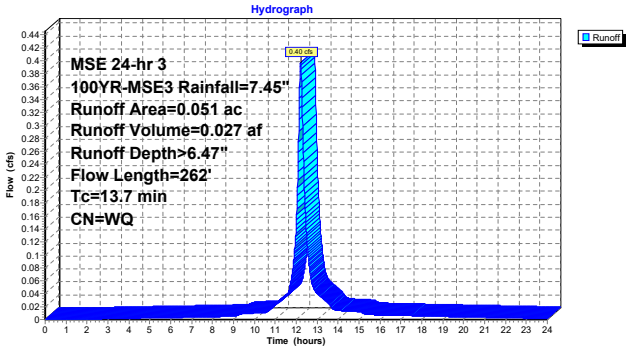
Runoff = 0.40 cfs @ 12.21 hrs, Volume= 0.027 af, Depth> 6.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.033	98	Impervious
	0.018	80	>75% Grass cover, Good, HSG D
	0.051		Weighted Average
	0.018		35.29% Pervious Area
	0.033		64.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.1	87	0.0109	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
1.6	175	0.0080	1.82		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
13.7	262	Total			

Subcatchment EX-2E: N OFFSITE



Summary for Subcatchment EX-3A: MID-SITE

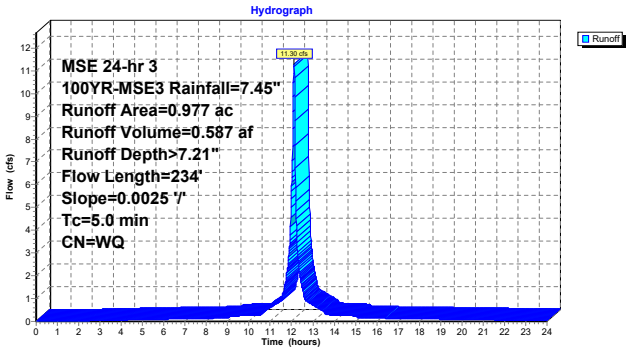
Runoff = 11.30 cfs @ 12.12 hrs, Volume= 0.587 af, Depth> 7.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.977	98	Impervious
	0.000	80	>75% Grass cover, Good, HSG D
	0.977		Weighted Average
	0.977		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	76	0.0025	0.53		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
2.6	158	0.0025	1.02		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
5.0	234	Total			

Subcatchment EX-3A: MID-SITE



Summary for Subcatchment EX-3B: MID-SITE

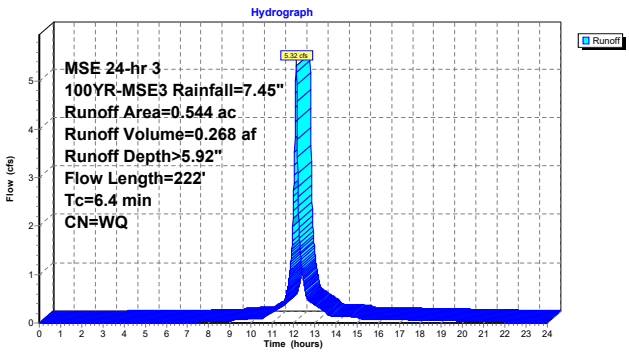
Runoff = 5.32 cfs @ 12.13 hrs, Volume= 0.268 af, Depth> 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.209	98	Impervious
	0.335	80	>75% Grass cover, Good, HSG D
	0.544		Weighted Average
	0.335		61.58% Pervious Area
	0.209		38.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	34	0.0174	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
1.7	188	0.0085	1.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.4	222	Total			

Subcatchment EX-3B: MID-SITE



Summary for Subcatchment EX-4A: SE OFFSITE

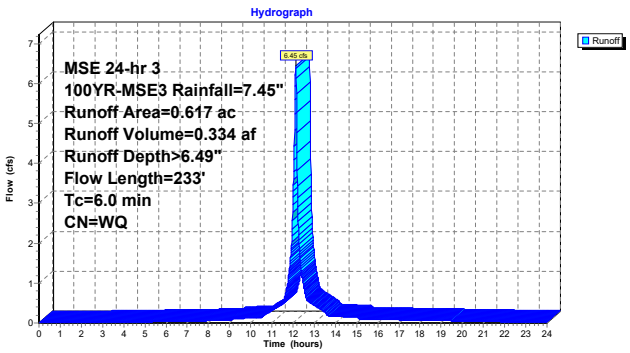
Runoff = 6.45 cfs @ 12.13 hrs, Volume= 0.334 af, Depth> 6.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.405	98	Impervious
	0.212	80	>75% Grass cover, Good, HSG D
	0.617		Weighted Average
	0.212		34.36% Pervious Area
	0.405		65.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	88	0.0216	1.28		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
4.9	145	0.0006	0.50		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.0	233	Total			

Subcatchment EX-4A: SE OFFSITE



Summary for Subcatchment EX-4B: SE SITE

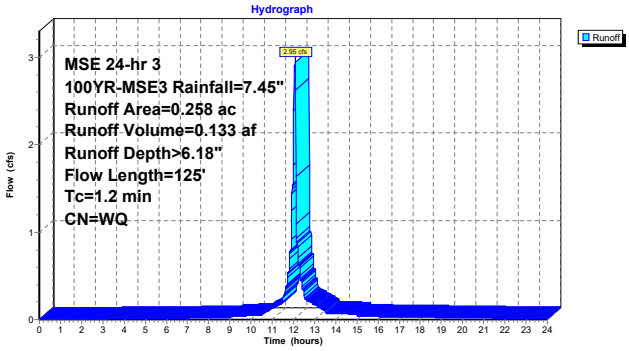
Runoff = 2.95 cfs @ 12.10 hrs, Volume= 0.133 af, Depth> 6.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

Area (ac)	CN	Description
* 0.131	98	Impervious
0.127	80	>75% Grass cover, Good, HSG D
0.258		Weighted Average
0.127		49.22% Pervious Area
0.131		50.78% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	31	0.0468	1.42		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
0.8	94	0.0134	1.86		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.2	125	Total			

Subcatchment EX-4B: SE SITE



Summary for Subcatchment EX-5A: SW OFFSITE

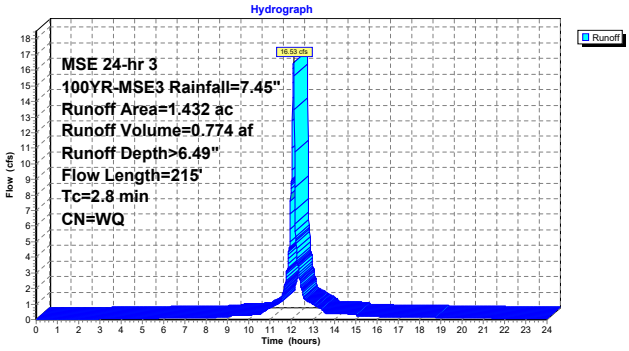
Runoff = 16.53 cfs @ 12.10 hrs, Volume= 0.774 af, Depth> 6.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

Area (ac)	CN	Description
* 0.940	98	Impervious
0.492	80	>75% Grass cover, Good, HSG D
1.432		Weighted Average
0.492		34.36% Pervious Area
0.940		65.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	21	0.0595	1.44		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
2.6	194	0.0039	1.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.8	215	Total			

Subcatchment EX-5A: SW OFFSITE



Summary for Subcatchment EX-5B: SW SITE

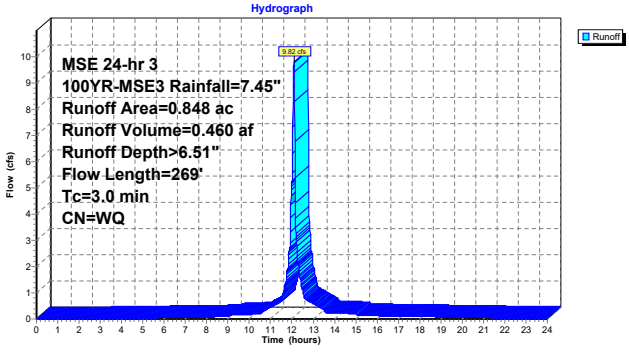
Runoff = 9.82 cfs @ 12.11 hrs, Volume= 0.460 af, Depth> 6.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

Area (ac)	CN	Description
* 0.564	98	Impervious
0.284	80	>75% Grass cover, Good, HSG D
0.848		Weighted Average
0.284		33.49% Pervious Area
0.564		66.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	78	0.0101	0.92		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
1.6	191	0.0099	2.02		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.0	269	Total			

Subcatchment EX-5B: SW SITE



Summary for Subcatchment PR-1A: NW OFFSITE

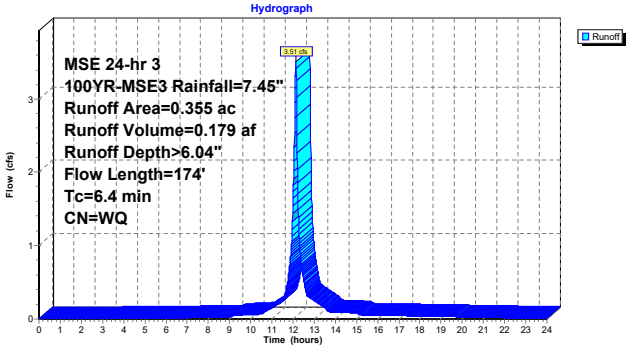
Runoff = 3.51 cfs @ 12.13 hrs, Volume= 0.179 af, Depth> 6.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

Area (ac)	CN	Description
* 0.157	98	Impervious
0.198	80	>75% Grass cover, Good, HSG D
0.355		Weighted Average
0.198		55.77% Pervious Area
0.157		44.23% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.5	58	0.0343	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
0.9	116	0.0172	2.11		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.4	174	Total			

Subcatchment PR-1A: NW OFFSITE



Summary for Subcatchment PR-1B: NW SITE

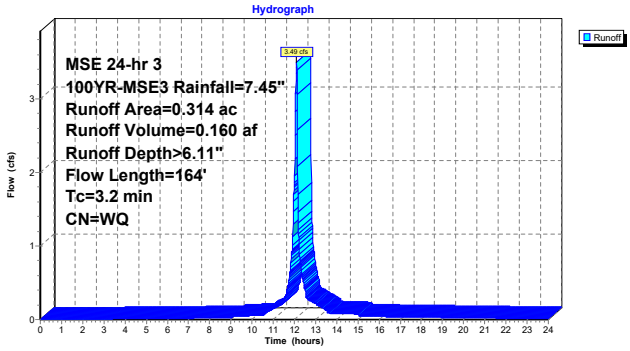
Runoff = 3.49 cfs @ 12.11 hrs, Volume= 0.160 af, Depth> 6.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.149	98	Impervious
	0.165	80	>75% Grass cover, Good, HSG D
	0.314		Weighted Average
	0.165		52.55% Pervious Area
	0.149		47.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	33	0.0803	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
0.7	131	0.0232	3.09		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.2	164	Total			

Subcatchment PR-1B: NW SITE



Summary for Subcatchment PR-2A: NE OFFSITE

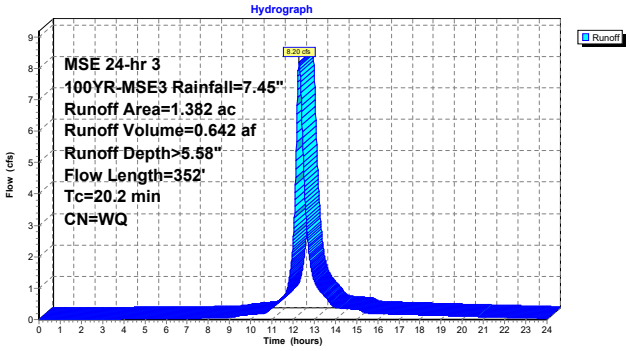
Runoff = 8.20 cfs @ 12.28 hrs, Volume= 0.642 af, Depth> 5.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.311	98	Impervious
	1.071	80	>75% Grass cover, Good, HSG D
	1.382		Weighted Average
	1.071		77.50% Pervious Area
	0.311		22.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.4	66	0.0029	0.07		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
3.8	286	0.0061	1.26		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
20.2	352	Total			

Subcatchment PR-2A: NE OFFSITE



Summary for Subcatchment PR-2B: N SITE

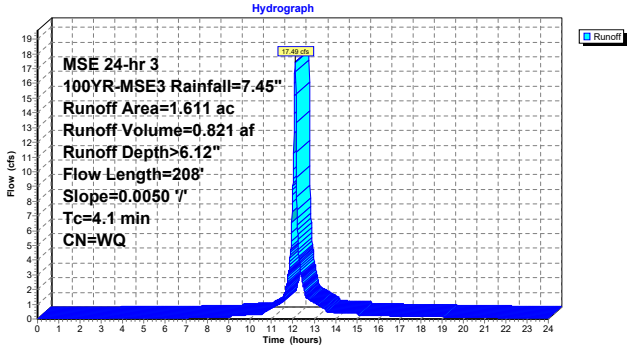
Runoff = 17.49 cfs @ 12.11 hrs, Volume= 0.821 af, Depth> 6.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.772	98	Impervious
	0.839	80	>75% Grass cover, Good, HSG D
	1.611		Weighted Average
	0.839		52.08% Pervious Area
	0.772		47.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.1	208	0.0050	0.85		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"

Subcatchment PR-2B: N SITE



Summary for Subcatchment PR-2C: DIRECT

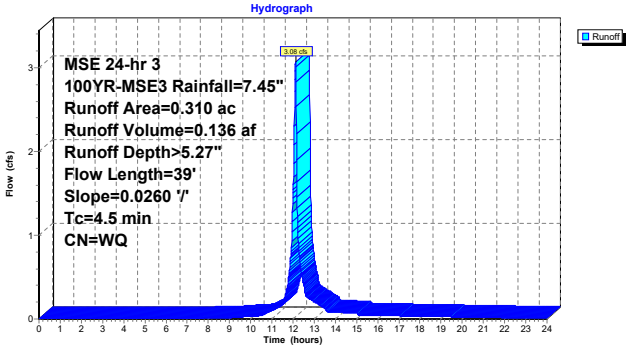
Runoff = 3.08 cfs @ 12.12 hrs, Volume= 0.136 af, Depth> 5.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.024	98	Impervious
	0.286	80	>75% Grass cover, Good, HSG D
	0.310		Weighted Average
	0.286		92.26% Pervious Area
	0.024		7.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	39	0.0260	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"

Subcatchment PR-2C: DIRECT



Summary for Subcatchment PR-2D: N OFFSITE

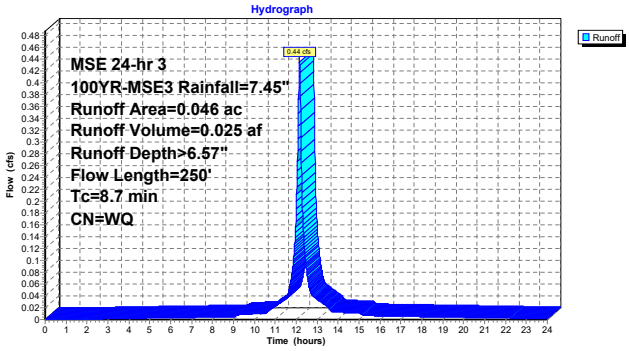
Runoff = 0.44 cfs @ 12.16 hrs, Volume= 0.025 af, Depth> 6.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.032	98	Impervious
	0.014	80	>75% Grass cover, Good, HSG D
	0.046		Weighted Average
	0.014		30.43% Pervious Area
	0.032		69.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	52	0.0189	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
2.3	198	0.0052	1.46		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
8.7	250	Total			

Subcatchment PR-2D: N OFFSITE



Summary for Subcatchment PR-2E: N OFFSITE

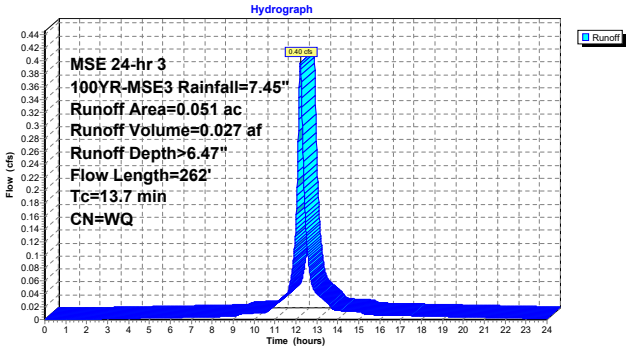
Runoff = 0.40 cfs @ 12.21 hrs, Volume= 0.027 af, Depth> 6.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.033	98	Impervious
	0.018	80	>75% Grass cover, Good, HSG D
	0.051		Weighted Average
	0.018		35.29% Pervious Area
	0.033		64.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.1	87	0.0109	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
1.6	175	0.0080	1.82		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
13.7	262	Total			

Subcatchment PR-2E: N OFFSITE



Summary for Subcatchment PR-3A: MID-SITE

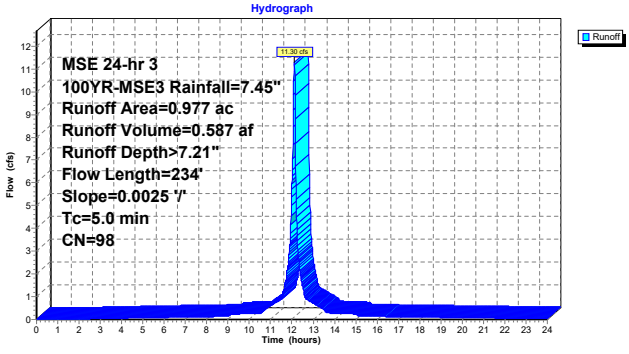
Runoff = 11.30 cfs @ 12.12 hrs, Volume= 0.587 af, Depth> 7.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.977	98	Impervious
	0.977		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	76	0.0025	0.53		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
2.6	158	0.0025	1.02		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
5.0	234	Total			

Subcatchment PR-3A: MID-SITE



Summary for Subcatchment PR-3B: MID-SITE

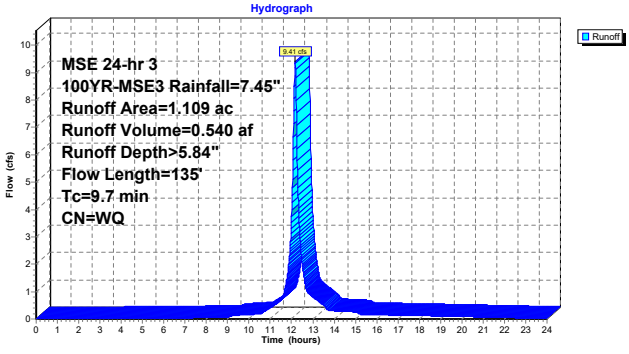
Runoff = 9.41 cfs @ 12.17 hrs, Volume= 0.540 af, Depth> 5.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.389	98	Impervious
	0.720	80	>75% Grass cover, Good, HSG D
	1.109		Weighted Average
	0.720		64.92% Pervious Area
	0.389		35.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	48	0.0065	0.09		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
0.5	87	0.0189	2.79		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
9.7	135	Total			

Subcatchment PR-3B: MID-SITE



Summary for Subcatchment PR-4A: SE OFFSITE

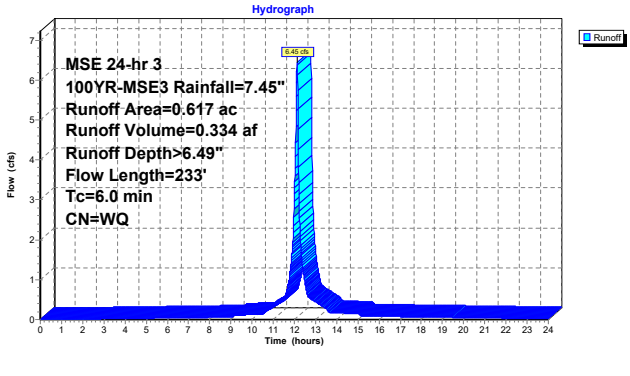
Runoff = 6.45 cfs @ 12.13 hrs, Volume= 0.334 af, Depth> 6.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.405	98	Impervious
	0.212	80	>75% Grass cover, Good, HSG D
	0.617		Weighted Average
	0.212		34.36% Pervious Area
	0.405		65.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	88	0.0216	1.28		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
4.9	145	0.0006	0.50		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
6.0	233	Total			

Subcatchment PR-4A: SE OFFSITE



Summary for Subcatchment PR-4B: SE SITE

[49] Hint: Tc<2dt may require smaller dt

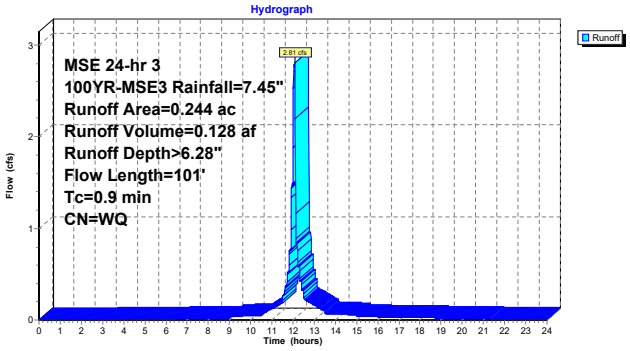
Runoff = 2.81 cfs @ 12.10 hrs, Volume= 0.128 af, Depth> 6.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.136	98	Impervious
	0.108	80	>75% Grass cover, Good, HSG D
	0.244		Weighted Average
	0.108		44.26% Pervious Area
	0.136		55.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	38	0.0297	1.23		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
0.4	63	0.0171	2.65		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	101	Total			

Subcatchment PR-4B: SE SITE



Summary for Subcatchment PR-5A: SW OFFSITE

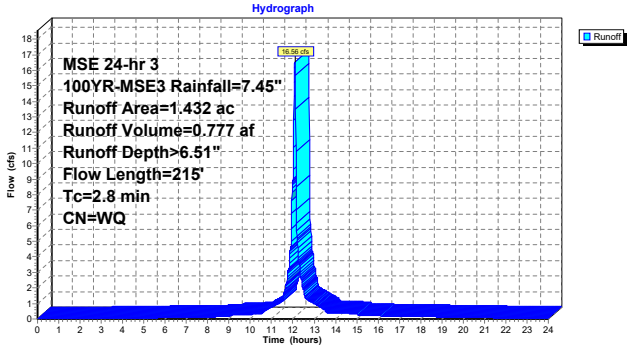
Runoff = 16.56 cfs @ 12.10 hrs, Volume= 0.777 af, Depth> 6.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.958	98	Impervious
	0.474	80	>75% Grass cover, Good, HSG D
	1.432		Weighted Average
	0.474		33.10% Pervious Area
	0.958		66.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	21	0.0595	1.44		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.75"
2.6	194	0.0039	1.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.8	215	Total			

Subcatchment PR-5A: SW OFFSITE



Summary for Subcatchment PR-5B: SW SITE

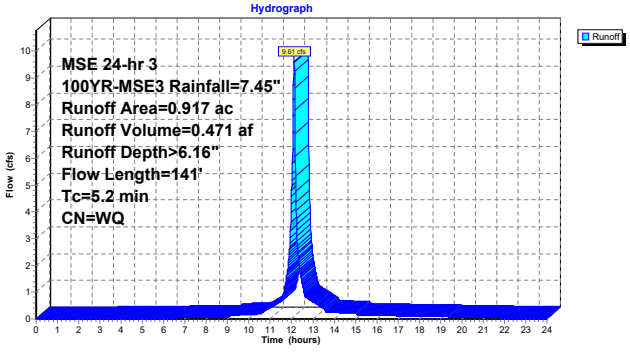
Runoff = 9.61 cfs @ 12.12 hrs, Volume= 0.471 af, Depth> 6.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100YR-MSE3 Rainfall=7.45"

	Area (ac)	CN	Description
*	0.459	98	Impervious
	0.458	80	>75% Grass cover, Good, HSG D
	0.917		Weighted Average
	0.458		49.95% Pervious Area
	0.459		50.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	48	0.0371	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.75"
0.6	93	0.0230	2.44		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
5.2	141	Total			

Subcatchment PR-5B: SW SITE



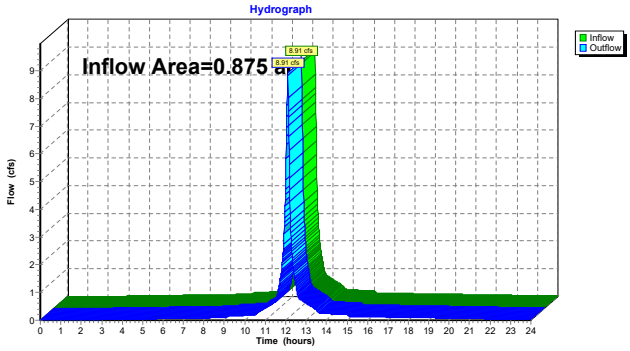
Summary for Reach 1R: SE STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.875 ac, 61.26% Impervious, Inflow Depth > 6.40" for 100YR-MSE3 event
Inflow = 8.91 cfs @ 12.10 hrs, Volume= 0.466 af
Outflow = 8.91 cfs @ 12.10 hrs, Volume= 0.466 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 1R: SE STORM SEWER



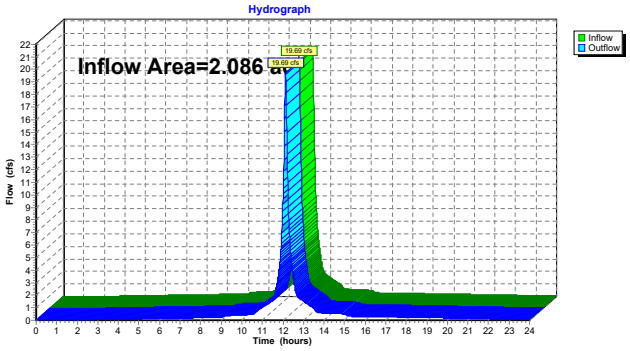
Summary for Reach 2R: S STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.086 ac, 65.48% Impervious, Inflow Depth > 6.48" for 100YR-MSE3 event
Inflow = 19.69 cfs @ 12.13 hrs, Volume= 1.127 af
Outflow = 19.69 cfs @ 12.13 hrs, Volume= 1.127 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 2R: S STORM SEWER



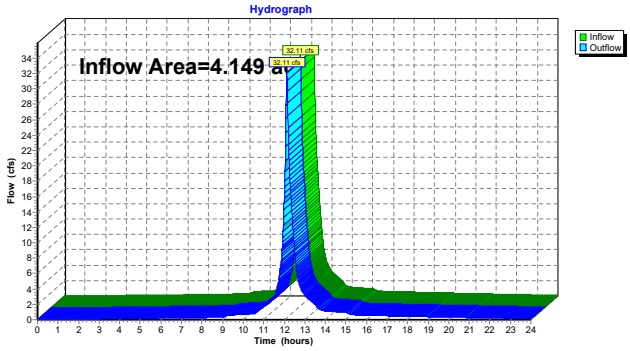
Summary for Reach 3R: S STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.149 ac, 45.75% Impervious, Inflow Depth > 6.07" for 100YR-MSE3 event
Inflow = 32.11 cfs @ 12.13 hrs, Volume= 2.098 af
Outflow = 32.11 cfs @ 12.13 hrs, Volume= 2.098 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 3R: S STORM SEWER



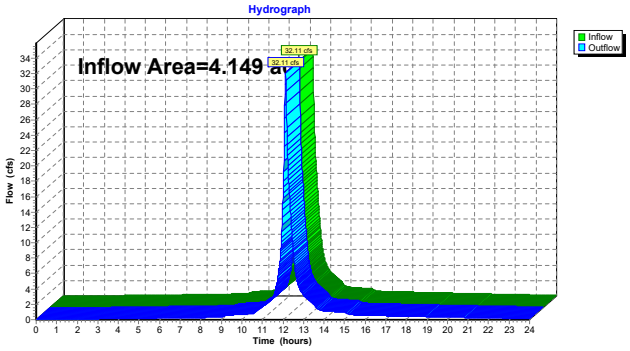
Summary for Reach 4R: MID-SITE STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.149 ac, 45.75% Impervious, Inflow Depth > 6.07" for 100YR-MSE3 event
Inflow = 32.11 cfs @ 12.13 hrs, Volume= 2.098 af
Outflow = 32.11 cfs @ 12.13 hrs, Volume= 2.098 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 4R: MID-SITE STORM SEWER



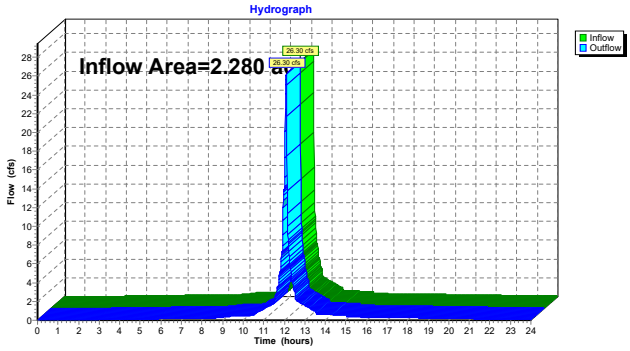
Summary for Reach 6R: SW RAVINE

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.280 ac, 65.96% Impervious, Inflow Depth > 6.50" for 100YR-MSE3 event
Inflow = 26.30 cfs @ 12.10 hrs, Volume= 1.234 af
Outflow = 26.30 cfs @ 12.10 hrs, Volume= 1.234 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 6R: SW RAVINE



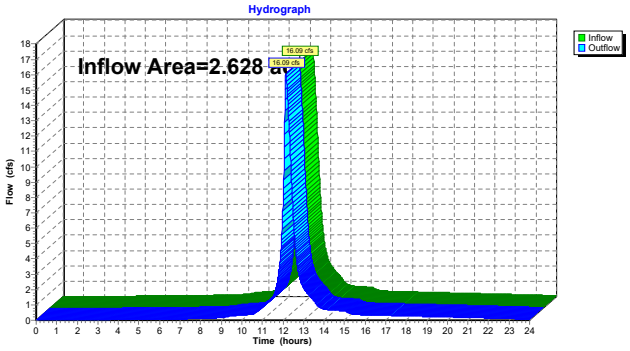
Summary for Reach 7R: NORTH STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.628 ac, 27.09% Impervious, Inflow Depth > 5.68" for 100YR-MSE3 event
Inflow = 16.09 cfs @ 12.15 hrs, Volume= 1.243 af
Outflow = 16.09 cfs @ 12.15 hrs, Volume= 1.243 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 7R: NORTH STORM SEWER



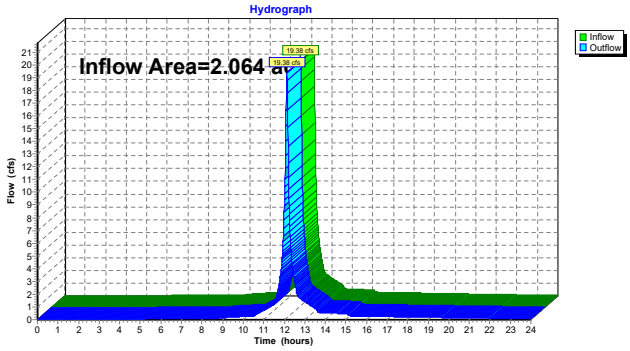
Summary for Reach 8R: NW OFFSITE

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.064 ac, 21.12% Impervious, Inflow Depth > 5.55" for 100YR-MSE3 event
Inflow = 19.38 cfs @ 12.13 hrs, Volume= 0.955 af
Outflow = 19.38 cfs @ 12.13 hrs, Volume= 0.955 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 8R: NW OFFSITE



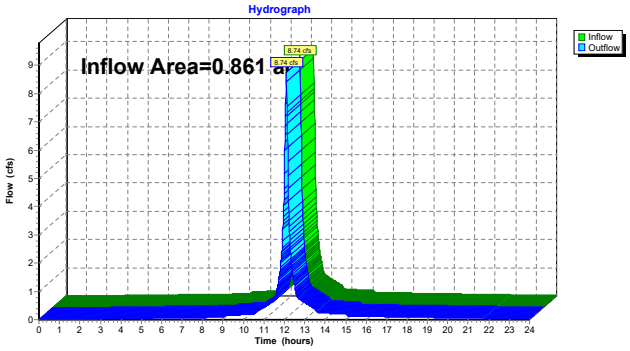
Summary for Reach 14R: SE STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.861 ac, 62.83% Impervious, Inflow Depth > 6.43" for 100YR-MSE3 event
Inflow = 8.74 cfs @ 12.10 hrs, Volume= 0.461 af
Outflow = 8.74 cfs @ 12.10 hrs, Volume= 0.461 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 14R: SE STORM SEWER



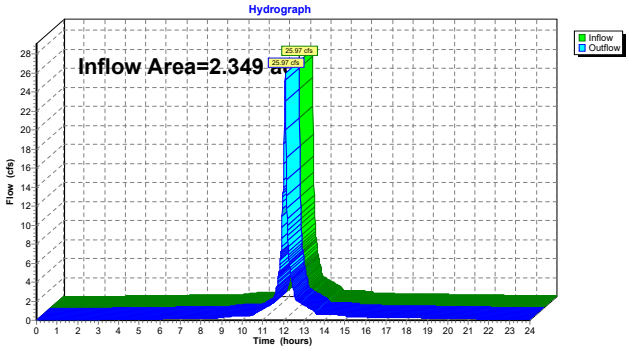
Summary for Reach 15R: SW RAVINE

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.349 ac, 60.32% Impervious, Inflow Depth > 6.38" for 100YR-MSE3 event
Inflow = 25.97 cfs @ 12.11 hrs, Volume= 1.248 af
Outflow = 25.97 cfs @ 12.11 hrs, Volume= 1.248 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 15R: SW RAVINE



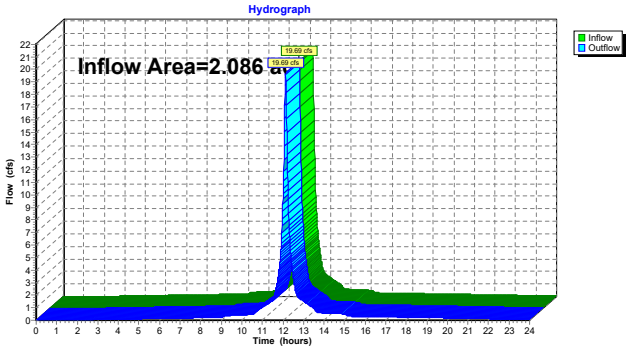
Summary for Reach 16R: MID-SITE STORM SEWER

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.086 ac, 65.48% Impervious, Inflow Depth > 6.48" for 100YR-MSE3 event
Inflow = 19.69 cfs @ 12.13 hrs, Volume= 1.127 af
Outflow = 19.69 cfs @ 12.13 hrs, Volume= 1.127 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 16R: MID-SITE STORM SEWER



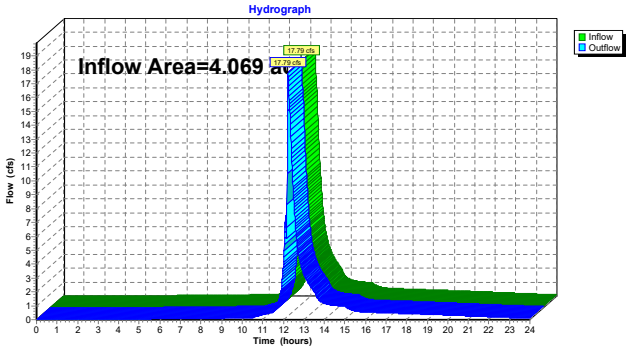
Summary for Reach 17R: NW Offsite

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.069 ac, 36.32% Impervious, Inflow Depth > 3.86" for 100YR-MSE3 event
Inflow = 17.79 cfs @ 12.22 hrs, Volume= 1.308 af
Outflow = 17.79 cfs @ 12.22 hrs, Volume= 1.308 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3

Reach 17R: NW Offsite



Summary for Pond 3P: 96" DuroMaxx

Inflow Area = 3.303 ac, 33.51% Impervious, Inflow Depth > 5.81" for 100YR-MSE3 event
Inflow = 25.04 cfs @ 12.12 hrs, Volume= 1.600 af
Outflow = 14.30 cfs @ 12.24 hrs, Volume= 0.917 af, Atten= 43%, Lag= 7.0 min
Primary = 14.30 cfs @ 12.24 hrs, Volume= 0.917 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 860.23' @ 12.24 hrs Surf.Area= 983 sf Storage= 31,711 cf

Plug-Flow detention time= 159.9 min calculated for 0.916 af (57% of inflow)
Center-of-Mass det. time= 78.4 min (850.6 - 772.2)

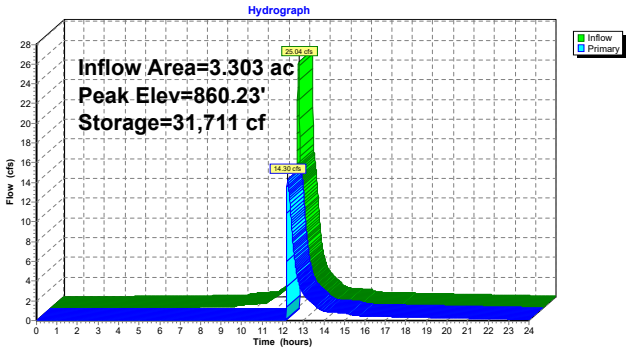
Volume	Invert	Avail.Storage	Storage Description
#1	859.00'	2,130 cf	**Above Ground - Overflow (Prismatic)**Listed below (Recalc)
#2	851.99'	321 cf	**35.4" Round CMP_Round 35.4" Header Row** L= 47.0'
#3	851.99'	402 cf	**35.4" Round CMP_Round 35.4" Header Connecters** L= 58.8'
#4	851.99'	30,685 cf	**94.5" Round CMP_Round 94.5"** L= 630.0'
		33,538 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
859.00	100	0	0
860.00	229	165	165
860.50	1,880	527	692
861.00	3,871	1,438	2,130

Device	Routing	Invert	Outlet Devices
#1	Primary	859.01'	**4.0' long x 5.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.35 2.51 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.69 2.73 2.77 2.86

Primary OutFlow Max=14.29 cfs @ 12.24 hrs HW=860.23' TW=0.00' (Dynamic Tailwater)
↑**1=Broad-Crested Rectangular Weir** (Weir Controls 14.29 cfs @ 2.93 fps)

Pond 3P: 96" DuroMaxx



Summary for Pond 20P: Existing Low Area

Inflow Area = 0.579 ac, 1.55% Impervious, Inflow Depth > 5.14" for 100YR-MSE3 event
Inflow = 5.73 cfs @ 12.12 hrs, Volume= 0.248 af
Outflow = 5.61 cfs @ 12.13 hrs, Volume= 0.248 af, Atten= 2%, Lag= 0.6 min
Primary = 5.61 cfs @ 12.13 hrs, Volume= 0.248 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 855.59' @ 12.13 hrs Surf.Area= 1,131 sf Storage= 220 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.4 min (785.7 - 785.3)

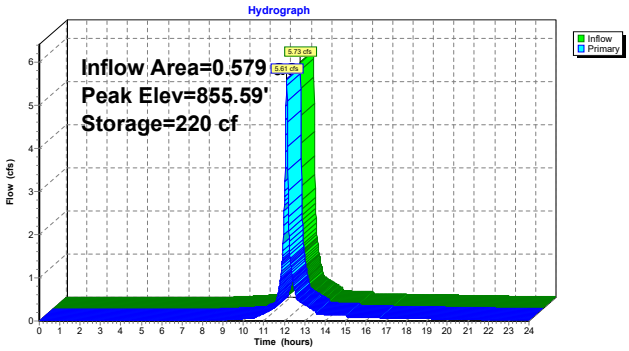
Volume	Invert	Avail.Storage	Storage Description
#1	855.20'	17,712 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
855.20	1	0	0
856.00	2,323	930	930
857.00	4,837	3,580	4,510
858.00	6,555	5,696	10,206
859.00	8,458	7,507	17,712

Device	Routing	Invert	Outlet Devices
#1	Primary	855.20'	**27.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=5.59 cfs @ 12.13 hrs HW=855.59' TW=0.00' (Dynamic Tailwater)
↑**1=Orifice/Grate** (Weir Controls 5.59 cfs @ 2.04 fps)

Pond 20P: Existing Low Area



Reuse Scenario Name		North Cistern
Watershed Input Parameters		
Watershed Area Tributary to Stormwater Reuse System	(acre)	3.3
Watershed Imperviousness* Tributary to Stormwater Reuse System *assumed to be directly-connected	(%)	34
Watershed Hydrologic Soil Group (HSG)		D
Stormwater Reuse System Input Parameters		
Estimated Reuse Storage Volume	(ac-ft)	0.721
	(cu-ft)	31408
	(gal)	234,948
Irrigation Application Area (ac)	(acre)	3.81
Irrigation Application Rate	(in/week)	1.0
	(ac-ft/day)	0.0454
Irrigation Season Start (month #)		5
Irrigation Season End (month #)		9
Does the system go offline and drain down at the end of the season?	(1=Yes / 0=No)	0
Stormwater Reuse Summary of Results - Stormwater Management		
Average Annual Precipitation	(in/yr)	27.7
Average Annual Watershed Runoff Volume	(ac-ft/yr)	2.89
Average Annual Runoff Coefficient		0.38
Average Annual Runoff Volume Reduction due to Stormwater Reuse for Irrigation	(ac-ft/yr)	2.3
	(%)	78.4
Average Annual Runoff Volume Bypassing the Reuse System (including Winterization Drawdown, if applicable)	(ac-ft/yr)	0.6
	(%)	21.6
Stormwater Reuse Summary of Results - Irrigation Demand		
Average Annual Irrigation Demand	(ac-ft/yr)	5.0
Average Annual Irrigation Demand met by Stormwater Reuse	(ac-ft/yr)	2.3
	(%)	45.1
Average Annual Irrigation Augmentation (from Potable Water Supply)	(ac-ft/yr)	2.8
	(%)	54.9
RWMWD Credit Factor For Stormwater Reuse		
Required Water Quality Volume for Watershed Based on RWMWD Rules (1.1 inch)	(ac-ft)	0.103
Average Annual Volume Reduction for an Infiltration System Sized to Meet the RWMWD Rules (Estimated by MIDS Calculator)	(%)	24.5
Average Annual Runoff Volume Reduction due to Stormwater Reuse for Irrigation	(%)	78.4
RWMWD Credit Factor For Stormwater Reuse		3.21
Reuse Storage Volume Provided	(ac-ft)	0.721
	(gal)	234948
	(cu-ft)	31408
Reuse Storage Volume that can be applied towards achieving the RWMWD Rules	(ac-ft)	0.234
	(gal)	76,168
	(cu-ft)	10182

Appendix 2. Geotechnical Report

AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
- ENVIRONMENTAL
- GEOTECHNICAL
- MATERIALS
- FORENSICS

REPORT OF GEOTECHNICAL EXPLORATION

St. Thomas STEAM Building

2330 Summit Avenue
St. Paul, Minnesota

AET No. 20-23322

Date:

January 26, 2021

Prepared for:

University of St. Thomas
2115 Summit Avenue
St. Paul, Minnesota 55105

www.amengtest.com

AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
- ENVIRONMENTAL
- GEOTECHNICAL
- MATERIALS
- FORENSICS

January 26, 2021

University of St. Thomas
2115 Summit Avenue
St. Paul, Minnesota 55105

Attn: James Brummer (brum4505@stthomas.edu)

RE: Geotechnical Exploration
St. Thomas STEAM Building
2330 Summit Avenue
St. Paul, Minnesota
AET No. 20-23322

Dear Mr. Brummer:

American Engineering Testing, Inc. (AET) is pleased to present the results of our subsurface exploration program and geotechnical engineering review for your STEAM building project in St. Paul, Minnesota. These services were performed according to our proposal to you dated November 2, 2020.

We are submitting one electronic (.pdf format) copy of the report to you. Additional copies are being sent on your behalf as noted below.

Please contact me if you have any questions about the report. I can also be contacted for arranging construction observation and testing services.

Sincerely,
American Engineering Testing, Inc.

Robin L. Flickinger
Senior Engineer/Manager
Phone: 651-659-1301
rflickinger@amengtest.com

cc: Dustin Schwake (dschwake@mcgough.com)

550 Cleveland Avenue North | St. Paul, MN 55114
Phone 651-659-9001 | Toll Free 800-972-6364 | Fax 651-659-1379 | www.amengtest.com | AA/EEO
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SIGNATURE PAGE

Prepared for:

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Attn: James Brummer

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Authored by:

Robin L. Flickinger
Senior Engineer

Reviewed by:

Thomas P. Venema, PE
Vice President/Principal Engineer

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under Minnesota Statute Section 326.02 to 326.15

Name: Thomas P. Venema

Date: January 26, 2021 **License #:13922**

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STANDARD SHEETS
Floor Slab Moisture/Vapor Protection
Basement/Retaining Wall Backfill and Water Control
Freezing Weather Effects on Building Construction
Bituminous Pavement Subgrade Preparation and Design

APPENDIX A – Geotechnical Field Exploration and Testing
Boring Log Notes
Unified Soil Classification System
Figure 1 - Boring Locations
Subsurface Boring Logs
Figure 2 - Utility Tunnel Design

APPENDIX B – Geotechnical Report Limitations and Guidelines for Use

1.0 INTRODUCTION

You are proposing to construct a new classroom and laboratory building at St. Thomas University in St. Paul, Minnesota. The project has been designated as the STEAM Building, a building for Science, Technology, Engineering, Arts and Math. To assist with planning and design, you have authorized American Engineering Testing, Inc. (AET) to conduct a subsurface exploration program at the site, conduct soil laboratory testing, and perform a geotechnical engineering review for the project. This report presents the results of the above services and provides our engineering recommendations based on this data.

2.0 SCOPE OF SERVICES

AET's services were performed according to our proposal to you dated November 2, 2020, which you authorized on November 16, 2020. The authorized scope consisted of the following:

- Performing 8 standard penetration test borings each to a depth of 30 feet.
- Select a boring to obtain a core sample of the Shale bedrock.
- Installing one piezometer to monitor the groundwater level.
- Conducting soil laboratory testing
- Performing a geotechnical engineering review based on the data and preparing this report

These services are intended for geotechnical purposes only. The scope is not intended to explore for the presence or extent of environmental contamination in the soil or groundwater.

3.0 PROJECT INFORMATION

The general location of the project site is on the west side of Cretin Avenue and north of the Grand Avenue extension. The new building will connect the west side of the existing Owens Science Hall, near Loras Hall. The Loras Hall building may be removed depending on the final design scheme of the structure. The site is to the north of the Facilities Building. We understand that the planned construction will be a new classroom and laboratory building. The building will have one level below grade with 4 levels above grade. The below grade elevation has been set at 848 feet, NGVD. All elevations in this report are referenced to National Geodetic Vertical Datum, NGVD. The building will be constructed with cast in place concrete walls below grade with a structural steel frame above grade. Based on the November 6, 2020 structural narrative prepared by BWBR

Architects, we understand that the typical wall footing loads will be on the order of 6 kips per lineal foot with column loads of up to 600 kips.

There will also be a Strong Floor (a 60 inch thick reinforced and post tensioned concrete slab) and Strong Wall (48 inches thick with reinforcement and post tensioning with rock anchors) that will need uplift resistance – we do not have the uplift loads at this time. The Strong Wall will be constructed over the Strong Floor with both used for projects requiring test loadings; anchorage points will set in the slab and wall. A basement area will be provided below for access to anchorage points for loading.

Our foundation design assumptions include a minimum factor of safety of 3 with respect to the ultimate bearing capacity. We assume the structure will be able to tolerate total settlements of up to 1 inch, and differential settlements over a 30-foot distance of up to ½ inch. Total settlements between the existing building and the new addition could also be up to 1 inch.

The above stated information represents our understanding of the proposed construction. This information is an integral part of our engineering review. It is important that you contact us if there are changes from that described so that we can evaluate whether modifications to our recommendations are appropriate.

4.0 SUBSURFACE EXPLORATION AND TESTING

4.1 Field Exploration Program

The subsurface exploration program conducted for the project consisted of 8 standard penetration test borings. The boring locations and depths were selected by your design team. The logs of the borings and details of the methods used appear in Appendix A. The logs contain information concerning soil layering, soil classification, geologic origins, and moisture condition. A density description or consistency is also noted for the natural soils, which is based on the standard penetration resistance (N-value).

We selected one boring, B-3, for diamond bit rock coring. We cored 20 feet into the shale bedrock formation. The core provides information about the consistency of the shale, weathering and the presence and thickness of limestone lenses ("stringers"). This information aids in selecting excavation techniques. A piezometer was set to a depth of 14½ feet adjacent to B-3 for groundwater level monitoring.

The boring locations are shown on Figure 1 in Appendix A. The borings were located in the field by AET personnel by spotting them based on nearby features. We then collected GPS Information for their locations and plotted them on a map from Google Earth. Surface elevations were measured in the field by AET personnel using an engineer's level. The benchmark reference was the main floor of the existing science building. We understand from the project narrative that the floor at that location is 864.0 feet.

4.2 Laboratory Testing

The laboratory test program included water content testing of selected samples. The test results appear in Appendix A on the individual boring logs adjacent to the samples upon which they were performed.

5.0 SITE CONDITIONS

5.1 Surface Observations

The site is currently occupied by a 4-story classroom building (Loras Hall) with surrounding landscaped areas and bituminous surface parking lots. The lowest level of Loras Hall appears to extend about 6 feet below surrounding grades. The site is fairly level with a slight slope from the east down towards the west. Elevations at our boring locations ranged from 862.1 at Boring 2 down to 859.8 feet at Boring 4.

5.2 Subsurface Soils/Geology

The site geology consists of fill overlying alluvial and till soils with Decorah shale as the primary underlying deposit.

5.2.1 Fill and Topsoil

We encountered fill and or topsoil at the surface of all of the boring locations extending to depths of 2 to about 4 feet. Deeper fill, to about 7 feet, was found at Boring B-7. The topsoil was below the fill at Borings 1 and 2. The fill and topsoil consist of a mixture of sandy lean clays, lean clays, clayey sands, and silty sands with varying amounts of organics and gravel. Borings 5 and 7 were taken in paved areas and we measured 5½ inches and 4 inches of bituminous over the fill. The N-values recorded in the fill and topsoil are variable; ranging from 4 to 62 blows per foot (bpf). We judge the fill and topsoil to have variable strength and compressibility. The silty and clayey fill soils are mostly slow draining and susceptible to freeze-thaw movements.

5.2.2 Coarse Alluvium

Coarse alluvial soils are present below the fill at all of the boring locations. The coarse alluvial soils consist of silty sands with gravel, sands with silt, sands, and clayey sands. Based on the N-values, these soils range from medium dense to very dense. The coarse alluvial soils are judged to have high strength and low compressibility. The alluvial sands and sands with silt are judged to be fast draining and to have low frost susceptibility. The silty sands and clayey sands are moderate to moderately fast draining and are susceptible to freeze thaw movements when exposed to freezing temperatures.

5.2.3 Fine Alluvium

Fine alluvial soils were encountered below the fill and topsoil at Borings 1, 4, and 8. These soils consist of silts with sand and sandy silts. Based on the N-values, these soils are in a loose to medium dense. The fine alluvial soils are judged to have low to moderate strength and high to moderate compressibility. The fine alluvial soils are judged to be slow draining and highly frost susceptible.

5.2.4 Till

Till soils were encountered in Boring 4. The till soils consist of gravelly clayey sands. We judge the till soils to have high strength and low compressibility. The till soils are slow draining and are susceptible to freeze-thaw movements when exposed to freezing temperatures.

5.2.5 Bedrock

Bedrock of the Decorah Shale formation is the primary underlying deposit. We encountered the Shale at depths of 6½ to 11½ feet below the ground surface, corresponding to elevation 850 to 853½ feet. The Decorah Shale is a green-gray calcareous shale with thinly bedded light gray limestone. The limestone layers ("stringers") encountered in our borings and core sample ranged from 1 to 3 inches in thickness. The Decorah shale has relatively high strength and relatively low compressibility for moderate foundation loading.

The Decorah shale can undergo volume changes with changes in water contents and due to elevated temperatures. When the water content in the shale increases, the shale could swell; the forces generated in swelling could lift relatively light structures or floor slabs. The swelling in the shale is more severe when the overburden soils are removed. The shale could also shrink, if it loses moisture content. Swell testing performed on samples for other projects at St. Thomas University suggested that a maximum swell of about 3% under no overburden pressure could occur, with no swell at confining pressures of about 4,000 to 6,000 pounds per square foot. Intermediate confining pressures could have a percent swell between 0 and 3%.

5.3 Groundwater

We encountered groundwater in Borings 4, 6, and 8 at depths of 10 to 12 feet below grade during drilling. Our experience with the parking ramp, South campus Facilities Building, McCarthy Gym Pool Renovation construction, and other borings drilled at the site; is that there are two groundwater levels. The first groundwater level occurs in the overburden soils above the shale bedrock and is at elevation 853 to 856 feet, about 6 to 8 feet below the ground surface. During construction of the structures mentioned above, groundwater was also encountered in the bedrock, at elevation 846 to 848 feet. The lower groundwater was present in the limestone seams in the clayey shale bedrock formation. The two groundwater tables acted independently of each other.

We installed a piezometer at Boring 3 on December 10, 2020 and measured the water level on December 18, 2020 at 10.5 feet below grade, elevation 850 feet. Groundwater level monitoring in piezometers and also monitoring of the pumping cycles of the McCarthy Gymnasium indicate that there are seasonal variations in the groundwater level, particularly in the upper groundwater in the overburden on top of the bedrock. The groundwater level is lower during the winter months, where there is no surface infiltration, and higher during the spring season or periods of heavy precipitation.

Groundwater levels fluctuate due to varying seasonal and annual rainfall and snow melt amounts, as well as other factors.

5.4 Stormwater Infiltration

Consideration is being given for stormwater infiltration at this site. The soils found in our borings consisted of cohesive silty sand and clayey sand fills to depths of 2 to 7 feet. Mostly cohesive soils naturally deposited soils, including clayey sands and silts, were found below the fill to the surface of shale bedrock. There were some layers of sand; these did not seem continuous. The bedrock depth was about 6½ to 11½ feet. This type of bedrock (shale) would be considered an impermeable layer. According to the Minnesota Stormwater Manual, the recommended design infiltration rate for a clayey sand soil type (SC) is 0.06 inches per hour. In our opinion, this type of soil is not conducive to rapid infiltration. Also we expect, based on our experience for adjacent projects, that perched groundwater conditions in the overburden soils above the bedrock will occur during wet periods of the year. In our opinion, based on the soil conditions, depth to bedrock and shallow groundwater conditions this site in not conducive to stormwater infiltration.

6.0 RECOMMENDATIONS

6.1 Approach Discussion

The proposed excavations for the STEAM building will be to depths of 12 to 16 feet below grade to construct footings and have the lower level slabs match the existing basement level elevation of the Owens Science building at 848 feet. Our soil borings indicate that this excavation will extend into the Decorah shale. Removal of the surface fill and overburden soils will be performed. In our experience at the campus, there is a potential that the surface fill could contain some environmental impacts; environmental testing would be needed to characterize the fill for offsite disposal or reuse on site. We anticipate that groundwater will be encountered in the overburden soils, when normal precipitation patterns are present. Groundwater will likely be encountered in the shale bedrock for excavations extending below about 848 to 850 feet.

In our opinion, the foundations for the STEAM building can be designed as spread footings bearing on the shale bedrock proportioned for a maximum bearing pressure of 12,000 psf. Where the buildings connect the new footings should match the elevation of the existing footings. We recommend that a minimum soil bearing pressure of 4,000 psf be used to resist the potential swelling of the bedrock. There is also a potential for swelling of the shale below the floor slabs

since this shale has been subjected to overburden pressure from the soils. We recommend that the shale be protected from changes in moisture content during construction of the foundation and floor slab to reduce the potential for swelling. Additional details and our recommendations will be presented in the following sections.

6.2 Building Grading

6.2.1 Excavation

Excavation of the overburden soils and excavation into the shale bedrock will be required for construction of the new building. Based on our experience with the adjacent parking ramp, South Campus Facilities Building and science buildings, excavation of the shale bedrock can be performed with a large backhoe with a toothed bucket. Final excavation of the shale to foundation base or floor slab grade elevation should be performed with a large backhoe with a smooth edged bucket. This will minimize disturbance of the foundation base and floor subgrade. We recommend over excavating the shale below the planned bottom of footing elevation to allow the placement of a 3 inch layer of lean concrete, or 6 inches of ½ to ¾ inch clear crushed aggregate immediately after excavation. We recommend that the lean concrete consist of conventional footing mix with a 3,000 psi design strength. If the crushed aggregate base is used, we recommend first placing a woven geotextile fabric over the shale, such as Mirafi 500X or equivalent. Alternatively, the foundations can be placed directly on the shale if it is not disturbed and kept moist/wet to maintain a stable moisture condition.

We also recommend over excavating the shale below the bottom of the lower level floor slabs for construction of a gravel drainage layer. Details on these recommendations will be presented in the following sections for floor slab design. Again, we recommend performing final excavation to subgrade elevation such that it could be covered with the geotextile and drainage aggregate as soon as possible after the shale is exposed.

The purpose of covering the shale immediately after final excavation, for both footings and floor slab, is to protect the exposed shale from changes in the moisture condition, which could lead to either swelling or shrinkage of the shale.

If the Loras Hall structure is to be demolished, we recommend that all of the building elements be removed. This includes all building elements such as lower level slabs, foundations and utilities. Any filling in the excavations after demolition should be coordinated with the proposed construction.

6.2.2 Construction Dewatering

Based on the conditions found in our borings and our experience at the adjacent parking ramp, South Campus Facilities Building and science building, dewatering will be required during excavation for the floor slab and foundations. Due to the presence of the shale at relatively shallow depths, it is our opinion that well points or wells would not be effective dewatering methods. Dewatering is typically performed by sump pits and pumps. Depending on the time of year, and precipitation patterns, we anticipate that groundwater will be encountered in the overburden soils above the surface of bedrock, which is at about elevation 850 to 853 feet. This groundwater should be pumped out prior to excavating into the shale. Groundwater will then likely be encountered in the shale, below about elevation 848 feet. This groundwater level could fluctuate, depending on location of the limestone seams (stringers) in shale bedrock formation. The groundwater in the shale bedrock is typically carried in the limestone stringers.

The crushed aggregate base discussed above that is placed below footings and below the floor slab, can be used for both construction dewatering and permanent dewatering. The drainage layer below the floor slab should be round gravel; crushed limestone has more of a potential to clog drains. The construction dewatering can be performed from temporary sump pumps and the permanent dewatering can be performed by drain pipes routed to an interior sump pump.

6.3 Foundation Design

In our opinion, footings bearing on a concrete mud mat or on the crushed aggregate base overlying competent Decorah shale can be proportioned for a maximum net allowable bearing capacity of 12,000 pounds per square foot (psf). If the shale is not disturbed and be maintained at a stable moisture content, the foundations can be cast directly on the shale. We recommend that a minimum bearing pressure of 4,000 psf be used for footings bearing on shale. Lower bearing pressures may be less than the swelling pressure of the shale, and if the shale increases in moisture content, the swelling could result in foundation heave. The factor of safety with respect to localized shear or base failure with the above bearing capacities would be at least 3.

Based on the above bearing pressures, we anticipate that post-construction foundation settlement, of the new foundations would not exceed ½ inch to ¾ of an inch. Differential settlement would be about ½ of the total settlement, over a distance of about 30 feet. The total settlement would be differential to connections to the existing building. Connections to the existing science building should allow for this settlement.

The building foundations will be at least 10 feet below the exterior grade and, therefore, will have adequate coverage for frost penetration. The interior foundations are within a heated space and would not be subjected to freezing. We recommend foundations for unheated building spaces (such as canopy or entryway foundations) be extended to a minimum of 60 inches below exterior grade.

Nine (3 at each corner of the "L" shaped Strong Wall) rock anchors will be installed to supply additional uplift resistance. The rock anchors are to be installed through the foundations. The anchorage bars are to be coupled to post tensioned anchor rods in the Strong Wall.

Depending upon the anchors chosen, values of up to 100 kips per anchor can be obtained with drilled lengths into the bedrock of about 20 to 30 feet. The rock anchor design is proprietary to the installation contractor; proof load testing should be performed after the anchor grout has gained sufficient strength. We recommend that an ultimate bond stress of 125 psi be assumed along the shale/grout interface. A factor of safety of 3 should be applied to this value. The center to center anchor spacing should be at least 4 feet.

6.4 Floor Slab Design

The excavation for the lower level slab will extend into the Decorah shale. As previously discussed in the excavation section of this report, the exposed shale should be protected by a geotextile fabric and drainage rock layer (open graded round gravel) as soon as possible after the shale is exposed. The floor slab loads would not likely be high enough to resist the swell pressures in the shale. If the swelling of the exposed shale were to occur, floor slab heave should not exceed 1 inch. Due to the possible differential movement (heave between the lower level slabs and foundations, we recommend that the lower level floor slabs be isolated from foundation elements. Our post construction observation of the adjacent parking ramp, South Campus Facilities Building and science building does not indicate that floor slab heave has occurred. We have not observed differential movements between the floor slab and foundation elements.

We recommend that the rock base be used as the drainage layer below the floor slab. Perforated drain pipes, 4 inches in diameter with a filter sock, should be placed in the rock drainage layer. The drainage pipes can be placed at a lateral spacing of 30 feet on center and connected to an interior sump pump. In our experience, we have observed two successful methods of casting the floor over the drainage layer. One method is to place a geotextile fabric on top of the drainage layer, and then place a well graded crushed aggregate, such as Class 5 road base, to form the floor slab subgrade. This allows for firm working surface for construction of the floor slab and for the placement of a vapor retarder. The vapor retarder should have a thickness of at least 10 mils, with the slab cast directly on the vapor retarder. In our experience, a thickness of 15 mils provides more durability during construction. The seams of the vapor retarder should be taped along with any protrusions and at the joint to the side walls.

The purpose of the vapor retarder is to reduce the potential for upward migration of water vapor from the soils/bedrock through the concrete slab. Water vapor migrating upward through the slab could damage the floor coverings, coatings, or sealers placed on the slab. For additional recommendations on moisture and vapor protection on slabs, please refer to the Standards Data Sheet at the end of this report entitled "Floor Slab Moisture/Vapor Protection."

Another method of slab placement is to place a 15 mil vapor retarder directly over the drainage rock layer. This subgrade is not as stable as the crushed rock Class 5 base, but it will allow placement of the slab. The placement of a geofabric below the vapor retarder aids in stability.

For floor slabs cast over the drainage rock on top the shale bedrock, with or without a well graded crushed rock base, we recommend using a modulus of subgrade reaction (K) of 260 pounds per cubic inch (pci) for the design of the slab. The concrete mix design should be selected to have a relatively low water-cement ratio and low curling and shrinkage potential. Concrete tends to curl and shrink more than normal if placed directly over a vapor retarder if the mix design is not adjusted.

6.5 Basement Backfilling/Water Control

We recommend the backfill placed around the below-grade walls consist of sands (SP) having no more than 5% of the particles (by weight) finer than the #200 sieve and no more than 40% finer than the #40 sieve. This type of sand will provide proper drainage and ease of compaction. The zone of sand backfill should be of consistent width, extending outward from the wall at least 5 feet from vertical.

Assuming that the lower level slabs will be constructed prior to backfilling, and the below-grade walls will not be allowed any rotation, the at-rest condition should be used for design of the walls. In this situation, if the zone of sand backfill extends outward from the wall at least 5 feet at bottom-of-footing grade, and then extends upward nearly vertical, the walls should be designed using an equivalent fluid weight lateral earth pressure of 75 pcf.

We recommend the lower level floor slab be constructed prior to backfilling the basement walls, and that all walls be properly braced. Assuming the free-draining sand backfill is used, we recommend using an equivalent fluid weight passive lateral pressure of 300 pcf and a friction factor of 0.35 for resistance to sliding on the shales or 0.45 for the crushed aggregate base or sand fill. We recommend using a factor of safety of at least 1.5 for sliding resistance and 2.0 for the passive lateral pressure resistance as the passive resistance requires an inch or more of movement to become fully engaged.

All backfill around the building which will support sidewalks, stoops, planters, or similar structural elements should be compacted to at least 95% of the Standard Proctor maximum dry density per ASTM: D698. Fill placed in landscaped areas can be compacted to a reduced level of 90%. If the backfill will be below pavement areas, we recommend increasing the compaction level to 100% in the top 3 feet of the subgrade. Care should be taken not to over-compact the backfill or use large equipment which could damage the foundation and basement walls or impart excessive lateral pressures.

We refer you to the standard sheet entitled “Basement/Retaining Wall Backfill and Water Control” at the end of this report for further details. It will be very important that these details be incorporated into the design, and that construction monitoring be performed to determine that proper materials and construction is implemented.

6.6 Tunnel Considerations

Utility tunnels are proposed to connect the STEAM building to the Owens Science Hall to the east and the also to the Facilities Building to the south. The tunnels will be below grade and connect to the basement levels of the structures. The elevation of the connection may vary from basement elevation 848 feet or higher. A standard detail for the tunnels has been used by the university (attached) which requires an inside dimension of the tunnel to be 6 feet wide by 7 feet in height. The tunnels are constructed of cast in place concrete with water stops at all construction joints. The tunnels are to be designed with waterproofing and will be "watertight", with a perimeter drain placed on the outside of the walls at foundation level. The tunnel base slab will be cast over a concrete mud slab that has been placed over a vapor retarder. As previously discussed there can be two ground water levels encountered, one above the bedrock at elevation 853 to 856 feet, and one in the bedrock from about 846 to 850 feet.

In our opinion the above design is appropriate for the soil and bedrock conditions. The bearing pressure for the tunnel base slab will be relatively light and consist of the weight of the tunnel structure, utilities and overburden pressure (including any surcharges) above the tunnel roof. Depending upon the amount of overburden we estimate that the base slab pressure could vary from about 500 to 1000 psf. A check for possible uplift from groundwater pressure should be performed as part of the design.

We recommend that the base slab be supported over naturally deposited overburden soils or over the shale bedrock if placed at an elevation that encounters bedrock. We recommend that any existing fill be removed below the tunnel base slab and be replaced with compacted granular fill, such as MnDOT 3149.2B.2 compacted to at least 98% of the maximum Standard Proctor dry density.

For the tunnel base slab supported over the shale bedrock it is important that the shale be protected from moisture changes to reduce the potential for shrinkage, from drying, which could later cause swelling with an increase in moisture. We expect that the bedrock will be in a wet condition upon excavation. The placement of the vapor retarder and mud slab in an expeditious manner will help maintain a stable moisture condition in the shale. Dewatering for placement of the base slab may need to be performed; the dewatering should be done in such a way not to cause uplift below the mud slab; the dewatering may need timed with the base slab placement. We recommend following the perimeter drainpipe, soil backfill, and design parameter recommendations presented in **Section 6.5** for the wall backfill.

6.7 Exterior Building Backfilling

Many of the on-site soils are at least moderately frost susceptible. Because of this, certain design considerations are needed to mitigate these frost effects. For details, we refer you to the attached sheet entitled "Freezing Weather Effects on Building Construction."

6.8 Pavements

6.8.1 Subgrade Preparation

We recommend excavation of all surface vegetation and "topsoil type" fill, and all existing pavements from below all new pavement areas, to expose the underlying silty sands or clayey sands. Existing non-organic fill can remain in place if in a stable condition.

Pavement subgrade fill should consist of sands or silty sands having no more than 15% of the particles finer than the #200 sieve. Fill should not be placed over frozen soils and frozen soils should not be used as fill.

Fill below the pavements should be placed and compacted to at least 95% of its Standard Proctor maximum dry density. If the fill is within the upper 3 feet of the subgrade, we recommend the compaction level be increased to 100%. We recommend that clayey soils not be used as fill in the upper 3 feet of the pavement subgrade.

6.8.2 Subgrade Stability and Test Roll

Subgrade stability within the upper 3 feet of the subgrade (*critical subgrade zone)* is important for proper pavement support, construction, and performance. Stability of the subgrade soils should be evaluated using the test roll procedure before placement of the aggregate base layers. If sands are used as fill, or exist as the subgrade soils, it may be best to do the test roll after the aggregate base is placed and compacted. The test roll should be conducted using a loaded, tandem-axle dump truck that makes repeated passes over the subgrade to evaluate the soils for excessive deflection or instability; an indicator that these soils will not provide suitable subgrade support. Unstable or weak soils should be removed and replaced; or be aerated, dried and recompacted back into place as recommended by AET geotechnical personnel. After passing the test roll procedure, the aggregate base can be placed and compacted.

6.8.3 Bituminous Pavement Section Thicknesses

Table 6.8.3 below presents recommended bituminous pavement designs based on two potential traffic situations (light and heavy duty). The light duty design should be used for pavements which are intended only for automobiles and passenger trucks/vans. The heavy duty design should be used in drive lanes and pavements which will experience the heavier truck traffic (up to 10-ton design load). The designs are based on a silty sand subgrade, prepared as recommended previously.

Table 6.8.3 – Pavement Thickness Designs (Assuming Silty Sand Subgrade)

Material	Section Thickness	
	Light Duty	**Heavy Duty**
Bituminous Wear Layer	1½ inches	2 inches
Bituminous Base Layer	2 inches	2½ inches
Class 5 or 6 Aggregate Base	8 inches	10 inches

We recommend the base layer be a mix meeting MnDOT SPWEA330-C using a 58S-34 oil, the wear course should meet MnDOT SPWEA330 using a 58V-34 oil (F-Oil)

6.8.4 Pavement Maintenance

Even if placed and compacted properly on stable subgrade conditions, bituminous pavements will still experience cracking in 1 to 3 years, primarily due to temperature-related expansion and shrinkage. We recommend that a regularly scheduled maintenance program consisting of patching of cracks and local distressed areas be implemented. Seal coating of the pavement surface after 3 to 5 years often helps prolong the pavement life.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Potential Difficulties

7.1.1 Runoff Water in Excavation

Water can be expected to collect in the excavation bottoms during times of inclement weather or snow melt. To allow observation of the excavation bottoms, to reduce the potential for soil disturbance, and to facilitate filling operations, we recommend water be removed from within the excavations during construction. Based on the soils and bedrock encountered, we anticipate the groundwater can be handled with conventional sump pumping.

7.1.2 Disturbance of Soils

The on-site soils and shales can be disturbed under construction traffic, especially if the soils are wet. If soils become disturbed, they should be subcut to the underlying undisturbed soils. The subcut soils can then be dried and recompacted back into place, or they should be removed and replaced with drier imported fill. Any disturbed shale below foundations should be removed and replaced with the recommended gravel or concrete. Disturbed shale for the floor slab subgrade should be replaced with gravel.

7.1.3 Cobbles and Boulders

The soils in overburden at this site can include cobbles and boulders. As discussed in report, we anticipate that the shale bedrock can be excavated with a large backhoe with toothed bucket. Final excavation to floor slab and foundation subgrade surfaces should be performed with a backhoe with a smooth edged bucket to minimize disturbance.

7.2 Excavation Backsloping

If excavation faces are not retained, the excavations should maintain maximum allowable slopes in accordance with *OSHA Regulations (Standards 29 CFR), Part 1926, Subpart P, "Excavations"* (can be found on www.osha.gov). Even with the required OSHA sloping, water seepage or surface runoff can potentially induce sideslope erosion or sloughing which could require slope maintenance.

7.3 Observation and Testing

The recommendations in this report are based on the subsurface conditions found at our test boring locations. Since the soil and bedrock conditions can be expected to vary away from the soil boring locations, we recommend on-site observation by a geotechnical engineer/technician during construction to evaluate these potential changes. Soil density testing should also be performed on new fill placed in order to document that project specifications for compaction have been satisfied.

8.0 ASTM STANDARDS

When we refer to an ASTM Standard in this report, we mean that our services were performed in general accordance with that standard. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.

9.0 LIMITATIONS

Within the limitations of scope, budget, and schedule, we have endeavored to provide our services according to generally accepted geotechnical engineering practices at this time and location. Other than this, no warranty, express or implied, is intended.

Important information regarding risk management and proper use of this report is given in Appendix B entitled “Geotechnical Report Limitations and Guidelines for Use.”

FLOOR SLAB MOISTURE/VAPOR PROTECTION

Floor slab design relative to moisture/vapor protection should consider the type and location of two elements, a granular layer and a vapor membrane (vapor retarder, water resistant barrier or vapor barrier). In the following sections, the pros and cons of the possible options regarding these elements will be presented, such that you and your specifier can make an engineering decision based on the benefits and costs of the choices.

GRANULAR LAYER

In American Concrete Institute (ACI) 302.1R-04, a "base material" is recommended over the vapor membrane, rather than the conventional clean "sand cushion" material. The base layer should be a minimum of 4 inches (100 mm) thick, trimmable, compactable, granular fill (not sand), a so-called crusher-run material. Usually graded from 1½ inches to 2 inches (38 to 50 mm) down to rock dust is suitable. Following compaction, the surface can be choked off with a fine-grade material. We refer you to ACI 302.1R-04 for additional details regarding the requirements for the base material.

In cases where potential static water levels or significant perched water sources appear near or above the floor slab, an under floor drainage system may be needed wherein a draintile system is placed within a thicker clean sand or gravel layer. Such a system should be properly engineered depending on subgrade soil types and rate/head of water inflow.

VAPOR MEMBRANE

The need for a vapor membrane depends on whether the floor slab will have a vapor sensitive covering, will have vapor sensitive items stored on the slab, or if the space above the slab will be a humidity controlled area. If the project does not have this vapor sensitivity or moisture control need, placement of a vapor membrane may not be necessary. Your decision will then relate to whether to use the ACI base material or a conventional sand cushion layer. However, if any of the above sensitivity issues apply, placement of a vapor membrane is recommended. Some floor covering systems (adhesives and flooring materials) require installation of a vapor membrane to limit the slab moisture content as a condition of their warranty.

VAPOR MEMBRANE/GRANULAR LAYER PLACEMENT

A number of issues should be considered when deciding whether to place the vapor membrane above or below the granular layer. The benefits of placing the slab on a granular layer, with the vapor membrane placed **below** the granular layer, include **reduction** of the following:

- Slab curling during the curing and drying process.
- Time of bleeding, which allows for quicker finishing.
- Vapor membrane puncturing.
- Surface blistering or delamination caused by an extended bleeding period.
- Cracking caused by plastic or drying shrinkage.

The benefits of placing the vapor membrane over the granular layer include the following:

- A lower moisture emission rate is achieved faster.
- Eliminates a potential water reservoir within the granular layer above the membrane.
- Provides a "slip surface", thereby reducing slab restraint and the associated random cracking.

If a membrane is to be used in conjunction with a granular layer, the approach recommended depends on slab usage and the construction schedule. The vapor membrane should be placed above the granular layer when:

- Vapor sensitive floor covering systems are used or vapor sensitive items will be directly placed on the slab.
- The area will be humidity controlled, but the slab will be placed before the building is enclosed and sealed from rain.
- Required by a floor covering manufacturer's system warranty.

The vapor membrane should be placed below the granular layer when:

- Used in humidity controlled areas (without vapor sensitive coverings/stored items), with the roof membrane in place, and the building enclosed to the point where precipitation will not intrude into the slab area. Consideration should be given to slight sloping of the membrane to edges where draintile or other disposal methods can alleviate potential water sources, such as pipe or roof leaks, foundation wall damp proofing failure, fire sprinkler system activation, etc.

There may be cases where membrane placement may have a detrimental effect on the subgrade support system (e.g., expansive soils). In these cases, your decision will need to weigh the cost of subgrade options and the performance risks.

BASEMENT/RETAINING WALL BACKFILL AND WATER CONTROL

DRAINAGE

Below grade basements should include a perimeter backfill drainage system on the exterior side of the wall. The exception may be where basements lie within free draining sands where water will not perch in the backfill. Drainage systems should consist of perforated or slotted PVC drainage pipes located at the bottom of the backfill trench, lower than the interior floor grade. The drain pipe should be surrounded by properly graded filter rock. A geosynthetic "filter fabric" should then envelope the filter rock. The drain pipe should be connected to a suitable means of disposal, such as a sump basket or a gravity outfall. A storm sewer gravity outfall would be preferred over exterior daylighting, as the latter may freeze during winter. For non-building, exterior retaining walls, weep holes at the base of the wall can be substituted for a drain pipe.

BACKFILLING

Prior to backfilling, damp/water proofing should be applied on perimeter basement walls. The backfill materials placed against basement walls will exert lateral loadings. To reduce this loading by allowing for drainage, we recommend using free-draining sands for backfill. The zone of sand backfill should extend outward from the wall at least 2 feet, and then upward and outward from the wall at a 30° or greater angle from vertical. The free-draining sand backfill should contain no more than 40% by weight passing the #40 sieve and no greater than 5% by weight passing the #200 sieve. The sand backfill should be placed in lifts and compacted with portable compaction equipment. This compaction should be to the specified levels if slabs or pavements are placed above. Where slab/pavements are not above, we recommend capping the sand backfill with a layer of clayey soil to minimize surface water infiltration. Positive surface drainage away from the building should also be maintained. If surface capping or positive surface drainage cannot be maintained, then the trench should be filled with more permeable soils, such as the Fine Filter or Coarse Filter Aggregates defined in MnDOT Specification 3149. You should recognize that if the backfill soils are not properly compacted, settlements may occur which may affect surface drainage away from the building.

Backfilling with silty or clayey soil is possible but not preferred. These soils can build-up water which increases lateral pressures and results in wet wall conditions and possible water infiltration into the basement. If you elect to place silty or clayey soils as backfill, we recommend you place a prefabricated drainage composite against the wall which is hydraulically connected to a drainage pipe at the base of the backfill trench. High plasticity clays should be avoided as backfill due to their swelling potential.

LATERAL PRESSURES

Lateral earth pressures on below grade walls vary, depending on backfill soil classification, backfill compaction and slope of the backfill surface. Static or dynamic surcharge loads near the wall will also increase lateral wall pressure. For design, we recommend the following ultimate lateral earth pressure values (given in equivalent fluid pressure values) for a drained soil compacted to 95% of the Standard Proctor density and a level ground surface.

	Equivalent Fluid Density	
Soil Type	**Active (pcf)**	**At-Rest (pcf)**
Sands (SP or SP-SM)	35	60
Silty Sands (SM)	45	65
Fine Grained Soils (SC, CL or ML)	70	90

Basement walls are normally restrained at the top which restricts movement. In this case, the design lateral pressures should be the "at-rest" pressure situation. Retaining walls which are free to rotate or deflect should be designed using the active case. Lateral earth pressures will be significantly higher than that shown if the backfill soils are not drained and become saturated.

FREEZING WEATHER EFFECTS ON BUILDING CONSTRUCTION

GENERAL

Because water expands upon freezing and soils contain water, soils which are allowed to freeze will heave and lose density. Upon thawing, these soils will not regain their original strength and density. The extent of heave and density/ strength loss depends on the soil type and moisture condition. Heave is greater in soils with higher percentages of fines (silts/clays). High silt content soils are most susceptible, due to their high capillary rise potential which can create ice lenses. Fine grained soils generally heave about 1/4" to 3/8" for each foot of frost penetration. This can translate to 1" to 2" of total frost heave. This total amount can be significantly greater if ice lensing occurs.

DESIGN CONSIDERATIONS

Clayey and silty soils can be used as perimeter backfill, although the effect of their poor drainage and frost properties should be considered. Basement areas will have special drainage and lateral load requirements which are not discussed here. Frost heave may be critical in doorway areas. Stoops or sidewalks adjacent to doorways could be designed as structural slabs supported on frost footings with void spaces below. With this design, movements may then occur between the structural slab and the adjacent on-grade slabs. Non-frost susceptible sands (with less than 12% passing a #200 sieve) can be used below such areas. Depending on the function of surrounding areas, the sand layer may need a thickness transition away from the area where movement is critical. With sand placement over slower draining soils, subsurface drainage would be needed for the sand layer. High density extruded insulation could be used within the sand to reduce frost penetration, thereby reducing the sand thickness needed. We caution that insulation placed near the surface can increase the potential for ice glazing of the surface.

The possible effects of adfreezing should be considered if clayey or silty soils are used as backfill. Adfreezing occurs when backfill adheres to rough surfaced foundation walls and lifts the wall as it freezes and heaves. This occurrence is most common with masonry block walls, unheated or poorly heated building situations and clay backfill. The potential is also increased where backfill soils are poorly compacted and become saturated. The risk of adfreezing can be decreased by placing a low friction separating layer between the wall and backfill.

Adfreezing can occur on exterior piers (such as deck, fence or other similar pier footings), even if a smooth surface is provided. This is more likely in poor drainage situations where soils become saturated. Additional footing embedment and/or widened footings below the frost zones (which include tensile reinforcement) can be used to resist uplift forces. Specific designs would require individual analysis.

CONSTRUCTION CONSIDERATIONS

Foundations, slabs and other improvements which may be affected by frost movements should be insulated from frost penetration during freezing weather. If filling takes place during freezing weather, all frozen soils, snow and ice should be stripped from areas to be filled prior to new fill placement. The new fill should not be allowed to freeze during transit, placement or compaction. This should be considered in the project scheduling, budgeting and quantity estimating. It is usually beneficial to perform cold weather earthwork operations in small areas where grade can be attained quickly rather than working larger areas where a greater amount of frost stripping may be needed. If slab subgrade areas freeze, we recommend the subgrade be thawed prior to floor slab placement. The frost action may also require reworking and recompaction of the thawed subgrade.

BITUMINOUS PAVEMENT SUBGRADE PREPARATION AND DESIGN

GENERAL

Bituminous pavements are considered layered "flexible" systems. Dynamic wheel loads transmit high local stresses through the bituminous/base onto the subgrade. Because of this, the upper portion of the subgrade requires high strength/stability to reduce deflection and fatigue of the bituminous/base system. The wheel load intensity dissipates through the subgrade such that the high level of soil stability is usually not needed below about 2 feet to 4 feet (depending on the anticipated traffic and underlying soil conditions). This is the primary reason for specifying a higher level of compaction within the upper subgrade zone versus the lower portion. Moderate compaction is usually desired below the upper critical zone, primarily to avoid settlements/sags of the roadway. However, if the soils present below the upper 3 feet subgrade zone are unstable, attempts to properly compact the upper 3 feet zone to the 100% level may be difficult or not possible. Therefore, control of moisture just below the 3 feet level may be needed to provide a non-yielding base upon which to compact the upper subgrade soils.

Long-term pavement performance is dependent on the soil subgrade drainage and frost characteristics. Poor to moderate draining soils tend to be susceptible to frost heave and subsequent weakening upon thaw. This condition can result in irregular frost movements and "pop-outs," as well as an accelerated softening of the subgrade. Frost problems become more pronounced when the subgrade is layered with soils of varying permeability. In this situation, the free-draining soils provide a pathway and reservoir for water infiltration which exaggerates the movements. The placement of a well-drained sand subbase layer as the top of subgrade can minimize trapped water, smooth frost movements and significantly reduce subgrade softening. In wet, layered and/or poor drainage situations, the long-term performance gain should be significant. If a sand subbase is placed, we recommend it be a "Select Granular Borrow" which meets Mn/DOT Specification 3149.2B2.

PREPARATION

Subgrade preparation should include stripping surficial vegetation and organic soils; where the exposed soils are within the upper "critical" subgrade zone (generally 2 feet deep for "auto only" areas and 3 feet deep for "heavy duty" areas), they should be evaluated for stability. Excavation equipment may make such areas obvious due to deflection and rutting patterns. Final evaluation of soils within the critical subgrade zone should be done by test rolling with heavy rubber-tired construction equipment, such as a loaded dump truck. Soils which rut or deflect 1" or more under the test roll should be corrected by either subcutting or replacement; or by scarification, drying, and recompaction. Reworked soils and new fill should be compacted per the "Specified Density Method" outlined in Mn/DOT Specification 2105.3F1 (a minimum of 100% of Standard Proctor density in the upper 3 feet subgrade zone, and a minimum of 95% below this).

Subgrade preparation scheduling can be an important consideration. Fall and Spring seasons usually have unfavorable weather for soil drying. Stabilizing non-sand subgrades during these seasons may be difficult, and attempts often result in compromising the pavement quality. Where construction scheduling requires subgrade preparation during these times, the use of a sand subbase becomes even more beneficial for constructability reasons.

SUBGRADE DRAINAGE

If a sand subbase layer is used, it should be provided with a means of subsurface drainage to prevent water build-up. This can be in the form of draintile lines which dispose into storm sewer systems, or outlets into ditches. Where sand subbase layers include sufficient sloping and water can migrate to lower areas, draintile lines can be limited to finger drains at the catch basins. Even if a sand layer is not placed, strategically placed draintile lines can aid in improving pavement performance. This would be most important in areas where adjacent non-paved areas slope towards the pavement. Perimeter edge drains can aid in intercepting water which may infiltrate below the pavement.

Appendix A

Geotechnical Field Exploration and Testing
Boring Log Notes
Unified Soil Classification System
Figure 1 – Boring Locations
Subsurface Boring Logs

Appendix A
Geotechnical Field Exploration and Testing
Report No. 20-23322

A.1 FIELD EXPLORATION

The subsurface conditions at the site were explored by drilling and sampling eight (8) standard penetration test borings. The locations of the borings appear on Figure 1, preceding the Subsurface Boring Logs in this appendix.

A.2 SAMPLING METHODS

A.2.1 Split-Spoon Samples (SS) - Calibrated to N_{60} Values

Standard penetration (split-spoon) samples were collected in general accordance with ASTM: D1586 with one primary modification. The ASTM test method consists of driving a 2-inch O.D. split-barrel sampler into the in-situ soil with a 140-pound hammer dropped from a height of 30 inches. The sampler is driven a total of 18 inches into the soil. After an initial set of 6 inches, the number of hammer blows to drive the sampler the final 12 inches is known as the standard penetration resistance or N-value. Our method uses a modified hammer weight, which is determined by measuring the system energy using a Pile Driving Analyzer (PDA) and an instrumented rod.

In the past, standard penetration N-value tests were performed using a rope and cathead for the lift and drop system. The energy transferred to the split-spoon sampler was typically limited to about 60% of its potential energy due to the friction inherent in this system. This converted energy then provides what is known as an N_{60} blow count.

The most recent drill rigs incorporate an automatic hammer lift and drop system, which has higher energy efficiency and subsequently results in lower N-values than the traditional N_{60} values. By using the PDA energy measurement equipment, we are able to determine actual energy generated by the drop hammer. With the various hammer systems available, we have found highly variable energies ranging from 55% to over 100%. Therefore, the intent of AET's hammer calibrations is to vary the hammer weight such that hammer energies lie within about 60% to 65% of the theoretical energy of a 140-pound weight falling 30 inches. The current ASTM procedure acknowledges the wide variation in N-values, stating that N-values of 100% or more have been observed. Although we have not yet determined the statistical measurement uncertainty of our calibrated method to date, we can state that the accuracy deviation of the N-values using this method is significantly better than the standard ASTM Method.

A.2.2 Disturbed Samples (DS)/Spin-up Samples (SU)

Sample types described as "DS" or "SU" on the boring logs are disturbed samples, which are taken from the flights of the auger. Because the auger disturbs the samples, possible soil layering and contact depths should be considered approximate.

A.2.3 Sampling Limitations

Unless actually observed in a sample, contacts between soil layers are estimated based on the spacing of samples and the action of drilling tools. Cobbles, boulders, and other large objects generally cannot be recovered from test borings, and they may be present in the ground even if they are not noted on the boring logs.

Determining the thickness of "topsoil" layers is usually limited, due to variations in topsoil definition, sample recovery, and other factors. Visual-manual description often relies on color for determination, and transitioning changes can account for significant variation in thickness judgment. Accordingly, the topsoil thickness presented on the logs should not be the sole basis for calculating topsoil stripping depths and volumes. If more accurate information is needed relating to thickness and topsoil quality definition, alternate methods of sample retrieval and testing should be employed.

A.3 CLASSIFICATION METHODS

Soil descriptions shown on the boring logs are based on the Unified Soil Classification (USC) system. The USC system is described in ASTM: D2487 and D2488. Where laboratory classification tests (sieve analysis or Atterberg Limits) have been performed, accurate classifications per ASTM: D2487 are possible. Otherwise, soil descriptions shown on the boring logs are visual-manual judgments. Charts are attached which provide information on the USC system, the descriptive terminology, and the symbols used on the boring logs.

The boring logs include descriptions of apparent geology. The geologic depositional origin of each soil layer is interpreted primarily by observation of the soil samples, which can be limited. Observations of the surrounding topography, vegetation, and development can sometimes aid this judgment.

A.4 WATER LEVEL MEASUREMENTS

The ground water level measurements are shown at the bottom of the boring logs. The following information appears under "Water Level Measurements" on the logs:

- Date and Time of measurement
- Sampled Depth: lowest depth of soil sampling at the time of measurement
- Casing Depth: depth to bottom of casing or hollow-stem auger at time of measurement
- Cave-in Depth: depth at which measuring tape stops in the borehole
- Water Level: depth in the borehole where free water is encountered
- Drilling Fluid Level: same as Water Level, except that the liquid in the borehole is drilling fluid

The true location of the water table at the boring locations may be different than the water levels measured in the boreholes. This is possible because there are several factors that can affect the water level measurements in the borehole. Some of these factors include: permeability of each soil layer in profile, presence of perched water, amount of time between water level readings, presence of drilling fluid, weather conditions, and use of borehole casing.

A.5 LABORATORY TEST METHODS

A.5.1 Water Content Tests

Conducted per AET Procedure 01-LAB-010, which is performed in general accordance with ASTM: D2216 and AASHTO: T265.

A.6 TEST STANDARD LIMITATIONS

Field and laboratory testing is done in general conformance with the described procedures. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.

A.7 SAMPLE STORAGE

Unless notified to do otherwise, we routinely retain representative samples of the soils recovered from the borings for a period of 30 days.

BORING LOG NOTES

DRILLING AND SAMPLING SYMBOLS

Symbol	Definition
B,H,N:	Size of flush-joint casing
CA:	Crew Assistant (initials)
CAS:	Pipe casing, number indicates nominal diameter in inches
CC:	Crew Chief (initials)
COT:	Clean-out tube
DC:	Drive casing; number indicates diameter in inches
DM:	Drilling mud or bentonite slurry
DR:	Driller (initials)
DS:	Disturbed sample from auger flights
FA:	Flight auger; number indicates outside diameter in inches
HA:	Hand auger; number indicates outside diameter
HSA:	Hollow stem auger; number indicates inside diameter in inches
LG:	Field logger (initials)
MC:	Column used to describe moisture condition of samples and for the ground water level symbols
N (BPF):	Standard penetration resistance (N-value) in blows per foot (see notes)
NQ:	NQ wireline core barrel
PQ:	PQ wireline core barrel
RD:	Rotary drilling with fluid and roller or drag bit
REC:	In split-spoon (see notes) and thin-walled tube sampling, the recovered length (in inches) of sample. In rock coring, the length of core recovered (expressed as percent of the total core run). Zero indicates no sample recovered.
REV:	Revert drilling fluid
SS:	Standard split-spoon sampler (steel; 1-3/8" is inside diameter; 2" outside diameter); unless indicated otherwise
SU	Spin-up sample from hollow stem auger
TW:	Thin-walled tube; number indicates inside diameter in inches
WASH:	Sample of material obtained by screening returning rotary drilling fluid or by which has collected inside the borehole after "falling" through drilling fluid
WH:	Sampler advanced by static weight of drill rod and 140-pound hammer
WR:	Sampler advanced by static weight of drill rod
94mm:	94 millimeter wireline core barrel
▼:	Water level directly measured in boring
∇:	Estimated water level based solely on sample appearance

TEST SYMBOLS

Symbol	Definition
CONS:	One-dimensional consolidation test
DEN:	Dry density, pcf
DST:	Direct shear test
E:	Pressuremeter Modulus, tsf
HYD:	Hydrometer analysis
LL:	Liquid Limit, %
LP:	Pressuremeter Limit Pressure, tsf
OC:	Organic Content, %
PERM:	Coefficient of permeability (K) test; F - Field; L - Laboratory
PL:	Plastic Limit, %
q_p:	Pocket Penetrometer strength, tsf (approximate)
q_c:	Static cone bearing pressure, tsf
q_u:	Unconfined compressive strength, psf
R:	Electrical Resistivity, ohm-cms
RQD:	Rock Quality Designation of Rock Core, in percent (aggregate length of core pieces 4" or more in length as a percent of total core run)
SA:	Sieve analysis
TRX:	Triaxial compression test
VSR:	Vane shear strength, remoulded (field), psf
VSU:	Vane shear strength, undisturbed (field), psf
WC:	Water content, as percent of dry weight
%-200:	Percent of material finer than #200 sieve

STANDARD PENETRATION TEST NOTES

The standard penetration test consists of driving the sampler with a 140 pound hammer and counting the number of blows applied in each of three 6" increments of penetration. If the sampler is driven less than 18" (usually in highly resistant material), permitted in ASTM:D1586, the blows for each complete 6" increment and for each partial increment is on the boring log. For partial increments, the number of blows is shown to the nearest 0.1' below the slash.

The length of sample recovered, as shown on the "REC" column, may be greater than the distance indicated in the N column. The disparity is because the N-value is recorded below the initial 6" set (unless partial penetration defined in ASTM:D1586 is encountered) whereas the length of sample recovered is for the entire sampler drive (which may even extend more than 18").

UNIFIED SOIL CLASSIFICATION SYSTEM
ASTM Designations: D 2487, D2488

AMERICAN ENGINEERING TESTING, INC.

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification: Group Symbol	Soil Classification: Group Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	Cu≥4 and 1≤Cc≤3[E]	GW	Well graded gravel[F]
			Cu<4 and/or 1>Cc>3[E]	GP	Poorly graded gravel[F]
		Gravels with Fines more than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	Cu≥6 and 1≤Cc≤3[E]	SW	Well-graded sand[I]
			Cu<6 and 1>Cc>3[E]	SP	Poorly-graded sand[I]
		Sands with Fines more than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines classify as CL or CH	SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve (see Plasticity Chart below)	Silts and Clays Liquid limit less than 50	inorganic	PI>7 and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI<4 or plots below "A" line[J]	ML	Silt[K,L,M]
		organic	Liquid limit–oven dried / Liquid limit – not dried <0.75	OL	Organic clay[K,L,M,N] / Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic silt[K,L,M]
		organic	Liquid limit–oven dried / Liquid limit – not dried <0.75	OH	Organic clay[K,L,M,P] / Organic silt[K,L,M,Q]
Highly organic soil			Primarily organic matter, dark in color, and organic in odor	PT	Peat[R]

Notes

[A]Based on the material passing the 3-in (75-mm) sieve.

[B]If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C]Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay

[D]Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

[E]$Cu = D_{60} / D_{10}$, $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F]If soil contains ≥15% sand, add "with sand" to group name.

[G]If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H]If fines are organic, add "with organic fines" to group name.

[I]If soil contains ≥15% gravel, add "with gravel" to group name.

[J]If Atterberg limits plot is hatched area, soils is a CL-ML silty clay.

[K]If soil contains 15 to 29% plus No. 200 add "with sand" or "with gravel", whichever is predominant.

[L]If soil contains ≥30% plus No. 200, predominantly sand, add "sandy" to group name.

[M]If soil contains ≥30% plus No. 200, predominantly gravel, add "gravelly" to group name.

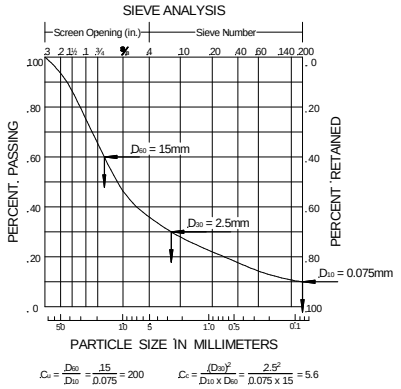
[N]PI≥4 and plots on or above "A" line.

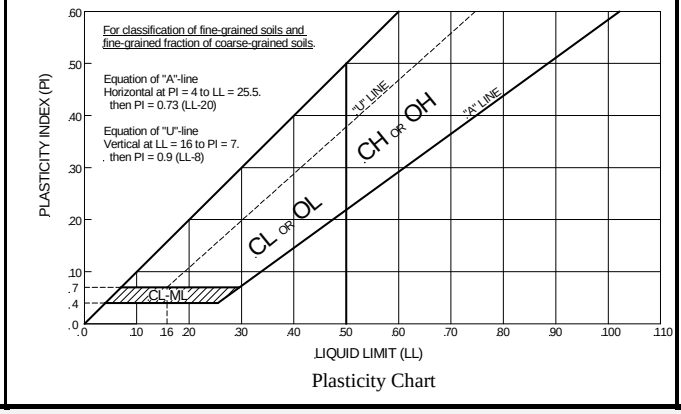
[O]PI<4 or plots below "A" line.

[P]PI plots on or above "A" line.

[Q]PI plots below "A" line.

[R]Fiber Content description shown below.





Plasticity Chart

ADDITIONAL TERMINOLOGY NOTES USED BY AET FOR SOIL IDENTIFICATION AND DESCRIPTION

Grain Size

Term	Particle Size
Boulders	Over 12"
Cobbles	3" to 12"
Gravel	#4 sieve to 3"
Sand	#200 to #4 sieve
Fines (silt & clay)	Pass #200 sieve

Gravel Percentages

Term	Percent
A Little Gravel	3% - 14%
With Gravel	15% - 29%
Gravelly	30% - 50%

Consistency of Plastic Soils

Term	N-Value, BPF
Very Soft	less than 2
Soft	2 - 4
Firm	5 - 8
Stiff	9 - 15
Very Stiff	16 - 30
Hard	Greater than 30

Relative Density of Non-Plastic Soils

Term	N-Value, BPF
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	Greater than 50

Moisture/Frost Condition (MC Column)

D (Dry): Absense of moisture, dusty, dry to touch.

M (Moist): Damp, although free water not visible. Soil may still have a high water content (over "optimum").

W (Wet/ Waterbearing): Free water visible intended to describe non-plastic soils. Waterbearing usually relates to sands and sand with silt.

F (Frozen): Soil frozen

Layering Notes

Laminations: Layers less than ½" thick of differing material or color.

Lenses: Pockets or layers greater than ½" thick of differing material or color.

Fiber Content of Peat

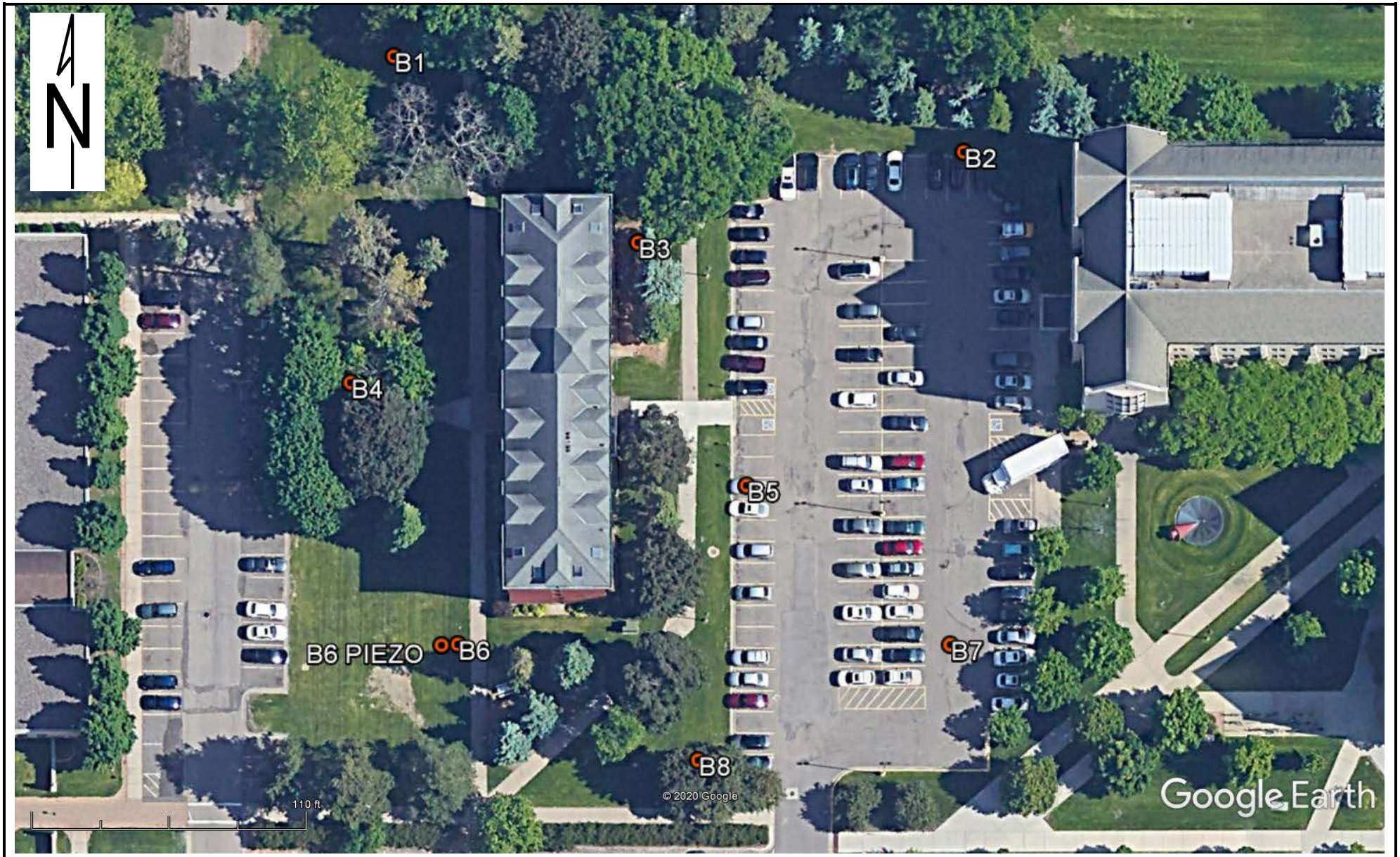
Term	Fiber Content (Visual Estimate)
Fibric Peat:	Greater than 67%
Hemic Peat:	33 – 67%
Sapric Peat:	Less than 33%

Organic/Roots Description (if no lab tests)

Soils are described as *organic*, if soil is not peat and is judged to have sufficient organic fines content to influence the soil properties. *Slightly organic* used for borderline cases.

With roots: Judged to have sufficient quantity of roots to influence the soil properties.

Trace roots: Small roots present, but not judged to be in sufficient quantity to significantly affect soil properties.



AMERICAN ENGINEERING TESTING, INC.	**Project:** St. Thomas STEAM Building; 2230 Summit Avenue, St. Paul, Minnesota		**AET Report No.:** 20-23322
	Subject: Soil Boring Locations		**Date:** 12/15/2020
	Scale: Shown	**Drawn By:** Google Earth	**Checked By:** RF	**Figure 1**

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **20-23322** Log of Boring No. **1 (p. 1 of 1)**

Project: **St. Thomas STEAM Building; 2330 Summit Avenue; St. Paul, MN**

Surface Elevation **860.2**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mostly clayey sand with organic fines, trace roots, black	FILL	18	M	SS	16	36				
2	FILL, mostly gravelly silty sand, brown	TOPSOIL									
3	SANDY LEAN CLAY, slightly organic, trace roots, dark brown, stiff (CL)	FINE ALLUVIUM	9	M	SS	14	16				
4	SILT WITH SAND, trace roots, gray, moist, loose, lenses and laminations of lean clay (ML)										
5	SILTY SAND WITH GRAVEL, fine to medium grained, brown, moist, dense (SM)	COARSE ALLUVIUM	38	M	SS	12					
6											
7											
8			45	M	SS	8					
9											
10	WEATHERED SHALE, gray, apparent limestone stringers 1 to 3 inches in thickness	DECORAH FORMATION	77/.08	M	SS	13					
11											
12			50/0.1	M	SS	0					
13											
14											
15			40/0.3	M	SS	6					
16											
17											
18											
19											
20			69	M	SS	18					
21											
22											
23											
24											
25			83/0.7	M	SS	14					
26											
27											
28											
29											
30			105	M	SS	18					
31	**END OF BORING**										

DEPTH: DRILLING METHOD **0-29½' 3.25" HSA**

BORING COMPLETED: **12/9/20**

DR: **SG** LG: **SD** Rig: **91C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
12/9/20	**9:21**	**31.0**	**29.5**	**31.0**		**None**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 20-23322.GPJ AET+CPT+WELL_20181012_JG.GDT 12/22/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **20-23322** Log of Boring No. **2 (p. 1 of 1)**

Project: **St. Thomas STEAM Building; 2330 Summit Avenue; St. Paul, MN**

Surface Elevation **862.1**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mostly clayey sand with organic fines, a little gravel, trace roots, dark brown	FILL	11	M	SS	20	10 19				
2	FILL, mixture of silty sand and clayey sand, a little gravel, trace roots, brown and dark brown	TOPSOIL	7	M	SS	6	45				
3	LEAN CLAY, slightly organic, black, firm (CL)										
4	SAND WITH SILT, fine grained, light brown, moist, medium dense (SP-SM)	COARSE ALLUVIUM	27	M	SS	16					
5											
6											
7	SILTY SAND WITH GRAVEL, brown to gray, very dense, lenses and laminations of clayey sand (SM)		76	M	SS	14					
8											
9											
10			58	M	SS	12					
11											
12	WEATHERED SHALE, gray, apparent limestone stringers 1 to 3 inches in thickness	DECORAH FORMATION	50/.4	M	SS	9					
13											
14			50/.1	M	SS	9					
15											
16											
17											
18											
19											
20			50/.3	M	SS	10					
21											
22											
23											
24											
25			50/.3	M	SS	10					
26											
27											
28											
29											
30			50/.2	M	SS	12					
	END OF BORING										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS						
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-29½'	**3.25" HSA**	**12/10/20**	**9:10**	**30.2**	**29.5**	**30.2**		**None**
BORING COMPLETED:	**12/10/20**							
DR: **SG**	LG: **SD** Rig: **91C**							

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 20-23322.GPJ AET+CPT+WELL_20181012_JG.GDT 12/22/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **20-23322** Log of Boring No. **3 (p. 1 of 1)**

Project: **St. Thomas STEAM Building; 2330 Summit Avenue; St. Paul, MN**

Surface Elevation **860.8**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	4" Wood chips	FILL									
2	FILL, mostly clayey sand with organic fines, a little gravel, organic clay and gravel, trace roots, dark brown, a little gray		8	M	SS	24	18				
3			14	M	SS	18	21				
4	SILTY SAND, fine grained, brown, moist, medium dense, laminations of clayey sand (SM)	COARSE ALLUVIUM									
5	SAND WITH SILT, fine grained, brown and gray, moist, very dense (SP-SM)		89/.7	M	SS	10					
7	WEATHERED SHALE, limestone stringers below 8'	DECORAH FORMATION	50/.2	M	SS	2					
9			30	M	SS	18					
10	No recovery from 10' to 11.3'				NQ						
12	SLIGHTLY WEATHERED SHALE, gray, limestone stringers between 1 to 3 detected above 16.8' and SLIGHTLY WEATHERED SHALE, gray, limestone stringers between 1 to 3 inches in thickess detected above 16.8' and from 17.2' to 17.6', 18.2' to 18.4', 18.6' to 18.7', 20.2' to 20.3', 21.3' to 21.4', 22.2' to 22.3', 23.0' to 23.1', 26.6' to 26.7', 27.0' to 27.2', and 29.9' to 30.1'				NQ	27					
19					NQ	57					
24					NQ	52					
29					NQ	57					
31	**END OF BORING**										

DEPTH:	DRILLING METHOD
0-10'	**3.25" HSA**
10'-31'	**NQ Core**
BORING COMPLETED:	**12/10/20**
DR: **SG**	LG: **SD** Rig: **91C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 20-23322.GPJ AET+CPT+WELL_20181012_JG.GDT 12/22/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **20-23322** Log of Boring No. **4 (p. 1 of 1)**

Project: **St. Thomas STEAM Building; 2330 Summit Avenue; St. Paul, MN**

Surface Elevation **859.8**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mostly silty sand with organic fines, trace roots, dark brown	FILL	9	M	SS	24					
3	SILT WITH SAND, trace roots, gray, a little light gray, moist, medium dense, laminations of lean clay (ML)	FINE ALLUVIUM	25	M	SS	16					
5	SILTY SAND WITH GRAVEL, fine to medium grained, brown, moist, dense (SM)	COARSE ALLUVIUM	44	M	SS	6					
7	GRAVELLY CLAYEY SAND, brown, hard (SC)	TILL	35	M	SS	1	9				
10	WEATHERED SHALE, gray (possible 2" limestone stringer from 26.6' to 26.8')	DECORAH FORMATION	50/.2	▼	SS	7					
13			26	W	SS	15					
15			50/.3	M	SS	2					
20			50/.4	M	SS	8					
25			50/.4	M	SS	10					
30			49/.7	M	SS	14					
	END OF BORING										

DEPTH: DRILLING METHOD

0-29½' 3.25" HSA

BORING COMPLETED: **12/9/20**

DR: **SG** LG: **SD** Rig: **91C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
12/9/20	**10:16**	**13.5**	**12.0**	**13.2**		**11.8**
12/9/20	**10:26**	**13.5**	**12.0**	**13.0**		**11.0**
12/9/20	**11:18**	**30.7**	**29.5**	**30.7**		**None**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 20-23322.GPJ AET+CPT+WELL_20181012_JG.GDT 12/22/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **20-23322** Log of Boring No. **5 (p. 1 of 1)**

Project: **St. Thomas STEAM Building; 2330 Summit Avenue; St. Paul, MN**

Surface Elevation **860.7**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	5.5" Bituminous pavement	FILL					16				
1	FILL, mostly silty sand with gravel, brown and dark brown		9	M	SS	12					
2											
3	FILL, mostly clayey sand, a little gravel, dark brown		4	M	SS	16	16				
4											
5	FILL, mixture of clayey sand and silty sand, a little gravel, brown, a little grayish brown	COARSE ALLUVIUM	26	M	SS	16					
6	SAND, fine grained, light brown, moist, medium dense (SP)										
7	SILTY SAND WITH GRAVEL, fine to medium grained, brown, moist, medium dense (SM)		32	M	SS	18	10				
8											
9	CLAYEY SAND WITH GRAVEL, gray and brown, hard, laminations of silty sand (SC)										
10	WEATHERED SHALE, gray, apparent limestone stringers 1 to 3 inches in thickness	DECORAH FORMATION	88/.6	M	SS	18					
11											
12			50/.1	M	SS	1					
13											
14											
15			50/.1	M	SS	12					
16											
17											
18											
19											
20			97	M	SS	16					
21											
22											
23											
24											
25			50/.2	M	SS	14					
26											
27											
28											
29											
30			50/.4	M	SS						
	END OF BORING										

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
0-29½' 3.25" HSA	**12/10/20**	**10:58**	**30.4**	**29.5**	**30.3**		**None**	
BORING COMPLETED: **12/10/20**								
DR: **SG** LG: **SD** Rig: **91C**								

AET_CORP 20-23322.GPJ AET+CPT+WELL_20181012_JG.GDT 12/22/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **20-23322** Log of Boring No. **6 (p. 1 of 1)**

Project: **St. Thomas STEAM Building; 2330 Summit Avenue; St. Paul, MN**

Surface Elevation **860.2**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	LEAN CLAY WITH SAND, slightly organic, trace roots, black, firm (CL) (possible fill)	TOPSOIL OR FILL	6	M	SS	20	24				
3	SAND WITH SILT, fine grained, light brown, a little light grayish brown, moist, medium dense (SP-SM)	COARSE ALLUVIUM	13	M	SS	10					
5	SILTY SAND WITH GRAVEL, fine to medium grained, brown, moist, dense (SM)		57	M	SS	6					
7	WEATHERED SHALE, gray and brown to about 8.5' then gray, apparent limestone stringers 1 to 3 inches in thickness below 10'	DECORAH FORMATION	36	M	SS	20					
10			50/0.4	M	SS	4					
12	▼										
13			90	M	SS	3					
15			50/.4	M	SS	4					
20			50/.3	M	SS	10					
25			50/.4	M	SS	10					
30			86/.8	M	SS	14					
	END OF BORING - OBSTRUCTED TO SPLIT SPOON AT 30.8'										

DEPTH: DRILLING METHOD

0-29½' 3.25" HSA

BORING COMPLETED: **12/9/20**

DR: **SG** LG: **SD** Rig: **91C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
12/9/20	**12:13**	**13.5**	**12.0**	**13.6**		**13.1**
12/9/20	**12:54**	**13.5**	**12.0**	**13.3**		**12.0**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 20-23322.GPJ AET+CPT+WELL_20181012_JG.GDT 12/22/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **20-23322** Log of Boring No. **7 (p. 1 of 1)**

Project: **St. Thomas STEAM Building; 2330 Summit Avenue; St. Paul, MN**

Surface Elevation **861.6**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	4" Bituminous pavement FILL, mostly silty sand with gravel, brown	FILL	23	M	SS	14					
2	FILL, mostly silty sand, a little gravel, brown										
3	FILL, mostly silty sand with gravel, brown and light brown		25	M	SS	10					
4											
5	FILL, mostly gravelly sand with silt, brown and light brown		62	M	SS	7					
6											
7	SILTY SAND WITH GRAVEL, brown, very dense, lenses and laminations of clayey sand (SM)	TILL	91/0.2	M	SS	12					
8											
9											
10	WEATHERED SHALE, gray, apparent limestone, stringer 1 to 3 inches in thickness	DECORAH FORMATION	49	M	SS	18					
11											
12			57/0.5	M	SS	12					
13											
14											
15			61/0.5	M	SS	12					
16											
17											
18											
19											
20			100/0.3	M	SS	3					
21											
22											
23											
24											
25			98/0.7	M	SS	14					
26											
27											
28											
29											
30			50/0.4	M	SS	10					
	END OF BORING - OBSTRUCTED TO SPLIT SPOON AT 30.4'										

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
0-29½' 3.25" HSA	**12/9/20**	**3:11**	**30.4**	**29.5**	**30.3**		**None**	
BORING COMPLETED: **12/9/20**								
DR: **SG** LG: **SD** Rig: **91C**								

AET_CORP 20-23322.GPJ AET+CPT+WELL_20181012_JG.GDT 12/22/20

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **20-23322** Log of Boring No. **8 (p. 1 of 1)**

Project: **St. Thomas STEAM Building; 2330 Summit Avenue; St. Paul, MN**

Surface Elevation **860.6**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mostly sandy lean clay, slightly organic, trace roots, black	FILL	9	M	SS	24	22				
3	SANDY SILT, trace roots, light gray and light brown, moist, loose, laminations of lean clay (ML)	FINE ALLUVIUM	9	M	SS	18	15				
5	SAND, a little gravel, fine to medium grained, light brown, moist, dense (SP)	COARSE ALLUVIUM	44	M	SS	10					
7	SAND WITH SILT AND GRAVEL, fine to medium grained, brown, moist, dense, lens of clayey sand around 7' (SP-SM)		32	M	SS	14					
8	WEATHERED SHALE, gray, a little brown to about 9' then gray	DECORAH FORMATION									
10			50/.2	▼	SS	10					
13			96	W	SS	18					
15			50/.3	M	SS	8					
20			50/.3	M	SS	10					
25			50/.3	M	SS	10					
30			104	M	SS	20					
31	**END OF BORING**										

DEPTH: DRILLING METHOD

0-29½' 3.25" HSA

BORING COMPLETED: **12/10/20**

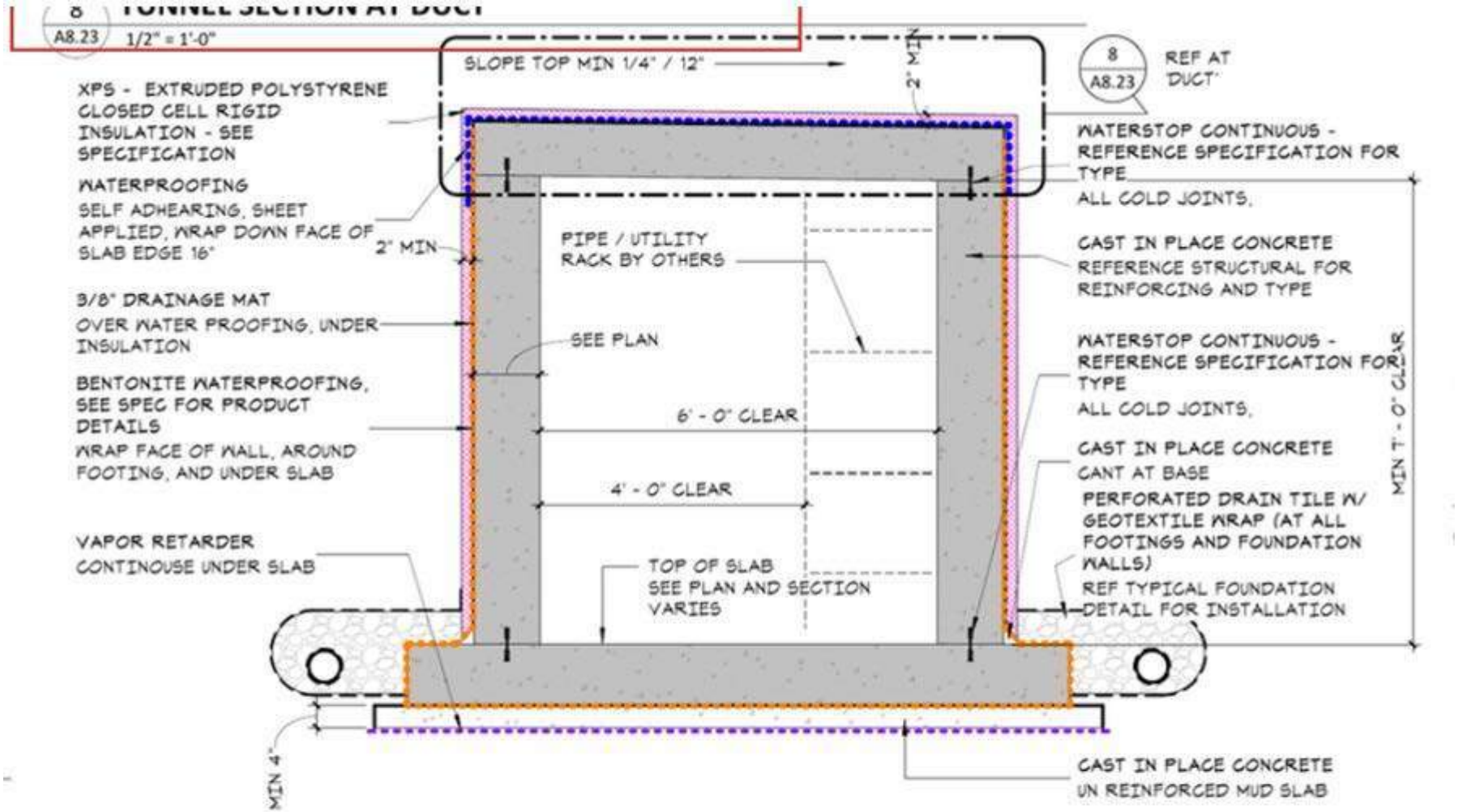
DR: **SG** LG: **SD** Rig: **91C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
12/10/20	**12:06**	**13.5**	**12.0**	**13.2**		**11.3**
12/10/20	**12:44**	**13.5**	**12.0**	**13.1**		**10.3**
12/10/20		**31.0**	**29.5**	**30.9**		**None**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP 20-23322.GPJ AET+CPT+WELL_20181012_JG.GDT 12/22/20



2 **TUNNEL SECTION - UTILITY**
A8.23 1/2" = 1'-0"

AMERCAN ENGINEERING TESTING, INC.	**PROJECT** St. Thomas STEAM Building; University of St. Thomas, St. Paul, MN			**AET NO.** **20-23322**
	SUBJECT Typical Utility Tunnel Design			**DATE** January 26, 2021
	SCALE **Not to scale**	**DRAWN BY** **OTHERS**	**CHECKED BY**	**FIGURE 1**

Appendix B

Geotechnical Report Limitations and Guidelines for Use

Appendix B
Geotechnical Report Limitations and Guidelines for Use
Report No. 20-23322

B.1 REFERENCE

This appendix provides information to help you manage your risks relating to subsurface problems which are caused by construction delays, cost overruns, claims, and disputes. This information was developed and provided by GBA[1], of which, we are a member firm.

B.2 RISK MANAGEMENT INFORMATION

B.2.1 Understand the Geotechnical Engineering Services Provided for this Report

Geotechnical engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical engineering services is typically a geotechnical engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

B.2.2 Geotechnical Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely for the client.

Likewise, geotechnical engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do <u>not</u> rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. If you are the least bit uncertain about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

1 Geoprofessional Business Association, 1300 Piccard Drive, LL14, Rockville, MD 20850
Telephone: 301/565-2733: www.geoprofessional.org, 2019

B.2.3 Read the Full Report

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety.

Do not rely on an executive summary. Do not read selective elements only. Read and refer to the report in full.

B.2.4 You Need to Inform Your Geotechnical Engineer About Change
Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, always inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

B.2.5 Most of the "Findings" Related in This Report Are Professional Opinions
Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

B.2.6 This Report's Recommendations Are Confirmation-Dependent
The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations only after observing actual subsurface conditions exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.

B.2.7 This Report Could Be Misinterpreted
Other design professionals' misinterpretation of geotechnical engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

B.2.8 Give Constructors a Complete Report and Guidance
Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical engineering report, along with any attachments or appendices, with your contract documents, but be certain to note conspicuously that you've included the material for information purposes only. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, only from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and be sure to allow enough time to permit them to do so.

Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

B.2.9 Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

B.2.10 Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical engineering study. For that reason, a geotechnical engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated subsurface environmental problems have led to project failures. If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

B.2.11 Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

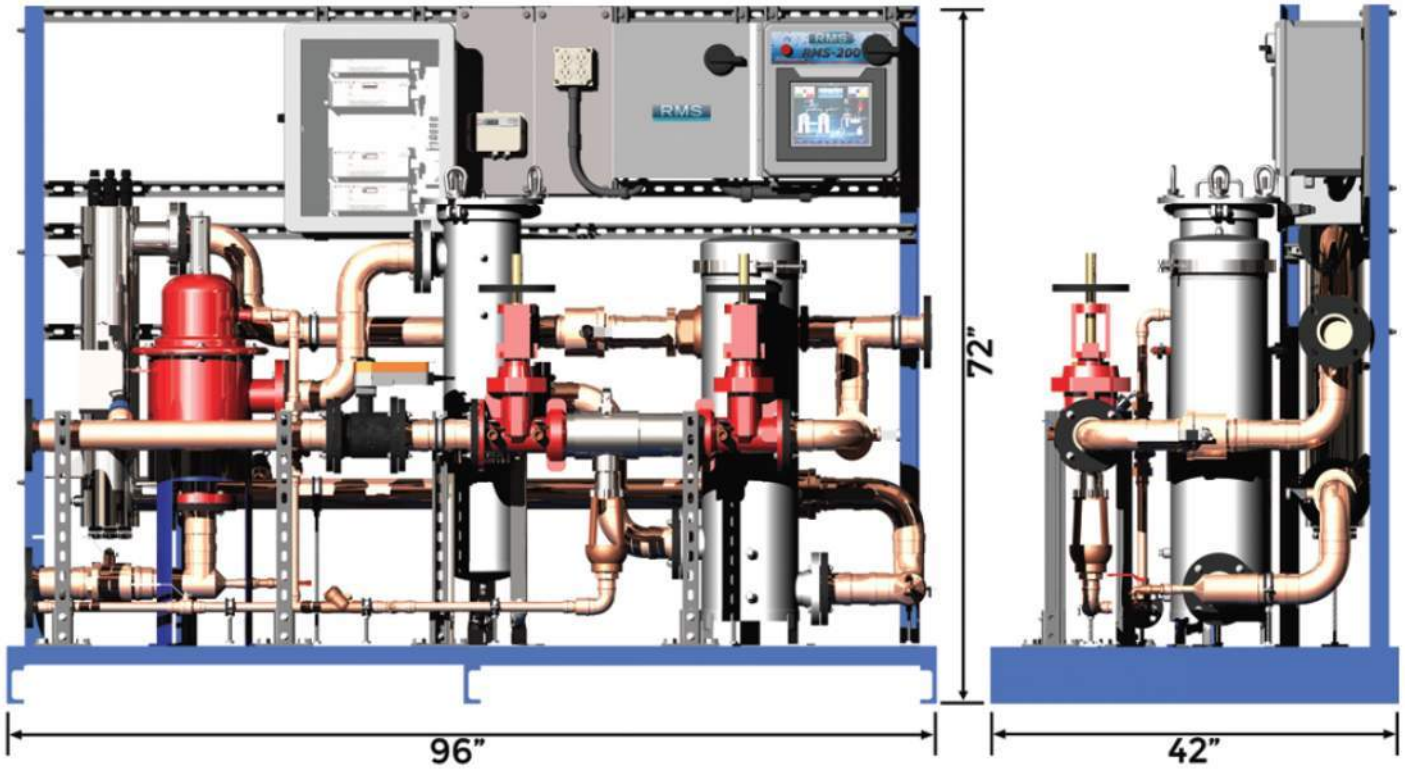
While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. Geotechnical engineers are not building-envelope or mold specialists.

Appendix 3. RMS - RWF 125 Spec

Rainwater Filtration Made-to-Order Skid 150gpm at max pressure 125psi with Domestic Backup Includes:

- 50 Micron Backwash Filter
- 5 Micron Bag Filter with Stainless Steel Housing
- Carbon Filter with Stainless Steel Housing
- UV Light
- 3" Flange Rainwater Inlet
- 3" Flange Domestic Inlet
- 3" Flange System Outlet
- 1" Flange Drain Line
- 3" Flow Meter
- 3" RPZ
- 3" Domestic Motorized Valve
- RMS 200 Controller - PLC Touchscreen U.L. Listed Control System
- Single Point Power Disconnect Panel
- Pre-Plumbed in Copper Pro Press
- Pre-Wired

Dimensions of 96" L x 42" W x 72" H



RAINWATER MANAGEMENT SOLUTIONS™

RWF-125
Standard Filtration Skid

ALL GRADES & ELEVATIONS TO BE SITE VERIFIED PRIOR TO CONSTRUCTION

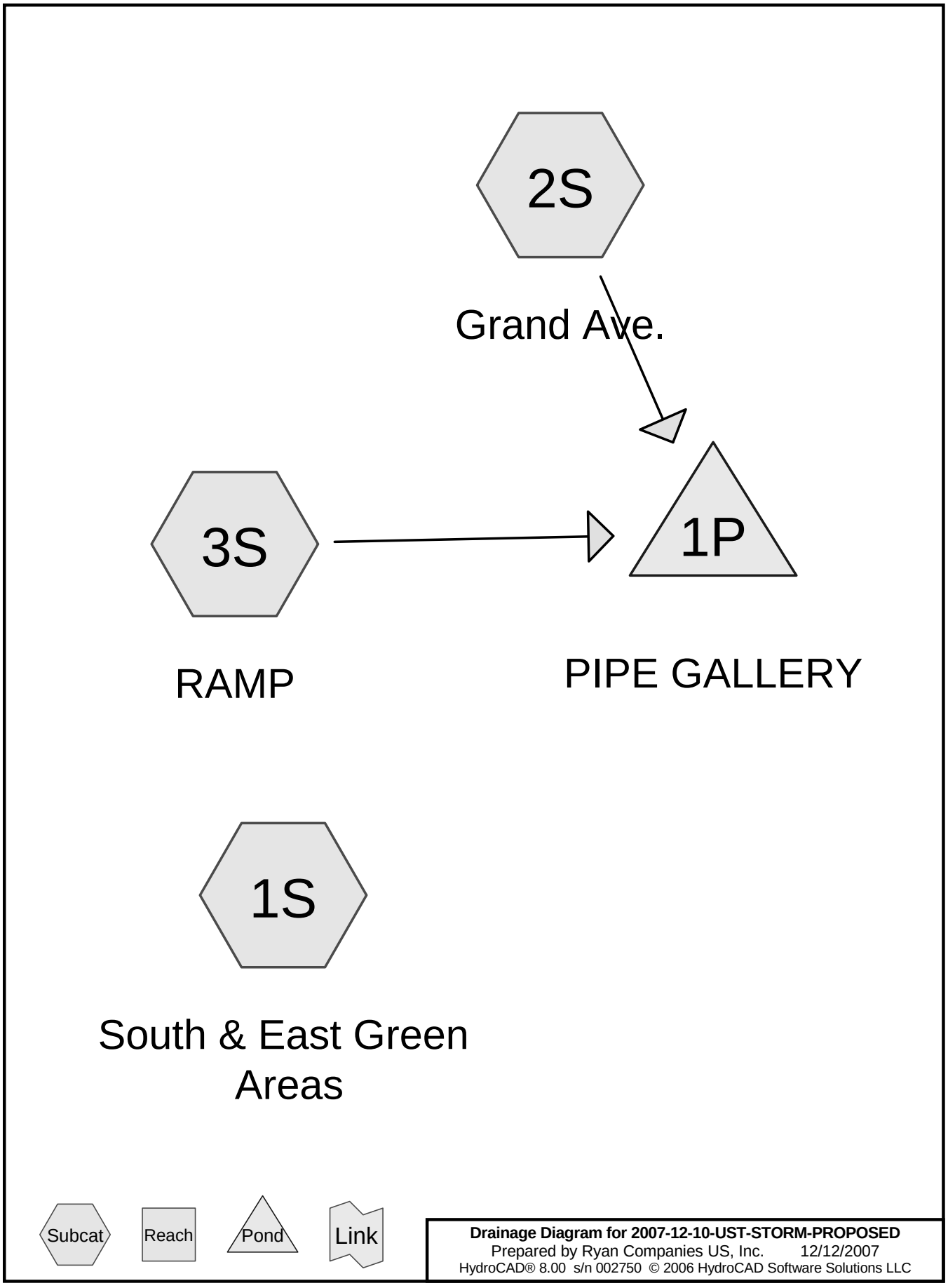
CREATED: 2/2019 | REV 0

NOT TO SCALE

DRAWING FOR ILLUSTRATIVE PURPOSES ONLY. NOT FOR CONSTRUCTION. DIMENSIONS AND LAYOUT SUBJECT TO CHANGE

RAINWATER MANAGEMENT SOLUTIONS, 1-866-653-8337
WWW.RAINWATERMANAGEMENT.COM

APPENDIX C



Drainage Diagram for 2007-12-10-UST-STORM-PROPOSED
Prepared by Ryan Companies US, Inc. 12/12/2007
HydroCAD® 8.00 s/n 002750 © 2006 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcats)
0.864	61	>75% Grass cover, Good, HSG B (1S)
1.329	88	Urban industrial, 72% imp, HSG B (2S)
1.366	98	Paved parking & roofs (2S,3S)
3.559		

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: South & East Green Areas Runoff Area=37,650 sf Runoff Depth>0.29"
Flow Length=75' Slope=0.0050 '/' Tc=14.5 min CN=61 Runoff=0.18 cfs 0.021 af

Subcatchment 2S: Grand Ave. Runoff Area=67,373 sf Runoff Depth>1.71"
Flow Length=605' Tc=15.3 min CN=89 Runoff=3.37 cfs 0.221 af

Subcatchment 3S: RAMP Runoff Area=50,000 sf Runoff Depth>2.57"
Flow Length=200' Slope=0.0100 '/' Tc=1.6 min CN=98 Runoff=4.88 cfs 0.246 af

Pond 1P: PIPE GALLERY Peak Elev=853.77' Storage=3,687 cf Inflow=6.56 cfs 0.467 af
Primary=2.93 cfs 0.467 af Secondary=0.00 cfs 0.000 af Outflow=2.93 cfs 0.467 af

Total Runoff Area = 3.559 ac Runoff Volume = 0.488 af Average Runoff Depth = 1.64"
34.74% Pervious Area = 1.236 ac 65.26% Impervious Area = 2.323 ac

Subcatchment 1S: South & East Green Areas

Runoff = 0.18 cfs @ 12.12 hrs, Volume= 0.021 af, Depth> 0.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=2.80"

Area (sf)	CN	Description
37,650	61	>75% Grass cover, Good, HSG B
37,650		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	75	0.0050	0.09		**Sheet Flow, East Grass Area** Grass: Short n= 0.150 P2= 2.80"

Subcatchment 2S: Grand Ave.

Runoff = 3.37 cfs @ 12.07 hrs, Volume= 0.221 af, Depth> 1.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=2.80"

Area (sf)	CN	Description
57,873	88	Urban industrial, 72% imp, HSG B
9,500	98	Paved parking & roofs
67,373	89	Weighted Average
16,204		Pervious Area
51,169		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.8	100	0.0100	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.3	45	0.0200	2.87		**Shallow Concentrated Flow, Grand Ave.** Paved Kv= 20.3 fps
1.2	460	0.0050	6.62	20.80	**Circular Channel (pipe),** Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.010 PVC, smooth interior
15.3	605	Total			

Subcatchment 3S: RAMP

[49] Hint: Tc<2dt may require smaller dt

Runoff = 4.88 cfs @ 11.90 hrs, Volume= 0.246 af, Depth> 2.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-YR Rainfall=2.80"

Area (sf)	CN	Description
50,000	98	Paved parking & roofs
50,000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	200	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps

Pond 1P: PIPE GALLERY

Inflow Area = 2.695 ac, Inflow Depth > 2.08" for 2-YR event
Inflow = 6.56 cfs @ 11.92 hrs, Volume= 0.467 af
Outflow = 2.93 cfs @ 12.18 hrs, Volume= 0.467 af, Atten= 55%, Lag= 15.5 min
Primary = 2.93 cfs @ 12.18 hrs, Volume= 0.467 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 853.77' @ 12.18 hrs Surf.Area= 4,049 sf Storage= 3,687 cf

Plug-Flow detention time= 8.2 min calculated for 0.467 af (100% of inflow)
Center-of-Mass det. time= 8.1 min (791.9 - 783.8)

Volume	Invert	Avail.Storage	Storage Description
#1	852.38'	11,310 cf	**48.0"D x 180.00'L Horizontal Cylinder S= 0.0010 '/'** x 5
#2	852.38'	704 cf	**48.0"D x 28.00'L Horizontal Cylinder** x 2
#3	856.38'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder**
#4	852.38'	1,448 cf	**24.0"D x 461.00'L Horizontal Cylinder S= 0.0050 '/'**
#5	854.67'	64 cf	**4.00'D x 5.10'H Vertical Cone/Cylinder**
#6	859.75'	505 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		14,200 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
859.75	10	0	0
860.75	1,000	505	505

Device	Routing	Invert	Outlet Devices
#1	Primary	852.20'	**24.0" x 49.0' long Culvert** CPP, mitered to conform to fill, Ke= 0.700 Outlet Invert= 851.96' S= 0.0049 '/' Cc= 0.900 n= 0.010 PVC, smooth interior
#2	Device 1	852.20'	**Custom Weir/Orifice, C= 2.62** Head (feet) 0.00 0.50 0.50 1.00 1.00 2.00 2.00 3.00 3.00 4.00 Width (feet) 1.04 1.04 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
#3	Device 1	856.40'	**5.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Secondary	860.20'	**50.0' long (Profile 6) Broad-Crested Rectangular Weir** Head (feet) 0.49 0.98 1.48 Coef. (English) 3.12 3.41 3.59

Primary OutFlow Max=2.93 cfs @ 12.18 hrs HW=853.77' (Free Discharge)
└**1=Culvert** (Passes 2.93 cfs of 8.60 cfs potential flow)
└**2=Custom Weir/Orifice** (Orifice Controls 2.93 cfs @ 5.63 fps)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=852.38' (Free Discharge)
└**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: South & East Green Areas Runoff Area=37,650 sf Runoff Depth>0.86"
Flow Length=75' Slope=0.0050 '/' Tc=14.5 min CN=61 Runoff=0.84 cfs 0.062 af

Subcatchment 2S: Grand Ave. Runoff Area=67,373 sf Runoff Depth>2.91"
Flow Length=605' Tc=15.3 min CN=89 Runoff=5.62 cfs 0.375 af

Subcatchment 3S: RAMP Runoff Area=50,000 sf Runoff Depth>3.86"
Flow Length=200' Slope=0.0100 '/' Tc=1.6 min CN=98 Runoff=7.20 cfs 0.370 af

Pond 1P: PIPE GALLERY Peak Elev=854.62' Storage=7,388 cf Inflow=10.16 cfs 0.744 af
Primary=3.76 cfs 0.744 af Secondary=0.00 cfs 0.000 af Outflow=3.76 cfs 0.744 af

Total Runoff Area = 3.559 ac Runoff Volume = 0.806 af Average Runoff Depth = 2.72"
34.74% Pervious Area = 1.236 ac 65.26% Impervious Area = 2.323 ac

Subcatchment 1S: South & East Green Areas

Runoff = 0.84 cfs @ 12.09 hrs, Volume= 0.062 af, Depth> 0.86"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=4.10"

Area (sf)	CN	Description
37,650	61	>75% Grass cover, Good, HSG B
37,650		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	75	0.0050	0.09		**Sheet Flow, East Grass Area** Grass: Short n= 0.150 P2= 2.80"

Subcatchment 2S: Grand Ave.

Runoff = 5.62 cfs @ 12.07 hrs, Volume= 0.375 af, Depth> 2.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=4.10"

Area (sf)	CN	Description
57,873	88	Urban industrial, 72% imp, HSG B
9,500	98	Paved parking & roofs
67,373	89	Weighted Average
16,204		Pervious Area
51,169		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.8	100	0.0100	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.3	45	0.0200	2.87		**Shallow Concentrated Flow, Grand Ave.** Paved Kv= 20.3 fps
1.2	460	0.0050	6.62	20.80	**Circular Channel (pipe),** Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.010 PVC, smooth interior
15.3	605	Total			

Subcatchment 3S: RAMP

[49] Hint: Tc<2dt may require smaller dt

Runoff = 7.20 cfs @ 11.90 hrs, Volume= 0.370 af, Depth> 3.86"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-YR Rainfall=4.10"

Area (sf)	CN	Description
50,000	98	Paved parking & roofs
50,000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	200	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps

Pond 1P: PIPE GALLERY

Inflow Area = 2.695 ac, Inflow Depth > 3.32" for 10-YR event
Inflow = 10.16 cfs @ 11.92 hrs, Volume= 0.744 af
Outflow = 3.76 cfs @ 12.22 hrs, Volume= 0.744 af, Atten= 63%, Lag= 18.1 min
Primary = 3.76 cfs @ 12.22 hrs, Volume= 0.744 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 854.62' @ 12.22 hrs Surf.Area= 4,439 sf Storage= 7,388 cf

Plug-Flow detention time= 13.1 min calculated for 0.743 af (100% of inflow)
Center-of-Mass det. time= 13.0 min (787.4 - 774.4)

Volume	Invert	Avail.Storage	Storage Description
#1	852.38'	11,310 cf	**48.0"D x 180.00'L Horizontal Cylinder S= 0.0010 '/'** x 5
#2	852.38'	704 cf	**48.0"D x 28.00'L Horizontal Cylinder** x 2
#3	856.38'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder**
#4	852.38'	1,448 cf	**24.0"D x 461.00'L Horizontal Cylinder S= 0.0050 '/'**
#5	854.67'	64 cf	**4.00'D x 5.10'H Vertical Cone/Cylinder**
#6	859.75'	505 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		14,200 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
859.75	10	0	0
860.75	1,000	505	505

Device	Routing	Invert	Outlet Devices
#1	Primary	852.20'	**24.0" x 49.0' long Culvert** CPP, mitered to conform to fill, Ke= 0.700 Outlet Invert= 851.96' S= 0.0049 '/' Cc= 0.900 n= 0.010 PVC, smooth interior
#2	Device 1	852.20'	**Custom Weir/Orifice, C= 2.62** Head (feet) 0.00 0.50 0.50 1.00 1.00 2.00 2.00 3.00 3.00 4.00 Width (feet) 1.04 1.04 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
#3	Device 1	856.40'	**5.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Secondary	860.20'	**50.0' long (Profile 6) Broad-Crested Rectangular Weir** Head (feet) 0.49 0.98 1.48 Coef. (English) 3.12 3.41 3.59

Primary OutFlow Max=3.76 cfs @ 12.22 hrs HW=854.62' (Free Discharge)
└**1=Culvert** (Passes 3.76 cfs of 15.65 cfs potential flow)
└**2=Custom Weir/Orifice** (Orifice Controls 3.76 cfs @ 7.23 fps)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=852.38' (Free Discharge)
└**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: South & East Green Areas Runoff Area=37,650 sf Runoff Depth>2.00"
Flow Length=75' Slope=0.0050 '/' Tc=14.5 min CN=61 Runoff=2.18 cfs 0.144 af

Subcatchment 2S: Grand Ave. Runoff Area=67,373 sf Runoff Depth>4.72"
Flow Length=605' Tc=15.3 min CN=89 Runoff=8.91 cfs 0.609 af

Subcatchment 3S: RAMP Runoff Area=50,000 sf Runoff Depth>5.76"
Flow Length=200' Slope=0.0100 '/' Tc=1.6 min CN=98 Runoff=10.58 cfs 0.551 af

Pond 1P: PIPE GALLERY Peak Elev=856.31' Storage=13,314 cf Inflow=15.45 cfs 1.160 af
Primary=5.02 cfs 1.159 af Secondary=0.00 cfs 0.000 af Outflow=5.02 cfs 1.159 af

Total Runoff Area = 3.559 ac Runoff Volume = 1.304 af Average Runoff Depth = 4.40"
34.74% Pervious Area = 1.236 ac 65.26% Impervious Area = 2.323 ac

Subcatchment 1S: South & East Green Areas

Runoff = 2.18 cfs @ 12.08 hrs, Volume= 0.144 af, Depth> 2.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YR Rainfall=6.00"

Area (sf)	CN	Description
37,650	61	>75% Grass cover, Good, HSG B
37,650		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	75	0.0050	0.09		**Sheet Flow, East Grass Area** Grass: Short n= 0.150 P2= 2.80"

Subcatchment 2S: Grand Ave.

Runoff = 8.91 cfs @ 12.07 hrs, Volume= 0.609 af, Depth> 4.72"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YR Rainfall=6.00"

Area (sf)	CN	Description
57,873	88	Urban industrial, 72% imp, HSG B
9,500	98	Paved parking & roofs
67,373	89	Weighted Average
16,204		Pervious Area
51,169		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.8	100	0.0100	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.3	45	0.0200	2.87		**Shallow Concentrated Flow, Grand Ave.** Paved Kv= 20.3 fps
1.2	460	0.0050	6.62	20.80	**Circular Channel (pipe),** Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.010 PVC, smooth interior
15.3	605	Total			

Subcatchment 3S: RAMP

[49] Hint: Tc<2dt may require smaller dt

Runoff = 10.58 cfs @ 11.90 hrs, Volume= 0.551 af, Depth> 5.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-YR Rainfall=6.00"

Area (sf)	CN	Description
50,000	98	Paved parking & roofs
50,000		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	200	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps

Pond 1P: PIPE GALLERY

Inflow Area = 2.695 ac, Inflow Depth > 5.16" for 100-YR event
Inflow = 15.45 cfs @ 11.92 hrs, Volume= 1.160 af
Outflow = 5.02 cfs @ 12.26 hrs, Volume= 1.159 af, Atten= 68%, Lag= 19.9 min
Primary = 5.02 cfs @ 12.26 hrs, Volume= 1.159 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 856.31' @ 12.26 hrs Surf.Area= 1,526 sf Storage= 13,314 cf

Plug-Flow detention time= 19.2 min calculated for 1.157 af (100% of inflow)
Center-of-Mass det. time= 19.0 min (784.7 - 765.6)

Volume	Invert	Avail.Storage	Storage Description
#1	852.38'	11,310 cf	**48.0"D x 180.00'L Horizontal Cylinder S= 0.0010 '/'** x 5
#2	852.38'	704 cf	**48.0"D x 28.00'L Horizontal Cylinder** x 2
#3	856.38'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder**
#4	852.38'	1,448 cf	**24.0"D x 461.00'L Horizontal Cylinder S= 0.0050 '/'**
#5	854.67'	64 cf	**4.00'D x 5.10'H Vertical Cone/Cylinder**
#6	859.75'	505 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		14,200 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
859.75	10	0	0
860.75	1,000	505	505

Device	Routing	Invert	Outlet Devices
#1	Primary	852.20'	**24.0" x 49.0' long Culvert** CPP, mitered to conform to fill, Ke= 0.700 Outlet Invert= 851.96' S= 0.0049 '/' Cc= 0.900 n= 0.010 PVC, smooth interior
#2	Device 1	852.20'	**Custom Weir/Orifice, C= 2.62** Head (feet) 0.00 0.50 0.50 1.00 1.00 2.00 2.00 3.00 3.00 4.00 Width (feet) 1.04 1.04 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
#3	Device 1	856.40'	**5.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Secondary	860.20'	**50.0' long (Profile 6) Broad-Crested Rectangular Weir** Head (feet) 0.49 0.98 1.48 Coef. (English) 3.12 3.41 3.59

Primary OutFlow Max=5.02 cfs @ 12.26 hrs HW=856.31' (Free Discharge)
└**1=Culvert** (Passes 5.02 cfs of 23.52 cfs potential flow)
└**2=Custom Weir/Orifice** (Orifice Controls 5.02 cfs @ 9.64 fps)
└**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=852.38' (Free Discharge)
└**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

APPENDIX D

Storm Water Management Report

University of St. Thomas
Soccer/ Softball Field Improvements
(Synthetic Turf)

February 11, 2013

ANDERSON - JOHNSON ASSOCIATES, INC.
AJA
LANDSCAPE ARCHITECTURE • SITE PLANNING • CIVIL ENGINEERING

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UNIVERSITY OF ST. THOMAS
SOCCER/ SOFTBALL FIELD IMPROVEMENTS

DESIGN NARRATIVE

University of St. Thomas (South Field), located at 2215 Summit Avenue in Saint Paul, is proposing to reconstruct their existing grass play field which lies in the northwest corner of the Cretin Avenue/ Goodrich Avenue intersection. A parking garage and building lie north of the field, a parking lot is located immediately west of the play field.

University of St. Thomas (UST) has been raising money for this project for a couple of years, and the administration recently gave the green light to proceed with efforts to obtain city and watershed permits and begin construction in mid-May. It is anticipated that construction will take approximately 10 weeks, which essentially involves scraping off 20 inches of grass and soil and replacing them with a 12" depth of sand, 8" depth of porous aggregate material, and topped with artificial turf. UST also plans to replace the old bleachers on the west side of the field, just east of Binz Refectory. There will be no lights on the field.

UST uses the South Field extensively as a practice and game field for their men's and women's soccer teams, women's softball team, intramural sports, other recreational use by students, and youth camps that their coaches hold during the summer. This kind of heavy use is rough on grass, and UST will get significantly more efficient use out of the fields with artificial turf. Soccer, in particular, will benefit by having a more "even" surface on which to play. UST has seen similar positive changes in the usability and durability of their football and baseball infield on the main campus since they converted them to turf about eight years ago.

The project, which disturbs more that one acre, triggers Watershed District review and approval of the proposed improvements. Therefore, University of St. Thomas is seeking approval of plans and calculations related to Rule C Stormwater Management and Rule F Erosion and Sediment Control. There are no wetlands on site and the site is not within a floodplain.

The artificial turf system (3.195 acres) will act as a filtration device allowing water to pass through the system and ultimately drained via drain tile. Therefore, the calculations reflect the full field surface utilized as a surface filtration device. These tile lines will direct water to an underground storage area. The purpose of the underground storage is to mitigate the flow to meet the City of St. Paul's 1.64 cfs/acre rule.

In summary, rate control and volume control have been met on site using the turf field as a filtration device to meet Watershed District rules and subsurface features to meet both City of St. Paul and Watershed District rules.

University of St. Thomas
Soccer / Softball Field Improvements
Drainage Summary

Link "SUM" - Existing

Event	Inflow Peak Flow (cfs)	Outflow Elevation (ft)	Outflow Peak Flow (cfs)
2 Yr	3.84	n/a	3.84
10 Yr	7.59	n/a	7.59
100 Yr	12.72	n/a	12.72

Link "SUM" - Proposed

Event	Inflow Peak Flow (cfs)	Outflow Elevation (ft)	Outflow Peak Flow (cfs)	Design OK?
2 Yr	1.57	n/a	1.57	YES
10 Yr	3.26	n/a	3.26	YES
100 Yr	5.12	n/a	5.12	YES

City of St. Paul flow standards: 1.64 cfs / acre max flow

Total Acres Disturbed:		4.537	Acres	
Max flow / Acre:		1.64	cfs / Acre	
Total Allowable Flow from Site:		7.44	cfs	
	Is	5.12	<	7.44 ?
Design OK?		**YES**		

ANDERSON - JOHNSON ASSOCIATES, INC.

LANDSCAPE ARCHITECTURE • SITE PLANNING • CIVIL ENGINEERING

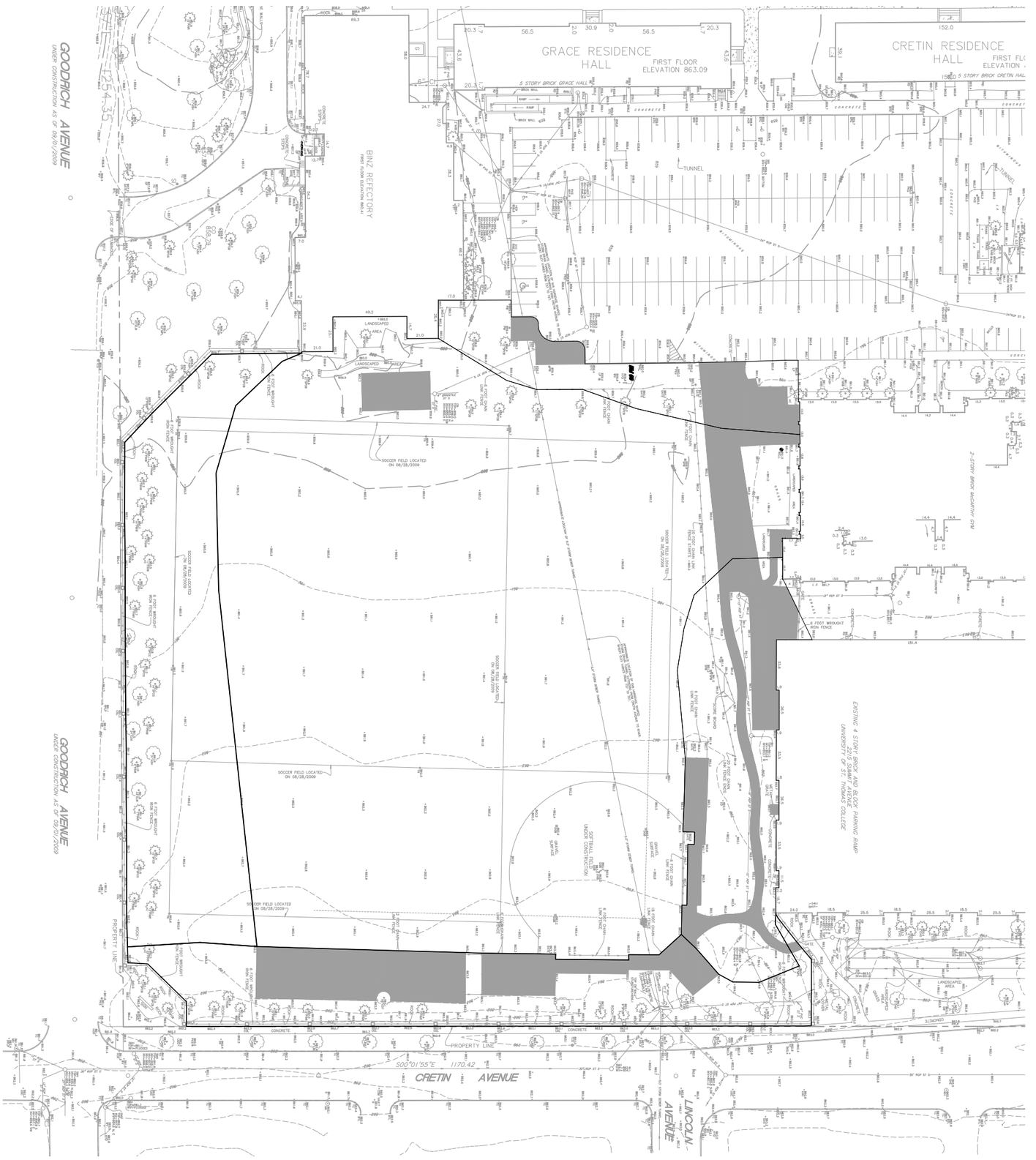
HydroCAD® Calculations

Existing Conditions

University of St. Thomas
Soccer / Softball Field Improvements
EXISTING CONDITIONS - DRAINAGE AREAS

AREA	PERVIOUS	IMPERVIOUS	TOTAL
E1	0.304 acres	0.172 acres	0.476 acres
E2	0.616 acres	0.000 acres	0.616 acres
E3	0.138 acres	0.071 acres	0.209 acres
E4	2.752 acres	0.087 acres	2.839 acres
E5	0.260 acres	0.137 acres	0.397 acres

TOTAL AREA	4.070 acres	0.467 acres	4.537 acres



Sheet
EX1
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SOCCER/SOFTBALL FIELD IMPROVEMENTS
UNIVERSITY OF ST. THOMAS
ST. PAUL, MINNESOTA

UNIVERSITY OF ST. THOMAS
2115 Summit Avenue
St. Paul, Minnesota 55105

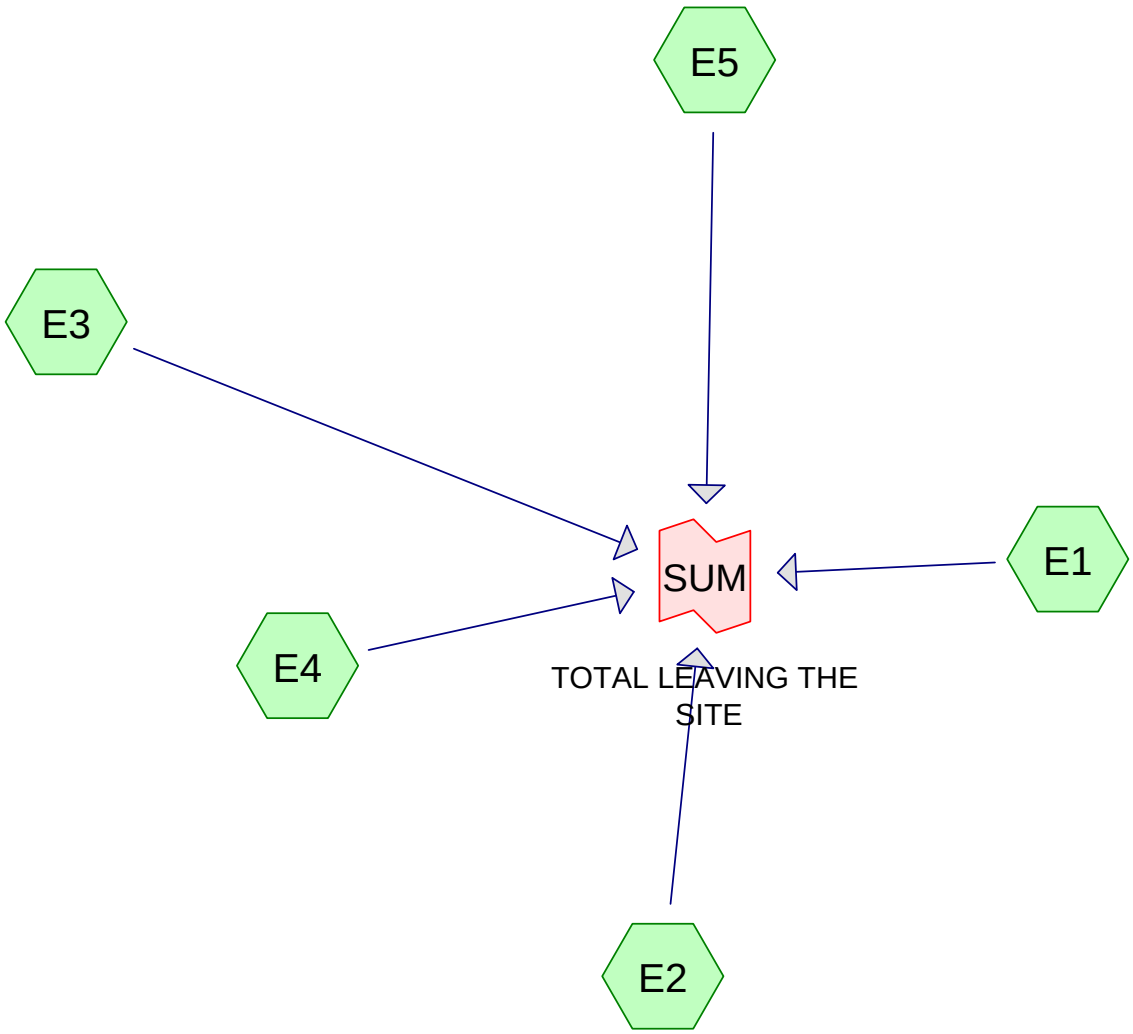
ANDERSON - JOHNSON ASSOCIATES, INC.
LANDSCAPE ARCHITECTURE • *SITE PLANNING* • *CIVIL ENGINEERING*
7575 GOLDEN VALLEY ROAD • *SUITE 200* • *MINNEAPOLIS, MN. 55427*
FAX (763) 544-0531 • *PH (763) 544-7129*

I hereby certify that this plan was prepared by me or under my direct supervision and that I am a duly licensed Landscape Architect under the laws of the State of Minnesota.

JAY R. POMEROY
Reg. No. 23543 Date 01/25/2013

EXISTING DRAINAGE AREA MAP

Project No. 12127
Date 01/25/2013
Drawn By JRP
Ck. By JRP
Revisions



Subcat Reach Pond Link

Routing Diagram for Existing
Prepared by Microsoft, Printed 2/11/2013
HydroCAD® 10.00 s/n 01280 © 2011 HydroCAD Software Solutions LLC

Summary for Subcatchment E1:

Runoff = 0.80 cfs @ 12.14 hrs, Volume= 0.062 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 yr storm Rainfall=2.80"

Area (ac)	CN	Description
0.304	80	>75% Grass cover, Good, HSG D
0.172	98	Unconnected pavement, HSG D
0.476	87	Weighted Average
0.304		63.87% Pervious Area
0.172		36.13% Impervious Area
0.172		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	50	0.0150	0.08		**Sheet Flow, Grass Area** Grass: Dense n= 0.240 P2= 2.80"
11.7	450	0.0010	0.64		**Shallow Concentrated Flow, Curb** Paved Kv= 20.3 fps
21.5	500	Total			

Summary for Subcatchment E2:

Runoff = 0.68 cfs @ 12.17 hrs, Volume= 0.057 af, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 yr storm Rainfall=2.80"

Area (ac)	CN	Description
0.616	80	>75% Grass cover, Good, HSG D
0.000	98	Unconnected pavement, HSG D
0.616	80	Weighted Average
0.616		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.7	120	0.0120	0.09		**Sheet Flow, Grass Field** Grass: Dense n= 0.240 P2= 2.80"
1.1	100	0.0100	1.50		**Shallow Concentrated Flow, shallow grass swale** Grassed Waterway Kv= 15.0 fps
22.8	220	Total			

Summary for Subcatchment E3:

Runoff = 0.49 cfs @ 12.01 hrs, Volume= 0.026 af, Depth= 1.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 yr storm Rainfall=2.80"

Area (ac)	CN	Description
0.138	80	>75% Grass cover, Good, HSG D
0.071	98	Paved parking, HSG D
0.209	86	Weighted Average
0.138		66.03% Pervious Area
0.071		33.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	55	0.0200	0.10		**Sheet Flow, Grass Area** Grass: Dense n= 0.240 P2= 2.80"

Summary for Subcatchment E4:

Runoff = 2.33 cfs @ 12.35 hrs, Volume= 0.275 af, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 yr storm Rainfall=2.80"

Area (ac)	CN	Description
2.752	80	>75% Grass cover, Good, HSG D
0.087	98	Paved parking, HSG D
2.839	81	Weighted Average
2.752		96.94% Pervious Area
0.087		3.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.0	250	0.0120	0.11		**Sheet Flow, Grass Field** Grass: Dense n= 0.240 P2= 2.80"

Summary for Subcatchment E5:

Runoff = 0.76 cfs @ 12.08 hrs, Volume= 0.049 af, Depth= 1.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 yr storm Rainfall=2.80"

Area (ac)	CN	Description
0.260	80	>75% Grass cover, Good, HSG D
0.137	98	Paved parking, HSG D
0.397	86	Weighted Average
0.260		65.49% Pervious Area
0.137		34.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	75	0.0110	0.08		**Sheet Flow, Grass Area**
					Grass: Dense n= 0.240 P2= 2.80"

Summary for Link SUM: TOTAL LEAVING THE SITE

Inflow Area = 4.537 ac, 10.29% Impervious, Inflow Depth = 1.24" for 2 yr storm event
Inflow = 3.84 cfs @ 12.19 hrs, Volume= 0.469 af
Primary = 3.84 cfs @ 12.19 hrs, Volume= 0.469 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs

Summary for Subcatchment E1:

Runoff = 1.42 cfs @ 12.14 hrs, Volume= 0.112 af, Depth= 2.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 yr storm Rainfall=4.20"

Area (ac)	CN	Description
0.304	80	>75% Grass cover, Good, HSG D
0.172	98	Unconnected pavement, HSG D
0.476	87	Weighted Average
0.304		63.87% Pervious Area
0.172		36.13% Impervious Area
0.172		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	50	0.0150	0.08		**Sheet Flow, Grass Area** Grass: Dense n= 0.240 P2= 2.80"
11.7	450	0.0010	0.64		**Shallow Concentrated Flow, Curb** Paved Kv= 20.3 fps
21.5	500	Total			

Summary for Subcatchment E2:

Runoff = 1.40 cfs @ 12.16 hrs, Volume= 0.113 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 yr storm Rainfall=4.20"

Area (ac)	CN	Description
0.616	80	>75% Grass cover, Good, HSG D
0.000	98	Unconnected pavement, HSG D
0.616	80	Weighted Average
0.616		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.7	120	0.0120	0.09		**Sheet Flow, Grass Field** Grass: Dense n= 0.240 P2= 2.80"
1.1	100	0.0100	1.50		**Shallow Concentrated Flow, shallow grass swale** Grassed Waterway Kv= 15.0 fps
22.8	220	Total			

Summary for Subcatchment E3:

Runoff = 0.88 cfs @ 12.01 hrs, Volume= 0.048 af, Depth= 2.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 yr storm Rainfall=4.20"

Area (ac)	CN	Description
0.138	80	>75% Grass cover, Good, HSG D
0.071	98	Paved parking, HSG D
0.209	86	Weighted Average
0.138		66.03% Pervious Area
0.071		33.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	55	0.0200	0.10		**Sheet Flow, Grass Area** Grass: Dense n= 0.240 P2= 2.80"

Summary for Subcatchment E4:

Runoff = 4.73 cfs @ 12.35 hrs, Volume= 0.542 af, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 yr storm Rainfall=4.20"

Area (ac)	CN	Description
2.752	80	>75% Grass cover, Good, HSG D
0.087	98	Paved parking, HSG D
2.839	81	Weighted Average
2.752		96.94% Pervious Area
0.087		3.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.0	250	0.0120	0.11		**Sheet Flow, Grass Field** Grass: Dense n= 0.240 P2= 2.80"

Summary for Subcatchment E5:

Runoff = 1.37 cfs @ 12.07 hrs, Volume= 0.090 af, Depth= 2.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 yr storm Rainfall=4.20"

Area (ac)	CN	Description
0.260	80	>75% Grass cover, Good, HSG D
0.137	98	Paved parking, HSG D
0.397	86	Weighted Average
0.260		65.49% Pervious Area
0.137		34.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	75	0.0110	0.08		**Sheet Flow, Grass Area**
					Grass: Dense n= 0.240 P2= 2.80"

Summary for Link SUM: TOTAL LEAVING THE SITE

Inflow Area = 4.537 ac, 10.29% Impervious, Inflow Depth = 2.39" for 10 yr storm event
Inflow = 7.59 cfs @ 12.19 hrs, Volume= 0.905 af
Primary = 7.59 cfs @ 12.19 hrs, Volume= 0.905 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs

Summary for Subcatchment E1:

Runoff = 2.24 cfs @ 12.14 hrs, Volume= 0.179 af, Depth= 4.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr storm Rainfall=6.00"

Area (ac)	CN	Description
0.304	80	>75% Grass cover, Good, HSG D
0.172	98	Unconnected pavement, HSG D
0.476	87	Weighted Average
0.304		63.87% Pervious Area
0.172		36.13% Impervious Area
0.172		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	50	0.0150	0.08		**Sheet Flow, Grass Area** Grass: Dense n= 0.240 P2= 2.80"
11.7	450	0.0010	0.64		**Shallow Concentrated Flow, Curb** Paved Kv= 20.3 fps
21.5	500	Total			

Summary for Subcatchment E2:

Runoff = 2.39 cfs @ 12.16 hrs, Volume= 0.194 af, Depth= 3.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr storm Rainfall=6.00"

Area (ac)	CN	Description
0.616	80	>75% Grass cover, Good, HSG D
0.000	98	Unconnected pavement, HSG D
0.616	80	Weighted Average
0.616		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.7	120	0.0120	0.09		**Sheet Flow, Grass Field** Grass: Dense n= 0.240 P2= 2.80"
1.1	100	0.0100	1.50		**Shallow Concentrated Flow, shallow grass swale** Grassed Waterway Kv= 15.0 fps
22.8	220	Total			

Summary for Subcatchment E3:

Runoff = 1.39 cfs @ 12.01 hrs, Volume= 0.077 af, Depth= 4.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr storm Rainfall=6.00"

Area (ac)	CN	Description
0.138	80	>75% Grass cover, Good, HSG D
0.071	98	Paved parking, HSG D
0.209	86	Weighted Average
0.138		66.03% Pervious Area
0.071		33.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	55	0.0200	0.10		**Sheet Flow, Grass Area** Grass: Dense n= 0.240 P2= 2.80"

Summary for Subcatchment E4:

Runoff = 8.04 cfs @ 12.35 hrs, Volume= 0.919 af, Depth= 3.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr storm Rainfall=6.00"

Area (ac)	CN	Description
2.752	80	>75% Grass cover, Good, HSG D
0.087	98	Paved parking, HSG D
2.839	81	Weighted Average
2.752		96.94% Pervious Area
0.087		3.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.0	250	0.0120	0.11		**Sheet Flow, Grass Field** Grass: Dense n= 0.240 P2= 2.80"

Summary for Subcatchment E5:

Runoff = 2.18 cfs @ 12.07 hrs, Volume= 0.146 af, Depth= 4.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr storm Rainfall=6.00"

Area (ac)	CN	Description
0.260	80	>75% Grass cover, Good, HSG D
0.137	98	Paved parking, HSG D
0.397	86	Weighted Average
0.260		65.49% Pervious Area
0.137		34.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	75	0.0110	0.08		**Sheet Flow, Grass Area** Grass: Dense n= 0.240 P2= 2.80"

Summary for Link SUM: TOTAL LEAVING THE SITE

Inflow Area = 4.537 ac, 10.29% Impervious, Inflow Depth = 4.01" for 100 yr storm event
Inflow = 12.72 cfs @ 12.19 hrs, Volume= 1.515 af
Primary = 12.72 cfs @ 12.19 hrs, Volume= 1.515 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs

ANDERSON - JOHNSON ASSOCIATES, INC.

LANDSCAPE ARCHITECTURE • SITE PLANNING • CIVIL ENGINEERING

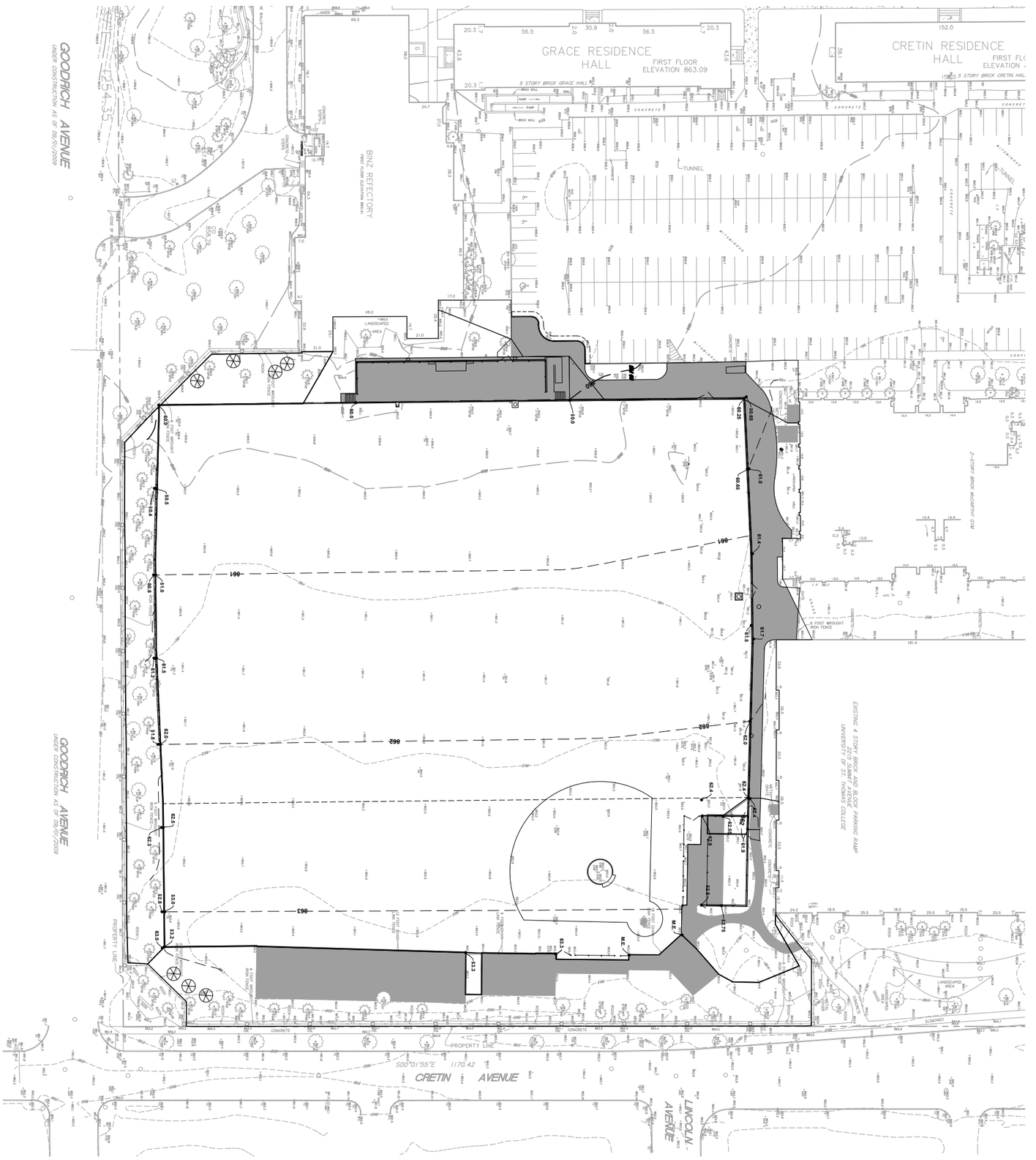
HydroCAD® Calculations

Proposed Conditions

University of St. Thomas
Soccer / Softball Field Improvements
PROPOSED CONDITIONS - DRAINAGE AREAS

AREA	PERVIOUS	IMPERVIOUS	TOTAL
P1	0.297 acres	0.172 acres	0.469 acres
P2	0.253 acres	0.000 acres	0.253 acres
P3	0.052 acres	0.071 acres	0.123 acres
P4	3.330 acres	0.210 acres	3.539 acres
P5	0.095 acres	0.058 acres	0.153 acres

TOTAL AREA	4.027 acres	0.510 acres	4.537 acres



Sheet
EX2
of 7

SOCCER/SOFTBALL FIELD IMPROVEMENTS
UNIVERSITY OF ST. THOMAS
ST. PAUL, MINNESOTA

UNIVERSITY OF ST. THOMAS
2115 Summit Avenue
St. Paul, Minnesota 55105

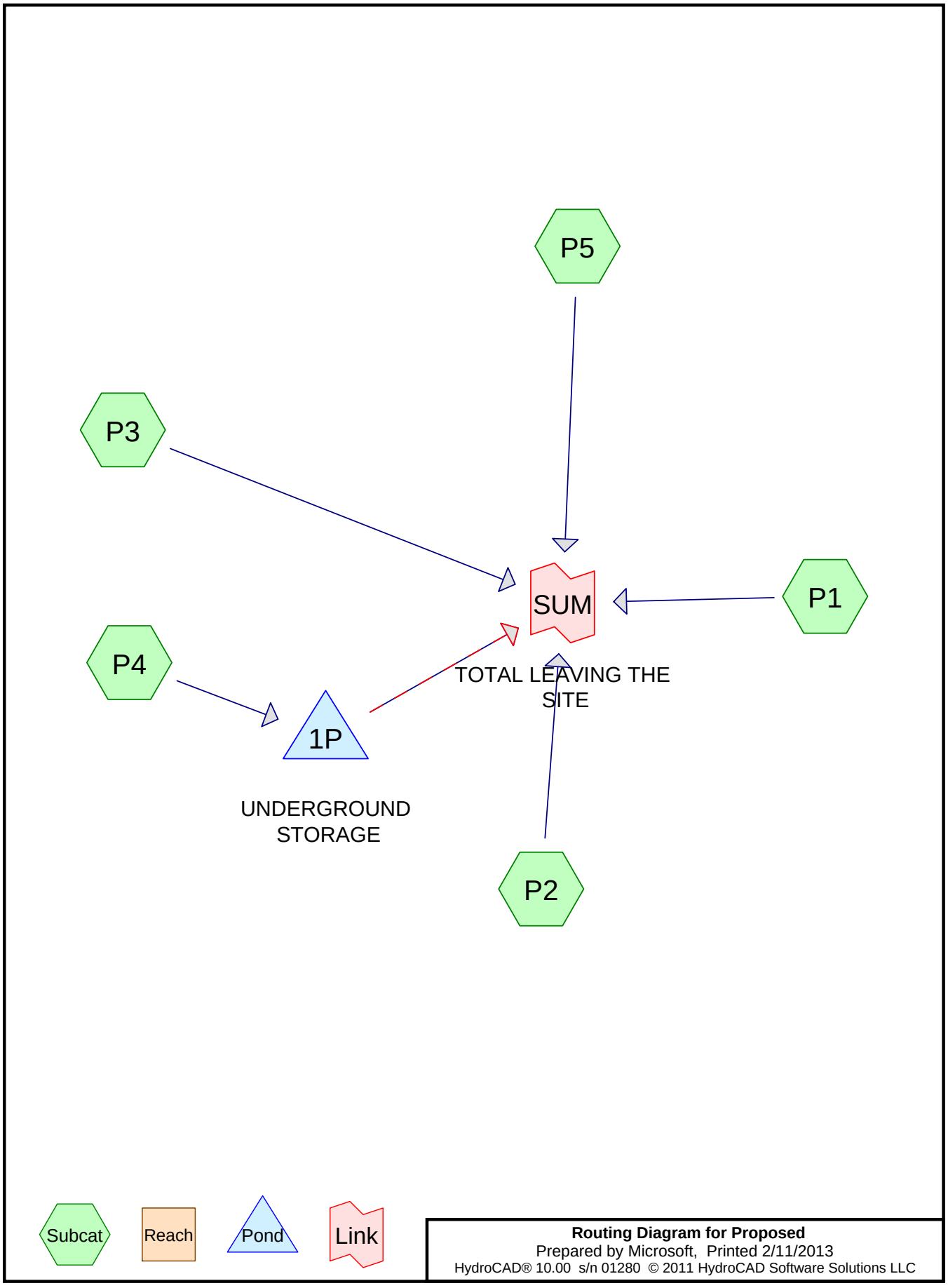
ANDERSON - JOHNSON ASSOCIATES, INC.
LANDSCAPE ARCHITECTURE • *SITE PLANNING* • *CIVIL ENGINEERING*
7575 GOLDEN VALLEY ROAD • SUITE 200 • MINNEAPOLIS, MN 55427
FAX (763) 544-0531 • PH (763) 544-7129

I hereby certify that this plan was prepared by me or under my direct supervision and that I am a duly licensed Landscape Architect under the laws of the State of Minnesota.

JAY R. POMEROY
Reg. No. 23543 Date 01/25/2013

PROPOSED DRAINAGE AREA MAP

Project No. 12127
Date 01/25/2013
Drawn By JRP
Ck. By JRP
Revisions



Routing Diagram for Proposed
Prepared by Microsoft, Printed 2/11/2013
HydroCAD® 10.00 s/n 01280 © 2011 HydroCAD Software Solutions LLC

Summary for Subcatchment P1:

Runoff = 0.78 cfs @ 12.14 hrs, Volume= 0.061 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 yr storm Rainfall=2.80"

Area (ac)	CN	Description
0.297	80	>75% Grass cover, Good, HSG D
0.172	98	Unconnected pavement, HSG D
0.469	87	Weighted Average
0.297		63.33% Pervious Area
0.172		36.67% Impervious Area
0.172		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	50	0.0150	0.08		**Sheet Flow, Grass Area** Grass: Dense n= 0.240 P2= 2.80"
11.7	450	0.0010	0.64		**Shallow Concentrated Flow, Curb** Paved Kv= 20.3 fps
21.5	500	Total			

Summary for Subcatchment P2:

Runoff = 0.28 cfs @ 12.17 hrs, Volume= 0.023 af, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 yr storm Rainfall=2.80"

Area (ac)	CN	Description
0.253	80	>75% Grass cover, Good, HSG D
0.000	98	Unconnected pavement, HSG D
0.253	80	Weighted Average
0.253		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.7	120	0.0120	0.09		**Sheet Flow, Grass Field** Grass: Dense n= 0.240 P2= 2.80"
1.1	100	0.0100	1.50		**Shallow Concentrated Flow, shallow grass swale** Grassed Waterway Kv= 15.0 fps
22.8	220	Total			

Summary for Subcatchment P3:

Runoff = 0.34 cfs @ 12.01 hrs, Volume= 0.018 af, Depth= 1.80"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 yr storm Rainfall=2.80"

Area (ac)	CN	Description
0.052	80	>75% Grass cover, Good, HSG D
0.071	98	Paved parking, HSG D
0.123	90	Weighted Average
0.052		42.28% Pervious Area
0.071		57.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	55	0.0200	0.10		**Sheet Flow, Grass Area** Grass: Dense n= 0.240 P2= 2.80"

Summary for Subcatchment P4:

Runoff = 1.78 cfs @ 12.39 hrs, Volume= 0.231 af, Depth= 0.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 yr storm Rainfall=2.80"

	Area (ac)	CN	Description
	0.135	80	>75% Grass cover, Good, HSG D
	0.210	98	Paved parking, HSG D
*	3.195	72	Turf Field
	3.540	74	Weighted Average
	3.330		94.07% Pervious Area
	0.210		5.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.0	250	0.0120	0.11		**Sheet Flow, Grass Field** Grass: Dense n= 0.240 P2= 2.80"

Summary for Subcatchment P5:

Runoff = 0.31 cfs @ 12.07 hrs, Volume= 0.020 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 2 yr storm Rainfall=2.80"

Area (ac)	CN	Description
0.095	80	>75% Grass cover, Good, HSG D
0.058	98	Paved parking, HSG D
0.153	87	Weighted Average
0.095		62.09% Pervious Area
0.058		37.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	75	0.0110	0.08		**Sheet Flow, Grass Area** Grass: Dense n= 0.240 P2= 2.80"

Summary for Pond 1P: UNDERGROUND STORAGE

Inflow Area = 3.540 ac, 5.93% Impervious, Inflow Depth = 0.78" for 2 yr storm event
Inflow = 1.78 cfs @ 12.39 hrs, Volume= 0.231 af
Outflow = 0.68 cfs @ 13.00 hrs, Volume= 0.231 af, Atten= 62%, Lag= 36.2 min
Primary = 0.68 cfs @ 13.00 hrs, Volume= 0.231 af
Secondary = 0.00 cfs @ 0.10 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Peak Elev= 855.56' @ 13.00 hrs Surf.Area= 0.170 ac Storage= 0.062 af
Flood Elev= 859.30' Surf.Area= 0.170 ac Storage= 0.384 af

Plug-Flow detention time= 62.8 min calculated for 0.231 af (100% of inflow)
Center-of-Mass det. time= 62.8 min (961.1 - 898.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	854.80'	0.164 af	**39.50'W x 187.56'L x 4.50'H Field A** 0.765 af Overall - 0.220 af Embedded = 0.545 af x 30.0% Voids
#2A	855.30'	0.220 af	**StormTech SC-740** x 208 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.45 sf x 8 rows
		0.384 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	854.80'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Secondary	860.00'	**110.0' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.68 cfs @ 13.00 hrs HW=855.56' (Free Discharge)
1=Orifice/Grate (Orifice Controls 0.68 cfs @ 3.46 fps)

Secondary OutFlow Max=0.00 cfs @ 0.10 hrs HW=854.80' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Link SUM: TOTAL LEAVING THE SITE

Inflow Area = 4.538 ac, 11.26% Impervious, Inflow Depth = 0.94" for 2 yr storm event
Inflow = 1.57 cfs @ 12.11 hrs, Volume= 0.354 af
Primary = 1.57 cfs @ 12.11 hrs, Volume= 0.354 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs

Summary for Subcatchment P1:

Runoff = 1.40 cfs @ 12.14 hrs, Volume= 0.110 af, Depth= 2.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 yr storm Rainfall=4.20"

Area (ac)	CN	Description
0.297	80	>75% Grass cover, Good, HSG D
0.172	98	Unconnected pavement, HSG D
0.469	87	Weighted Average
0.297		63.33% Pervious Area
0.172		36.67% Impervious Area
0.172		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	50	0.0150	0.08		**Sheet Flow, Grass Area** Grass: Dense n= 0.240 P2= 2.80"
11.7	450	0.0010	0.64		**Shallow Concentrated Flow, Curb** Paved Kv= 20.3 fps
21.5	500	Total			

Summary for Subcatchment P2:

Runoff = 0.57 cfs @ 12.16 hrs, Volume= 0.047 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 yr storm Rainfall=4.20"

Area (ac)	CN	Description
0.253	80	>75% Grass cover, Good, HSG D
0.000	98	Unconnected pavement, HSG D
0.253	80	Weighted Average
0.253		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.7	120	0.0120	0.09		**Sheet Flow, Grass Field** Grass: Dense n= 0.240 P2= 2.80"
1.1	100	0.0100	1.50		**Shallow Concentrated Flow, shallow grass swale** Grassed Waterway Kv= 15.0 fps
22.8	220	Total			

Summary for Subcatchment P3:

Runoff = 0.57 cfs @ 12.01 hrs, Volume= 0.032 af, Depth= 3.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 yr storm Rainfall=4.20"

Area (ac)	CN	Description
0.052	80	>75% Grass cover, Good, HSG D
0.071	98	Paved parking, HSG D
0.123	90	Weighted Average
0.052		42.28% Pervious Area
0.071		57.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	55	0.0200	0.10		**Sheet Flow, Grass Area** Grass: Dense n= 0.240 P2= 2.80"

Summary for Subcatchment P4:

Runoff = 4.36 cfs @ 12.35 hrs, Volume= 0.515 af, Depth= 1.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 yr storm Rainfall=4.20"

	Area (ac)	CN	Description
	0.135	80	>75% Grass cover, Good, HSG D
	0.210	98	Paved parking, HSG D
*	3.195	72	Turf Field
	3.540	74	Weighted Average
	3.330		94.07% Pervious Area
	0.210		5.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.0	250	0.0120	0.11		**Sheet Flow, Grass Field** Grass: Dense n= 0.240 P2= 2.80"

Summary for Subcatchment P5:

Runoff = 0.54 cfs @ 12.07 hrs, Volume= 0.036 af, Depth= 2.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 10 yr storm Rainfall=4.20"

Area (ac)	CN	Description
0.095	80	>75% Grass cover, Good, HSG D
0.058	98	Paved parking, HSG D
0.153	87	Weighted Average
0.095		62.09% Pervious Area
0.058		37.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	75	0.0110	0.08		**Sheet Flow, Grass Area** Grass: Dense n= 0.240 P2= 2.80"

Summary for Pond 1P: UNDERGROUND STORAGE

Inflow Area = 3.540 ac, 5.93% Impervious, Inflow Depth = 1.74" for 10 yr storm event
Inflow = 4.36 cfs @ 12.35 hrs, Volume= 0.515 af
Outflow = 1.15 cfs @ 13.15 hrs, Volume= 0.515 af, Atten= 74%, Lag= 47.5 min
Primary = 1.15 cfs @ 13.15 hrs, Volume= 0.515 af
Secondary = 0.00 cfs @ 0.10 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Peak Elev= 856.53' @ 13.15 hrs Surf.Area= 0.170 ac Storage= 0.188 af
Flood Elev= 859.30' Surf.Area= 0.170 ac Storage= 0.384 af

Plug-Flow detention time= 85.3 min calculated for 0.515 af (100% of inflow)
Center-of-Mass det. time= 85.2 min (958.9 - 873.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	854.80'	0.164 af	**39.50'W x 187.56'L x 4.50'H Field A** 0.765 af Overall - 0.220 af Embedded = 0.545 af x 30.0% Voids
#2A	855.30'	0.220 af	**StormTech SC-740** x 208 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.45 sf x 8 rows
		0.384 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	854.80'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Secondary	860.00'	**110.0' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.15 cfs @ 13.15 hrs HW=856.53' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 1.15 cfs @ 5.86 fps)

Secondary OutFlow Max=0.00 cfs @ 0.10 hrs HW=854.80' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link SUM: TOTAL LEAVING THE SITE

Inflow Area = 4.538 ac, 11.26% Impervious, Inflow Depth = 1.95" for 10 yr storm event
Inflow = 3.26 cfs @ 12.11 hrs, Volume= 0.739 af
Primary = 3.26 cfs @ 12.11 hrs, Volume= 0.739 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs

Summary for Subcatchment P1:

Runoff = 2.21 cfs @ 12.14 hrs, Volume= 0.177 af, Depth= 4.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr storm Rainfall=6.00"

Area (ac)	CN	Description
0.297	80	>75% Grass cover, Good, HSG D
0.172	98	Unconnected pavement, HSG D
0.469	87	Weighted Average
0.297		63.33% Pervious Area
0.172		36.67% Impervious Area
0.172		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	50	0.0150	0.08		**Sheet Flow, Grass Area** Grass: Dense n= 0.240 P2= 2.80"
11.7	450	0.0010	0.64		**Shallow Concentrated Flow, Curb** Paved Kv= 20.3 fps
21.5	500	Total			

Summary for Subcatchment P2:

Runoff = 0.98 cfs @ 12.16 hrs, Volume= 0.080 af, Depth= 3.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr storm Rainfall=6.00"

Area (ac)	CN	Description
0.253	80	>75% Grass cover, Good, HSG D
0.000	98	Unconnected pavement, HSG D
0.253	80	Weighted Average
0.253		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.7	120	0.0120	0.09		**Sheet Flow, Grass Field** Grass: Dense n= 0.240 P2= 2.80"
1.1	100	0.0100	1.50		**Shallow Concentrated Flow, shallow grass swale** Grassed Waterway Kv= 15.0 fps
22.8	220	Total			

Summary for Subcatchment P3:

Runoff = 0.87 cfs @ 12.01 hrs, Volume= 0.050 af, Depth= 4.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr storm Rainfall=6.00"

Area (ac)	CN	Description
0.052	80	>75% Grass cover, Good, HSG D
0.071	98	Paved parking, HSG D
0.123	90	Weighted Average
0.052		42.28% Pervious Area
0.071		57.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	55	0.0200	0.10		**Sheet Flow, Grass Area** Grass: Dense n= 0.240 P2= 2.80"

Summary for Subcatchment P4:

Runoff = 8.19 cfs @ 12.35 hrs, Volume= 0.940 af, Depth= 3.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr storm Rainfall=6.00"

	Area (ac)	CN	Description
	0.135	80	>75% Grass cover, Good, HSG D
	0.210	98	Paved parking, HSG D
*	3.195	72	Turf Field
	3.540	74	Weighted Average
	3.330		94.07% Pervious Area
	0.210		5.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.0	250	0.0120	0.11		**Sheet Flow, Grass Field** Grass: Dense n= 0.240 P2= 2.80"

Summary for Subcatchment P5:

Runoff = 0.86 cfs @ 12.07 hrs, Volume= 0.058 af, Depth= 4.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 100 yr storm Rainfall=6.00"

Area (ac)	CN	Description
0.095	80	>75% Grass cover, Good, HSG D
0.058	98	Paved parking, HSG D
0.153	87	Weighted Average
0.095		62.09% Pervious Area
0.058		37.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.4	75	0.0110	0.08		**Sheet Flow, Grass Area** Grass: Dense n= 0.240 P2= 2.80"

Summary for Pond 1P: UNDERGROUND STORAGE

Inflow Area = 3.540 ac, 5.93% Impervious, Inflow Depth = 3.18" for 100 yr storm event
Inflow = 8.19 cfs @ 12.35 hrs, Volume= 0.940 af
Outflow = 1.95 cfs @ 13.16 hrs, Volume= 0.940 af, Atten= 76%, Lag= 48.6 min
Primary = 1.95 cfs @ 13.16 hrs, Volume= 0.940 af
Secondary = 0.00 cfs @ 0.10 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs
Peak Elev= 859.29' @ 13.16 hrs Surf.Area= 0.170 ac Storage= 0.383 af
Flood Elev= 859.30' Surf.Area= 0.170 ac Storage= 0.384 af

Plug-Flow detention time= 110.0 min calculated for 0.940 af (100% of inflow)
Center-of-Mass det. time= 109.9 min (966.2 - 856.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	854.80'	0.164 af	**39.50'W x 187.56'L x 4.50'H Field A** 0.765 af Overall - 0.220 af Embedded = 0.545 af x 30.0% Voids
#2A	855.30'	0.220 af	**StormTech SC-740** x 208 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap Row Length Adjustment= +0.44' x 6.45 sf x 8 rows
		0.384 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	854.80'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Secondary	860.00'	**110.0' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.95 cfs @ 13.16 hrs HW=859.29' (Free Discharge)
1=Orifice/Grate (Orifice Controls 1.95 cfs @ 9.92 fps)

Secondary OutFlow Max=0.00 cfs @ 0.10 hrs HW=854.80' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Link SUM: TOTAL LEAVING THE SITE

Inflow Area = 4.538 ac, 11.26% Impervious, Inflow Depth = 3.45" for 100 yr storm event
Inflow = 5.12 cfs @ 12.11 hrs, Volume= 1.303 af
Primary = 5.12 cfs @ 12.11 hrs, Volume= 1.303 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.10-72.00 hrs, dt= 0.01 hrs

ANDERSON - JOHNSON ASSOCIATES, INC.

LANDSCAPE ARCHITECTURE • SITE PLANNING • CIVIL ENGINEERING

Volume Control Calculations

University of St. Thomas
Soccer / Softball Field Improvements

Impervious Areas for CRWD calculations

Subwatershed ID	Drainage Area
P1	0.172 Acres
P2	0.000 Acres
P3	0.071 Acres
P4	0.210 Acres
P5	0.058 Acres
New Turf Field	3.195 Acres
Total Impervious Area	3.706 Acres

Capitol Region Watershed District Volume Control Worksheet

Permit Name	University of St. Thomas Soccer / Softball Improvements	Permit Number	
Permit Contact & Phone Number	David Rey, P.E., AJA, phone 763-544-7129		

►Complete the steps below to determine the volume required to be reduced and calculate the proposed amount of volume to be retained. A site plan/map showing impervious surfaces shall also be submitted for review along with other submittal requirements as stated in the District rules.

►Instructions: Fill in the yellow boxes with the requested information. Numbers in the black-outlined boxes will be calculated for you (if filling out electronically). Orange boxes are key totals.

STEP 1: Determine Impervious Surface Areas

(a) Total Site Area: 4.537 acres

(b) Total Impervious Area: 3.70585399 acres x 43,560 sq. ft./acre = 161,427 square feet

STEP 2: Determine Required Volume Reduction Runoff Volume from Impervious Surfaces

161,427	x	1.0	x	0.9	x 0.083333	=	12,107 cubic feet **(c)**
Impervious Area (sq. ft.) from **(b)**.		Inches		Runoff Coefficient	Inches per Foot		Required Volume Reduction (Cu. Ft.)

STEP 3: Determine Infiltration Rate, Drawdown Time and Volume Reduction for Proposed Onsite BMPs.

►For each BMP, select the appropriate hydrological soil group classification and design infiltration rate from Table A. Select the design infiltration rate from Table A based on the least permeable soil horizon within the first five feet below the bottom elevation of the proposed BMP. Enter the infiltration rate in Table B.

►The applicant may complete double-ring infiltrometer test measurements at the proposed bottom elevation of the BMP to the requirements of ASTM D3385. The measured infiltration rate shall be divided by the appropriate correction factor selected from the Minnesota Stormwater Manual. The test must be completed by a licensed soil scientist or engineer.

Table A. Design Infiltration Rates

Soil Group	Rate	Soil Textures	ASTM Unified Soil Class Symbols
A	1.60 in/hr	Gravel, sandy gravel, or silty gravel	GW, GP, GM, SW
	0.80 in/hr	Sand, loamy sand, or sandy loam	SP
B	0.60 in/hr	Silt loam	SM
	0.30 in/hr	Loam	MH
C	0.20 in/hr	Sandy clay loam	ML
D	0.00 in/hr	Clay loam, silty clay loam, sandy clay, silty clay, or clay	GC, SC, CL, OL, CH, OH
Source: *Minnesota Stormwater Manual, November 2005.*			

►Complete Table B by entering the infiltration rate, drawdown time, and drainage area to the BMP. The spreadsheet will then calculate the maximum depth to be retained/infiltrated. That depth can then be used to calculate the appropriate area of the BMPs in Tables D and/or the rock depth below outlet in Table E.

Table B. Volume Reduction BMPs

Volume Reduction BMP ID	Infiltration Rate (in/hr)	Drawdown Time (hr)	Max Water Depth to be Retained/ Infiltrated* (ft)	Drainage Area (acres)
Example: Rain Garden	0.6	48	2.4	0.3
Turf Field Section	1.6	48	6.4	3.53934803
		48		
		48		
Example: Subsurface Trench**	0.8	48	8	1.5
		48		
		48		

* Maximum Depth = ((Infiltration rate/12) x Drawdown time)

**Subsurface trench max depth = ((Infiltration rate/12) x Drawdown time)/0.4 rock void space

Table C. Storage Volume Calculation Formulas for Various Volume Reduction Practices

Category	Method	Accepted Storage Volume Credit Formulas (cu. Ft.) (Below outlet of practice)	Nomenclature
Rain Barrel/Cistern	Storage & Slow Release, Evaporation	V = 0.785 x D2 x H or V = Gallons per Barrel x 0.1337	D = barrel diameter (ft) H = barrel height (ft)
Green Roof/Roof Gardens	Storage & Slow Release, ET	V = L x W x [(Ds x Pe) + Dt]	L = length of soil area (ft) W = width of soil area (ft) Ds = depth of soil (ft) Dt = depth of storage between soil surface & overflow of practice (ft) Pe = effective porosity of the soil (typically 0.3-0.5)
Subsurface Infiltration	Storage & Infiltration	V = (pipe volume + rock void volume) Pipe Vol. = Pipe [A x L] Rock Void Vol. = ([W x H x L] - Pipe[A x L]) x n	n = porosity (ft3/ft3) of rock media W = width of trench (ft) H = height of trench (ft) L = length of trench and pipe (ft) A = area of pipe (ft2)
Rain Gardens/Surface Infiltration	Storage & Infiltration	V = BMP Area x I x 4	BMP area using max depth from Table B (ft2) I = infiltration rate (in/hr) 4 = conversion for 48 hr drawdown
Filtration/Rain Garden w/ Underdrain	Storage, Moisture Retention & ET	V = (BMP Area x I x 4) x 70%	BMP area using max depth from Table B (ft2) I = infiltration rate (in/hr) 4 = conversion for 48 hr drawdown
Sand Filter	Moisture Retention & Slow Release, Evaporation	V = (W x H x L) x n	n = porosity (ft3/ft3) of media W = width of BMP (ft) H = height of BMP (ft) L = length of BMP (ft)
Pervious Pavement	Storage & Infiltration	V = (W x H x L) x n	n = porosity (ft3/ft3) of media W = width of BMP (ft) H = height of BMP (ft) L = length of BMP (ft)

►Table C on the previous page can be used to determine the calculation of volume reduction provided with various volume reduction BMPs. All computations, calculations, and modeling used to determine BMP design shall be submitted for review including plans showing detailed dimensions and size of the BMPs. Table D and E shall be completed for surface infiltration basins/rain gardens (Table D) and subsurface storage and infiltration BMPs (Table E). For all other BMPs, calculations, computations, or modeling must be submitted justifying the volume reduction proposed.

Table D. Surface Infiltration and Rain Garden Volume Calculation Table

Volume Reduction BMP ID	Area (sq. ft.)	Infiltration Rate (in/hr)	Multiplier	Volume Reduction* (cu. ft.)
Example: Rain Garden	200	0.6	4	480
Turf Field	139190	1.6	4	890816
2			4	
3			4	
4			4	
5			4	
*Volume reduction = Area x Infiltration Rate x 4			Total =	890816

Table E. Subsurface Storage and Infiltration Volume Calculation Table

Volume Reduction BMP	Pipe Diameter (Ft.)	Pipe X-section area (Sq. Ft.)	Pipe Length (Ft.)*	Pipe Storage (Cu. Ft.)	Rock depth, below outlet (Ft.)**	Trench width (Ft.)	Trench X-section area (Sq. Ft.)
Example	3.0	7.1	125.0	883.1	4.5	4.5	20.3
3							
4							
5							

Table E Continued…	Volume Reduction BMP	Trench area - Pipe area (Sq.Ft.)	Trench Length (Ft.)*	Trench Rock Porosity, n (%)	Trench Rock Storage (Cu. Ft.)	Total BMP Volume Reduction (Cu. Ft.)
	Example	13.2	125.0	0.4	659.3	1542.4
	2					
	3					
	4					
	5					
					TOTAL =	

* Pipe length and trench length must be equal.
**Rock depth below outlet shall not be greater than the maximum water depth found in Table B.

Summary of Total Onsite Volume Reduction = Subtotal from Table D + Subtotal from Table E

890,816	+		+		=	890,816 cubic feet	**box (d)**
Table D		Table E		Other BMPs*		Total Volume Reduction	

* Calculations and/or modeling must be submitted justifying the volume reduction proposed for other BMPs.

STEP 4: Do on-site BMPs achieve required volume reduction?

Is **Step 3 box (d)** equal to or greater than **Step 2 box (c)**? **Yes**

If yes, you have provided storage to achieve the volume standard.

If no, go to **Step 5**.

STEP 5: Determination of Alternative Compliance Eligibility

Does a condition listed in Table F exist at the site (Yes or No)? **yes**

If yes, fill out next line and attach documentation justifying the site conditions and go to **STEP 6**.

*List the specific site condition that applies to this project. **Type D soils**

If no, revise site plan to achieve greater volume reduction, return to **STEP 3**.

Table F. Alternative Compliance Site Conditions

Type	Specific Site Conditions	Submittal Requirements
Potential Contamination	Potential Stormwater Hotspots (PSHs)	PSH Locations & Flow Paths
	Contaminated Soils	Permitted Brownfield, Soil Borings
Physical Limitations	Low Permeability (Type D Soils)	Soil Borings
	Bedrock within 3 vertical feet of bottom or infiltration area	Soil Borings
	Seasonal High Groundwater within 3 vertical feet of bottom of infiltration area	Soil Borings
	Karst Areas	Soil Borings
Land Use Limitations	Utility Locations	Site Map
	Nearby Wells	Well Locations

STEP 6: Analyze Alternative Volume Reduction Methods

►After determining that a site condition from Table F exists and infiltration practices are not advised, the applicant shall evaluate alternative volume reduction methods that may be achieved onsite such as filtration, cisterns, or green roofs. Enter BMPs in tables above and calculate total volume reduction achieved.

After analyzing alternative volume reduction and entering the volume reduction in, does **Step 3 box (d)** equal or exceed **Step 2 box (c)**? **Yes**

STEP 7: Utilizing Offsite BMPs or Banking Credits

►For the remaining volume reduction needed, the applicant shall determine if there are offsite locations available to achieve the volume reduction required or if there are volume reduction banking credits available. Enter offsite BMPs and/or banking credits in **Step 3** above, noting them as offsite and recalculate total volume reduction achieved.

After analyzing the off-site/banking volume reduction and entering the volume reduction in, does **Step 3 box (d)** equal or exceed **Step 2 box (c)**? **Yes**

If yes, you have provided storage to achieve the volume standard.

If no, go to **Step 8**.

STEP 8: Contribution to Stormwater Impact Fund

►For the remaining volume reduction needed, the applicant shall pay into a stormwater impact fund that will be used by the District to complete volume reduction projects. The contribution amount is $40,000 per acre of impervious surfaces on a project site. At this contribution amount, the rate per cubic foot is $12.25. Use the formula below to calculate the amount needed to contribute.

box (e)	x	$12.25	=	
Remaining Volume Required (ft^3)				Amount to Contribute to Stormwater Impact Fund

STEP 9: Summary/Verification Step

►Complete **Step 9** by filling in the blanks below as applicable. Verify that the volume reduction provided is equal to or greater than the required volume reduction amount.

Verify **Step 3 box (d)** + **Step 8 box (e)** are equal to or greater than **Step 2 box (c)**.

890816	+		=	890,816	Provided Volume Reduction (cu.ft.) **(box (d) + box (e))**
box (d)		**box (e)**		12,107	Required Volume Reduction (cu. ft.) **(box (c))**

Have you met the volume reduction standard?	**Yes**

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AJA

LANDSCAPE ARCHITECTURE • SITE PLANNING • CIVIL ENGINEERING

Soils Reports

(Subsurface Exploration for Structural Properties)

BRAUN INTERTEC

LOG OF BORING

Braun Project BL-13-00451
GEOTECHNICAL EVALUATION
University of St. Thomas Field Reconstruction
Goodrich Ave & Cretin Ave S
St. Paul, Minnesota

BORING: **ST-1**

LOCATION: See attached sketch.

DRILLER: G. Scallon | METHOD: 3 1/4" HSA, Autohammer | DATE: **2/1/13** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Depth feet	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
0.0					
0.3	FILL	FILL: Silty Sand, fine- to medium-grained, dark brown, frozen. (Topsoil Fill)			
	FILL	FILL: Silty Sand, fine- to coarse-grained, with Gravel and possible Cobbles, brown and dark brown, frozen to moist.	7		
			19		
7.0	SM	SILTY SAND, fine- to coarse-grained, with Gravel, Shale fragments and Clayey Sand seams, gray and brown, moist, very dense. (Alluvium)	*		*50/1/2"
9.0	SH	WEATHERED SHALE, gray to greenish gray. (Bedrock)	36		
11.0		END OF BORING.			
		Water not observed with 9 1/2 feet of hollow-stem auger in the ground.			
		Boring immediately backfilled.			

DRAFT

BRAUN INTERTEC

LOG OF BORING

Braun Project BL-13-00451
GEOTECHNICAL EVALUATION
University of St. Thomas Field Reconstruction
Goodrich Ave & Cretin Ave S
St. Paul, Minnesota

BORING: **ST-2**

LOCATION: See attached sketch.

DRILLER: G. Scallon | METHOD: 3 1/4" HSA, Autohammer | DATE: **2/1/13** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Depth feet	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
0.0					
0.3	FILL	FILL: Silty Sand, fine- to medium-grained, dark brown, frozen. (Topsoil Fill)			
	FILL	FILL: Silty Sand, fine- to coarse-grained, with Gravel and Clayey Sand seams, brown, dark brown and black, frozen to moist.	24		
5.0	SP-SM	POORLY GRADED SAND with SILT, fine- to coarse-grained, with Gravel, brown, moist, dense. (Alluvium)	33		
7.0	SM	SILTY SAND, fine- to coarse-grained, with Gravel and Clayey Sand seams, with possible Cobbles and Boulders, brown and gray, dry to moist, medium dense. (Alluvium)	30*		*No sample recovery.
10.0	SH	WEATHERED SHALE, greenish gray. (Bedrock)	34		
11.0		END OF BORING.			
		Water not observed with 9 1/2 feet of hollow-stem auger in the ground.			
		Boring immediately backfilled.			

DRAFT

LOG OF BORING-DRAFT N:\GINT\PROJECTS\MINNEAPOLIS\2013\00451.GPJ BRAUN_V8_CURRENT.GDT 2/5/13 10:43

BRAUN INTERTEC

LOG OF BORING

Braun Project BL-13-00451
GEOTECHNICAL EVALUATION
University of St. Thomas Field Reconstruction
Goodrich Ave & Cretin Ave S
St. Paul, Minnesota

BORING: **ST-3**

LOCATION: See attached sketch.

DRILLER: G. Scallon | METHOD: 3 1/4" HSA, Autohammer | DATE: **2/1/13** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Depth feet	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
0.0					
0.8	FILL	FILL: Silty Sand, fine- to coarse-grained, black, frozen. (Topsoil Fill)			
	FILL	FILL: Silty Sand, fine- to coarse-grained, trace Gravel and Clayey Sand seams, brown and light brown, frozen to moist.	12		
4.0	SP-SM	POORLY GRADED SAND with SILT, fine- to coarse-grained, with Gravel, brown, moist, medium dense. (Alluvium)	14		
7.0	SM	SILTY SAND, fine- to coarse-grained, with Gravel, Cobbles and possible Boulders, brown and gray, dry to moist, very dense. (Alluvium)	20*/0"		*Only gravel recovery.
9.0	SH	WEATHERED SHALE, greenish gray. (Bedrock)	36		
11.0		END OF BORING.			
		Water not observed with 9 1/2 feet of hollow-stem auger in the ground.			
		Boring immediately backfilled.			

DRAFT

LOG OF BORING-DRAFT N:\GINT\PROJECTS\MINNEAPOLIS\2013\00451.GPJ BRAUN_V8_CURRENT.GDT 2/5/13 10:43

BRAUN INTERTEC

LOG OF BORING

Braun Project BL-13-00451
GEOTECHNICAL EVALUATION
University of St. Thomas Field Reconstruction
Goodrich Ave & Cretin Ave S
St. Paul, Minnesota

BORING: **ST-4**

LOCATION: See attached sketch.

DRILLER: G. Scallon | METHOD: 3 1/4" HSA, Autohammer | DATE: **2/1/13** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Depth feet	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
0.0					
1.0	FILL	FILL: Silty Sand, fine- to medium-grained, dark brown, frozen.			
4.0	FILL	FILL: Silty Sand, fine- to medium-grained, trace Gravel, brown with dark brown, frozen to moist.	11		
7.0	SP-SM	POORLY GRADED SAND with SILT, fine- to coarse-grained, trace Gravel to with Gravel, brown, moist, medium dense. (Alluvium)	14		
9.0	SM	SILTY SAND, fine- to coarse-grained, with Gravel, Cobbles and possible Boulders, brown and gray, moist, dense. (Alluvium)	38		
11.0	SH	WEATHERED SHALE, brown to greenish gray. (Bedrock)	28		
		END OF BORING.			
		Water not observed with 9 1/2 feet of hollow-stem auger in the ground.			
		Boring immediately backfilled.			

DRAFT

BRAUN INTERTEC

LOG OF BORING

Braun Project BL-13-00451
GEOTECHNICAL EVALUATION
University of St. Thomas Field Reconstruction
Goodrich Ave & Cretin Ave S
St. Paul, Minnesota

BORING: **ST-5**

LOCATION: See attached sketch.

DRILLER: G. Scallon | METHOD: 3 1/4" HSA, Autohammer | DATE: **2/1/13** | SCALE: **1" = 4'**

(See Descriptive Terminology sheet for explanation of abbreviations)

Depth feet	ASTM Symbol	Description of Materials (ASTM D2488 or D2487)	BPF	WL	Tests or Notes
0.0	FILL	FILL: Silty Sand, fine- to medium-grained, mixed with Organic Clay, black, frozen. (Topsoil Fill)			
3.0	FILL	FILL: Silty Sand, fine- to medium-grained, trace Gravel to with Gravel, light brown, brown and dark brown, moist.	22		
6.0	SM	SILTY SAND, fine- to medium-grained, trace Gravel, brown, moist, medium dense. (Alluvium)	12		
9.0	SM	SILTY SAND, fine- to coarse-grained, with Gravel and Clayey Sand seams, possible Cobbles, brown and gray, dry to moist, very dense. (Alluvium)	12		
11.0		END OF BORING.	42/6"		

Water not observed with 9 1/2 feet of hollow-stem auger in the ground.

Boring immediately backfilled.

DRAFT

Storm Water Pollution Prevention Plan

Narrative

Soccer / Softball Field Improvements

University of St. Thomas

February 11, 2013

I. Information for General Stormwater Permit Application Form

A. Online applications may be obtained at the following website: www.pca.state.mn.us/water/stormwater/stormwater-c.html

B. Question 1a: A Stormwater Pollution Prevention Plan has been developed for this project and is incorporated into the project's plans and specifications.

C. Question 1b.: An environmental review was not required for this project. Therefore this requirement is not applicable to the project.

D. Question 2a: This project does not have a discharge point within 1 mile of an impaired water. Therefore, this requirement is not applicable to the project.

E. Question 2b: This project does not discharge to a Calcareous fen. Therefore, this requirement is not applicable to the project.

F. Question 3a: This project does not include alternative treatment methods.

G. Question 3c: The project does not disturb 50 or more acres.

H. Questions 5, 6 and 7; see information below in "General Project Description".

I. Question 8: A project map is shown on the Drawings but does not need to be included with the application. Disturbance is less than 50 acres.

J. Question 9: Project type is Other - Institutional

K. Question 10: see information below in "General Project Description".

L. Question 10b: Additional new impervious surface is less than one acre. Skip to Question 12.

M. Question 12: Name of water body within 1 mile of site receiving site storm water discharge:
1. No receiving lakes, streams, etc. within 1 mile; City storm water management system is receiving; Lake; Search for receiving water is based on the Impaired Water Search Map (included in the Appendix to this Narrative). Documentation of the search is included in the Appendix to this Narrative.

II. General Project Description

A. Construction work will be performed at 2215 Summit Avenue, in the City of St. Paul, Minnesota, in Ramsey County. The site is located in part of Section 5, Township 28, Range 23.

B. Latitude and longitude coordinates of project locations:
1. Lat: 44° 56' 19" = 44.93860
2. Long: -93° 11' 36" = -93.19353
3. Method used to determine coordinates: http://www.findlatitudeandlongitude.com/

C. The site will involve a disturbance of approximately 4.537 acres.

D. Existing area of impervious surface in disturbance area = 0.467 acres. Proposed area of impervious surface in disturbance area = 0.510 acres. Net increase in impervious surface is 0.043 acres.

E. Approximately 9,000 cubic yards of soil will be excavated, total.

F. There are no wetlands on the site.

G. The site is an existing university (educational facility) in St. Paul, MN. The field is located on the south portion of the University's property.

H. The scope of work for the project is to construct a synthetic turf field in place of the existing softball and soccer field. The existing grass field will be replaced with synthetic turf. Underground storm water storage is incorporated into the work to account for discharge rate control requirements.

I. Work includes site removals, erosion control measures, soil excavation, soil export and granular import, fine grading, storm sewer, curbing, paving, turf installation, and site restoration.

J. The site utilize existing storm sewer systems that is connected into the City of St. Paul's storm water system. Drainage area maps are included in the Appendix to this Narrative. Storm water management calculations for the work have been submitted to Capital Region Watershed District and the City of St. Paul.

K. Soil Borings for the site have been performed and are included in the Project Manual. Soils are generally consist of silty and poorly-graded sand overlying weathered shale or silty sand.

L. Approximate quantities for erosion control and sediment control BMP's are as noted below:
1. Silt Fence:690 lf
2. Storm Sewer Sediment Control Devices: 8
3. Rock Construction Entrances: 1

III. Potential for Sediment and Pollutant Discharge

A. Construction site soil erosion / sedimentation

B. Dust from site soils

C. Tracking of soils from construction site to paved areas

D. Concrete truck wash-out areas

E. Fueling areas

F. Solid Waste (paper, plastic, asphalt and concrete debris, building materials and similar)

IV. Person / Company knowledgeable, experienced and responsible for implementing the SWPPP:

A. SWPPP plan preparation:
1. Company:
Anderson - Johnson Associates, Inc.
7575 Golden Valley Road, Suite 200
Minneapolis, MN 55427
Phone 763.544.7129
Fax 763.544.0531
2. Responsible Person:
Jay Pomeroy
3. SWPPP plan training:
a. SWPPP training has been obtained.
(1) Dates of Training: October 6 / October 7, 2008
(a) Name of Training Instructor: John Chapman, Shane Missaghi
(b) Number of Hours Training: 12
(2) Date for Recertification Training: December 14, 2011
(a) Name of Training Instructor: John Chapman, Omid Mohseni
(b) Number of Hours Training: 5.5
(3) Entity providing Training: University of Minnesota
(4) Content of Training Course: Design of SWPPP
(5) Certification Expires in the year 2015.

B. SWPPP plan implementation during construction (installation, inspection and maintenance):
   1. Company:
      To be determined by private Bid.
   2. Responsible Person:
      To be determined following public Bid award.
   3. SWPPP implementation training:
      Shall be obtained and documented in accordance with the requirements of the NPDES General Stormwater Permit for Construction Activity (MN R100001).
      a. Dates of Training: _____
      b. Name of Training Instructor: _____
      c. Entity providing Training: _____
      d. Number of Hours Training: _____
      e. Content of Training Course: _____

C. Post Construction responsibility (long term operation and maintenance)
   1. Company:
      University of St. Thomas
      2115 Summit Avenue- PHP
      St. Paul, MN 55105
   2. Responsible Person:
      Jim Brummer: 651-962-6595

D. Inspection and maintenance logs shall be kept in the Contractors on-site job trailer or other suitable temporary storage area.

V. General Construction Sequence

A. Erosion Control Devices, noted herein, include:

   1. Silt fence
   2. Sediment filter at storm sewer inlets
   3. Rock construction entrance
   4. Final sodding
   5. Other features identified by the Minnesota Pollution Control Agency, local Watershed District, City, or Engineer as a Best Management Practice (BMP) device.

B. Contractor and Owner shall apply for NPDES Phase II Permit within 24 hours of award of Contract.
   1. Once obtained, the Contractor shall post the permit in the job site trailer or other suitable temporary storage area.

C. The Engineer will conduct a pre-construction meeting specifically to review the requirements of the SWPPP and the NPDES permit. At this meeting, the Contractor shall identify how they will construct the site to comply with the SWPPP and NPDES permit. Modifications to the SWPPP will be made as necessary.

D. Install silt fence as shown on the Contract Drawings.
   1. Silt fence shall be as specified in Section 31 25 00.

E. Contractor shall confirm locations for construction access to the site and provide a rock construction entrance at each location.

F. Have silt fence and other erosion control devices inspected by local authorities, as required by the local authority.

G. Upon approval of perimeter silt fence, rock construction entrances, and other erosion control devices, commence with the following construction sequence:
   1. Install erosion control devices as described on the Drawings (sediment control devices at storm sewer inlets, silt fence, etc.)
   2. Remove all items scheduled for removal or, in the way of construction operations.
   3. Excavate soils within field footprint to depth detailed on the Drawings.

4. Install collector drain tile system, underground stormwater chamber system and all storm sewer structures. Protect the Underground Storage Area from sedimentation.
5. Install concrete curbs and maintenance strips.
6. Install fence post footings.
7. Install sand sub-base and porous rock base material.
8. Pave designated areas shown on Drawing.
9. Install synthetic turf and place infill.
10. Construct remaining site features and other miscellaneous items including concrete pavement, bituminous paving, fencing, scoreboards, safety net backstops and bleachers.
11. Remove construction entrance.
12. Fine grade remaining unpaved disturbance areas and sod as described on the Drawings.
13. Provide final stabilization of site including turf establishment and clean-up.

H. Provide maintenance to erosion control devices and BMP's to comply with the requirements of the permit.

I. Inspect erosion control devices and provide routine maintenance as follows:
1. Inspect erosion control a minimum of once per week and after each rain event measuring 0.5" or more. Record inspection on log posted in Contractor's construction trailer or other suitable temporary storage area.
Records of each inspection and maintenance activity shall include:
a. Date and time of inspections.
b. Name of person conducting inspection.
c. Findings of inspections, including recommendations for corrective actions.
d. Corrective actions taken (including dates, times, and party completing maintenance activities.
e. Date and amount of all rainfall events greater than one quarter inch (0.25 inch) in 24 hours.
f. Documentation of changes made to the SWPPP as required by the NPDES General Stormwater Permit for Construction Activity (MN R100001)
(1) Inspections are not required where the ground is frozen.
2. Provide maintenance for all devices as follows:
a. Silt fences and erosion control devices at storm sewer inlets shall be inspected for depth of sediment, tears, to see if fabric is securely attached to support posts or structure, and to see that posts and devices are securely in place.
b. Silt fences, erosion control devices at storm sewer inlets, and other erosion control devices shall be cleaned when sediment reaches 1/3 the height of the erosion control device, within 24 hours.
c. Rock construction entrances shall be inspected for clogging of river rock. River rock that has become clogged with sediment shall be removed and replaced with fresh river rock.
d. Repairs or replacements to all erosion control devices shall occur within 24 hours of discovery.
e. Temporary diversion berms shall be inspected and any breaches promptly repaired.
f. Tracked sediment from construction vehicles on to public streets and paved areas (including paved areas on the construction site) shall be removed within 24 hours of discovery.
g. Removal of sediment and restabilization of surface waters shall be accomplished within 7 days of discovery.

J. Provide dewatering of excavations as identified in Section 31 00 00. Discharged water shall be routed through temporary or permanent sediment basins prior to discharge from the site.

K. Stabilize denuded areas and stockpiles within the following number of days of last construction activity (temporary or permanent) in that area:
1. Within 14 days.

L. Provide maintenance of all final sodded areas until fully established.

M. Provide cleaning of storm sewer system at the completion of the project. Cleaning shall include removal of accumulated sediment from all surface waters as defined by the permit (for example, curb and gutter, pavements, swales, and storm sewer piping and structures).

N. Remove silt fence and erosion control devices at storm sewer inlets following full establishment of site vegetation. Dispose of materials properly off-site.

O. Apply for Notice of Termination (NOT) with MPCA. NOT must be submitted within 30 days after:
1. Site has undergone Final Stabilization (at least 70% vegetative cover), and
2. Removal of all temporary erosion control measures (silt fence, etc.), and
3. Final cleanout and maintenance of all permanent storm water facilities, and
4. Completion of all maintenance activities and site cleanup

VI. Erosion and Sediment Controls - Stabilization Practices

A. Temporary Stabilization:
1. Disturbed portions of the site where construction activity temporarily ceases for the time frames noted above shall be stabilized with a temporary seed and mulch according to the following:
   a. All areas of bare soil exposed to possible erosion shall be shaped to drain with minimum potential for erosion. The disturbed areas shall then be seeded with perennial ryegrass and annual wheat at a rate of 10 pounds per acre (0.25 lbs./1,000 sq. ft.) and 20 pounds per acre (0.50 lbs./1,000 sq. ft.) respectively, then and covered with straw mulch at a rate of 4,000 pounds per acre, disc anchored.
2. Slopes steeper than 6:1 (6' horizontal for every 1' vertical) shall be “cat tracked” by running a caterpillar type tracked vehicle up and down the slope vertically along the entire length of the slope to create continuous series of horizontal ridges in the soil surface. Cat tracking shall occur immediately following grading (rough, finish and fine).
3. Stabilize areas to be paved by placing Class V aggregate base course.

B. Permanent Stabilization:
1. Permanent stabilization shall occur in accordance with Specification Sections 32 12 00, 32 13 13, and 32 92 23 as shown on the Construction Drawings.

VII. Storm Water Management

A. Storm Water Discharge has been engineered to not exceed the existing rate of runoff for any of the subwatersheds on site.

B. All calculations have been submitted to, reviewed and (will be) approved by the City of St. Paul and Capitol Region Watershed District.

VIII. Material Inventory

A. The following materials are anticipated to be present on site during construction:
1. Concrete
2. Bituminous pavements / tack coat
3. Fertilizers
4. Petroleum based products
5. Cleaning solvents

IX. Spill Prevention

A. Good Housekeeping Requirements - The following good housekeeping practices shall be followed on site during construction

1. Store only enough product on site to perform work.
2. All materials stored on site shall be stored in a neat, orderly manner in their appropriate containers or in a temporary enclosure.
3. Products shall be kept in their original containers with the original manufacturer's label.
4. Substances shall not be mixed unless approved by the manufacturer.
5. Whenever possible, all of a product shall be used up before disposing of the container.
6. Manufacturer's recommendations for proper use and disposal shall be followed.
7. The Contractor's site superintendent shall inspect daily to ensure proper used and disposal of materials.

B. Product Specific Practices

1. Petroleum products
   a. All on site vehicles shall be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage. Petroleum products shall be stored in tightly sealed containers which are clearly labeled. Any asphalt substances used onsite shall be applied according to the manufacturer's recommendations.
2. Fertilizers
   a. Fertilizers used shall be applied only in the minimum amounts recommended by the manufacturer. Once applied, fertilizer shall be worked into the soil to limit exposure to storm water. Fertilizers shall be brought to the site on the day of use. The contents of any partially used bags of fertilizer shall be transferred to a sealable plastic bin to avoid spills.
3. Paints
   a. All containers shall be tightly sealed and stored when not required for use. Excess paint shall not be discharged to the storm sewer system but shall be properly disposed of according to manufacturers' instructions or State and local regulations.
4. Concrete Truck Washing
   a. All liquid and solid wastes generated by concrete washout operations shall be contained in a leak proof containment facility or impermeable liner. A compacted clay liner that does not allow washout liquids to enter ground water is considered an impermeable liner. The liquid and solid wastes must not contact the ground and there must not be runoff from the concrete washout operations or areas. Liquid and solid wastes shall be disposed of properly and in compliance with MPCA regulations. A sign shall be installed adjacent to each washout facility to inform concrete equipment operators to utilize the proper facilities.
5. No engine degreasing is allowed on site.
6. External washing of trucks and other construction equipment shall be limited to a defined area of the site or shall be accomplished at an appropriate off site area.

C. Spill Control Practices - In addition to the good housekeeping and material management practices discussed in the previous sections of this plan, the following practices shall be followed for spill prevention and cleanup:

1. Manufacturers' recommended methods for spill cleanup shall be clearly posted and site personnel shall be made aware of the procedures and the location of the information and cleanup supplies.
2. Materials and equipment necessary for spill cleanup shall be kept in the material storage area onsite. Equipment and materials shall include but not be limited to brooms, dust pans, mops, rags, gloves, goggles, kitty litter, sand, sawdust, and plastic and metal trash containers specially for this purpose.
3. All spills shall be cleaned up immediately after discovery.
4. The spill area shall be kept well ventilated and personnel shall wear appropriate protective clothing to prevent injury from contact with a hazardous substance.

5. Spills of toxic or hazardous material shall be reported to the appropriate State or local government agency, regardless of the size.
6. The spill prevention plan shall be adjusted to include measures to prevent this type of spill from reoccurring and how to clean up the spill if there is another one. A description of the spill, what caused it, and the cleanup measures shall also be included.
7. The Contractor's site superintendent, responsible for the day-to-day site operations, shall be the spill prevention and cleanup coordinator. He shall designate at least three other site personnel who shall receive spill prevention and cleanup training. These individuals shall each become responsible for a particular phase of prevention and cleanup. The names of responsible spill personnel shall be posted in the material storage area and in the office trailer onsite.

X. Waste Disposal

A. All waste materials shall be appropriately stored on site until permanently removed from site.

B. Compliance with Instructions, Ordinances and State Laws: The Contractor shall comply with all instructions and ordinances of the State of Minnesota, and all counties and municipalities regarding waste disposal.

C. Dumpsters and similar storage devices shall be properly secured and closed to prevent wind or other means to dislocate the materials from the proper storage container. Loose materials and debris shall be collected on a daily basis.

D. Disposal of Materials and Debris: All debris resulting from the removal and demolition operations shall be disposed of off-site by the Contractor subject to any specific regulations imposed by laws, ordinances, orders and decrees.

E. Burying of construction materials and debris will not be permitted.

XI. Hazardous Waste

A. All hazardous waste materials shall be disposed of in the manner specified by local or State regulations. Site personnel shall be instructed in these practices and the Contractor's site superintendent shall oversee these practices.

B. Vehicle fueling shall be in a single location on the site, away from existing wetlands and undisturbed areas.

C. The Contractor shall follow the requirements of the Development Response Action Plan (DRAP) and Environmental Contingency Plan (ECP).

XII. Sanitary Waste

A. Sanitary Waste shall be collected from portable units provided by the Contractor on a regular basis. Use of portable units shall comply with local and State regulations.

SWPPP prepared by:

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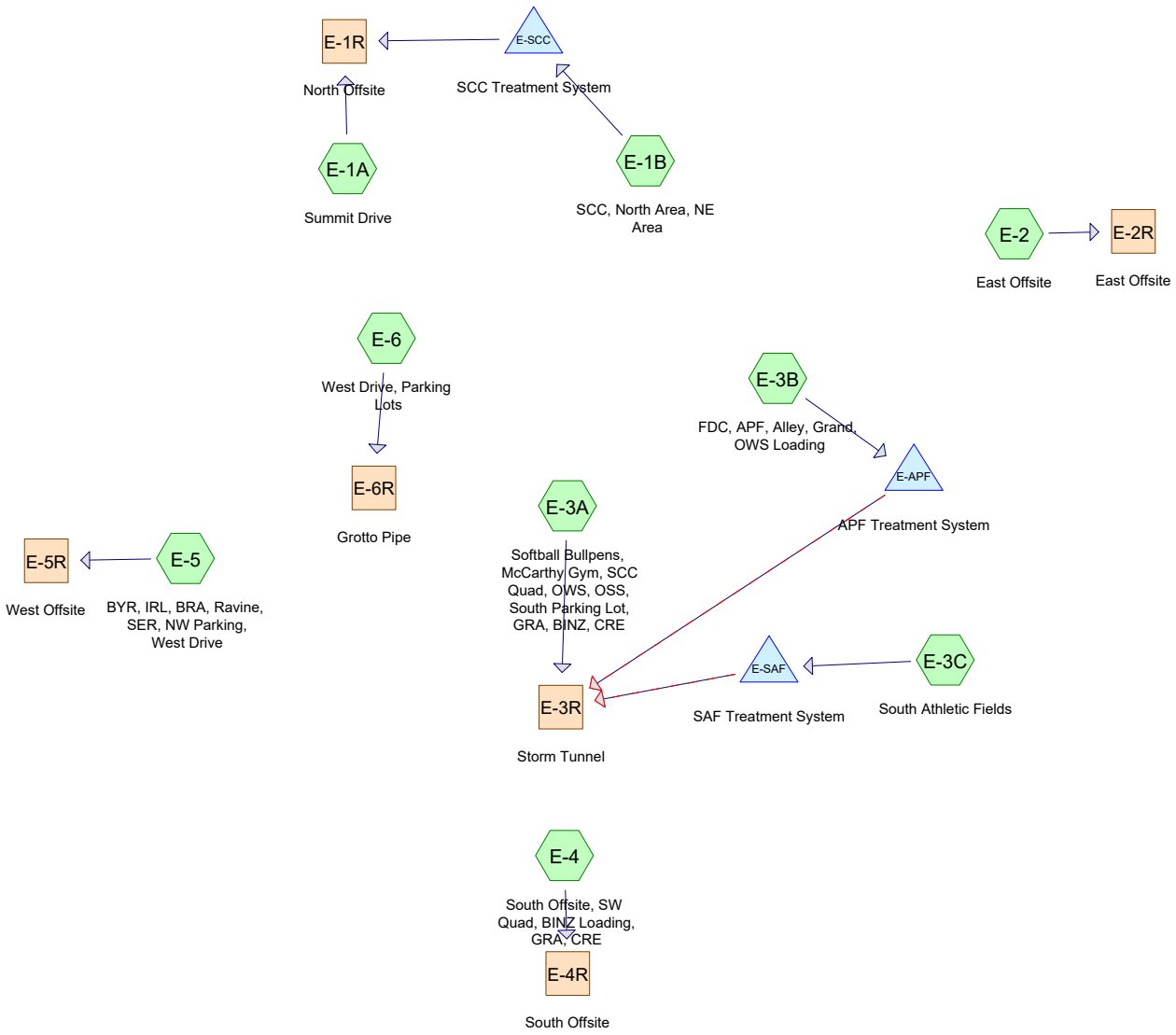
APPENDIX E



Subcat Reach Pond Link

Routing Diagram for UST Arena_Existing Stormwater Management
Prepared by Ryan Companies US, INC., Printed 1/19/2024
HydroCAD® 10.00-22 s/n 02289 © 2018 HydroCAD Software Solutions LLC

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E-1A: Summit Drive Runoff Area=10,911 sf 56.33% Impervious Runoff Depth=1.83"
Flow Length=145' Tc=9.5 min CN=90 Runoff=0.72 cfs 0.038 af

Subcatchment E-1B: SCC, North Area, NE Runoff Area=142,763 sf 37.00% Impervious Runoff Depth=1.59"
Flow Length=352' Tc=20.1 min CN=87 Runoff=5.84 cfs 0.435 af

Subcatchment E-2: East Offsite Runoff Area=46,306 sf 35.47% Impervious Runoff Depth=1.52"
Flow Length=75' Slope=0.0050 '/' Tc=14.5 min CN=86 Runoff=2.12 cfs 0.134 af

Subcatchment E-3A: Softball Bullpens, Runoff Area=235,584 sf 78.40% Impervious Runoff Depth=2.19"
Flow Length=670' Tc=10.8 min CN=94 Runoff=17.05 cfs 0.985 af

Subcatchment E-3B: FDC, APF, Alley, Runoff Area=116,878 sf 85.27% Impervious Runoff Depth=2.28"
Flow Length=558' Tc=19.8 min CN=95 Runoff=6.62 cfs 0.511 af

Subcatchment E-3C: South Athletic Fields Runoff Area=161,418 sf 7.64% Impervious Runoff Depth=0.80"
Flow Length=250' Slope=0.0120 '/' Tc=39.0 min CN=74 Runoff=2.09 cfs 0.248 af

Subcatchment E-4: South Offsite, SW Runoff Area=149,326 sf 20.94% Impervious Runoff Depth=1.38"
Flow Length=521' Tc=10.5 min CN=84 Runoff=7.20 cfs 0.394 af

Subcatchment E-5: BYR, IRL, BRA, Runoff Area=260,841 sf 25.40% Impervious Runoff Depth=1.25"
Flow Length=424' Slope=0.0540 '/' Tc=10.3 min CN=82 Runoff=11.45 cfs 0.622 af

Subcatchment E-6: West Drive, Parking Runoff Area=115,303 sf 64.89% Impervious Runoff Depth=2.00"
Flow Length=524' Tc=10.0 min CN=92 Runoff=8.01 cfs 0.441 af

Reach E-1R: North Offsite Inflow=0.72 cfs 0.038 af
Outflow=0.72 cfs 0.038 af

Reach E-2R: East Offsite Inflow=2.12 cfs 0.134 af
Outflow=2.12 cfs 0.134 af

Reach E-3R: Storm Tunnel Inflow=18.36 cfs 1.744 af
Outflow=18.36 cfs 1.744 af

Reach E-4R: South Offsite Inflow=7.20 cfs 0.394 af
Outflow=7.20 cfs 0.394 af

Reach E-5R: West Offsite Inflow=11.45 cfs 0.622 af
Outflow=11.45 cfs 0.622 af

Reach E-6R: Grotto Pipe Inflow=8.01 cfs 0.441 af
Outflow=8.01 cfs 0.441 af

Pond E-APF: APF Treatment System Peak Elev=854.32' Storage=6,031 cf Inflow=6.62 cfs 0.511 af
Outflow=2.83 cfs 0.511 af

Pond E-SAF: SAF Treatment System Peak Elev=855.70' Storage=0.081 af Inflow=2.09 cfs 0.248 af
Primary=0.76 cfs 0.248 af Secondary=0.00 cfs 0.000 af Outflow=0.76 cfs 0.248 af

Pond E-SCC: SCC Treatment System Peak Elev=856.57' Storage=18,935 cf Inflow=5.84 cfs 0.435 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 28.451 ac Runoff Volume = 3.808 af Average Runoff Depth = 1.61"
56.07% Pervious = 15.953 ac 43.93% Impervious = 12.498 ac

Summary for Subcatchment E-1A: Summit Drive

Runoff = 0.72 cfs @ 12.17 hrs, Volume= 0.038 af, Depth= 1.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.83"

	Area (sf)	CN	Description
*	0	98	Constructed IMP
*	6,146	98	Existing IMP
	4,765	80	>75% Grass cover, Good, HSG D
	10,911	90	Weighted Average
	4,765		43.67% Pervious Area
	6,146		56.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	7	0.0340	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.1	7	0.0340	0.93		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
2.3	20	0.0340	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.2	16	0.0340	1.10		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
4.9	50	0.0340	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
1.0	45	0.0120	0.77		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.5	145	Total			

Summary for Subcatchment E-1B: SCC, North Area, NE Area

Runoff = 5.84 cfs @ 12.30 hrs, Volume= 0.435 af, Depth= 1.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.83"

	Area (sf)	CN	Description
*	0	98	Constructed IMP
*	52,819	98	Existing IMP
	89,944	80	>75% Grass cover, Good, HSG D
	142,763	87	Weighted Average
	89,944		63.00% Pervious Area
	52,819		37.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	66	0.0029	0.07		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
3.8	286	0.0061	1.26		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
20.1	352	Total			

Summary for Subcatchment E-2: East Offsite

Runoff = 2.12 cfs @ 12.23 hrs, Volume= 0.134 af, Depth= 1.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.83"

	Area (sf)	CN	Description
*	0	98	Constructed IMP
*	16,423	98	Existing IMP
	29,883	80	>75% Grass cover, Good, HSG D
	46,306	86	Weighted Average
	29,883		64.53% Pervious Area
	16,423		35.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	75	0.0050	0.09		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"

for Subcatchment E-3A: Softball Bullpens, McCarthy Gym, SCC Quad, OWS, OSS, South Parking Lot, G

Runoff = 17.05 cfs @ 12.18 hrs, Volume= 0.985 af, Depth= 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.83"

	Area (sf)	CN	Description
*	5,144	98	Constructed IMP
*	179,547	98	Existing IMP
	50,893	80	>75% Grass cover, Good, HSG D
	235,584	94	Weighted Average
	50,893		21.60% Pervious Area
	184,691		78.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	46	0.0150	0.98		**Sheet Flow, Pavement outside SCC** Smooth surfaces n= 0.011 P2= 2.80"
3.8	24	0.0150	0.11		**Sheet Flow, Pavement outside SCC** Grass: Short n= 0.150 P2= 2.80"
0.4	18	0.0150	0.81		**Sheet Flow, Pavement outside SCC** Smooth surfaces n= 0.011 P2= 2.80"
2.2	12	0.0150	0.09		**Sheet Flow, Pavement outside SCC** Grass: Short n= 0.150 P2= 2.80"
1.9	96	0.0150	0.86		**Shallow Concentrated Flow, Pervious Quad** Short Grass Pasture Kv= 7.0 fps
0.6	100	0.0050	2.78	2.18	**Pipe Channel, Pipe from Quad** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.015 Concrete sewer w/manholes & inlets
1.1	374	0.0087	5.82	18.29	**Pipe Channel, Pipe from Quad to Storm Tunnel** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Concrete sewer w/manholes & inlets
10.8	670	Total			

Summary for Subcatchment E-3B: FDC, APF, Alley, Grand, OWS Loading

Runoff = 6.62 cfs @ 12.28 hrs, Volume= 0.511 af, Depth= 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.83"

	Area (sf)	CN	Description
*	18,416	98	Constructed IMP
*	81,247	98	Existing IMP
	17,215	80	>75% Grass cover, Good, HSG D
	116,878	95	Weighted Average
	17,215		14.73% Pervious Area
	99,663		85.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.3	85	0.0080	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.80"
1.4	76	0.0170	0.91		**Shallow Concentrated Flow, East of OWS** Short Grass Pasture Kv= 7.0 fps
4.4	170	0.0010	0.64		**Shallow Concentrated Flow, Grand Ave** Paved Kv= 20.3 fps
0.1	15	0.0050	3.47	2.73	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Corrugated PP, smooth interior
0.4	138	0.0050	5.52	17.33	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012 Corrugated PP, smooth interior
0.2	74	0.0040	4.93	15.50	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'

n= 0.012 Corrugated PP, smooth interior

19.8	558	Total

Summary for Subcatchment E-3C: South Athletic Fields

Runoff = 2.09 cfs @ 12.61 hrs, Volume= 0.248 af, Depth= 0.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.83"

	Area (sf)	CN	Description
*	6,762	98	Constructed IMP
*	5,572	98	Existing IMP
	7,842	80	>75% Grass cover, Good, HSG D
*	141,242	72	Turf Field
	161,418	74	Weighted Average
	149,084		92.36% Pervious Area
	12,334		7.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.0	250	0.0120	0.11		**Sheet Flow, Grass Field** Grass: Dense n= 0.240 P2= 2.80"

Summary for Subcatchment E-4: South Offsite, SW Quad, BINZ Loading, GRA, CRE

Runoff = 7.20 cfs @ 12.18 hrs, Volume= 0.394 af, Depth= 1.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.83"

	Area (sf)	CN	Description
*	31,274	98	Existing IMP
	118,052	80	>75% Grass cover, Good, HSG D
	149,326	84	Weighted Average
	118,052		79.06% Pervious Area
	31,274		20.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.0890	0.29		**Sheet Flow, Arena South of Brady** Grass: Short n= 0.150 P2= 2.80"
0.0	8	0.0430	4.21		**Shallow Concentrated Flow, Area south of Brady** Paved Kv= 20.3 fps
4.7	413	0.0430	1.45		**Shallow Concentrated Flow, Area south of Brady** Short Grass Pasture Kv= 7.0 fps
10.5	521	Total			

Summary for Subcatchment E-5: BYR, IRL, BRA, Ravine, SER, NW Parking, West Drive

Runoff = 11.45 cfs @ 12.18 hrs, Volume= 0.622 af, Depth= 1.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.83"

	Area (sf)	CN	Description
*	0	98	Constructed IMP
*	66,259	98	Existing IMP
	99,447	73	Woods, Fair, HSG C
	95,135	80	>75% Grass cover, Good, HSG D
	260,841	82	Weighted Average
	194,582		74.60% Pervious Area
	66,259		25.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	100	0.0540	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
3.3	324	0.0540	1.63		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.3	424	Total			

Summary for Subcatchment E-6: West Drive, Parking Lots

Runoff = 8.01 cfs @ 12.17 hrs, Volume= 0.441 af, Depth= 2.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.83"

	Area (sf)	CN	Description
*	9,839	98	Constructed IMP
*	64,980	98	Existing IMP
	40,484	80	>75% Grass cover, Good, HSG D
	115,303	92	Weighted Average
	40,484		35.11% Pervious Area
	74,819		64.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	100	0.0440	0.22		**Sheet Flow, Grass Area south of SCC** Grass: Short n= 0.150 P2= 2.80"
0.8	56	0.0190	1.24		**Shallow Concentrated Flow, Sidewalk south of SCC** Cultivated Straight Rows Kv= 9.0 fps
0.9	33	0.0010	0.64		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	28	0.0100	5.36	4.21	**Pipe Channel, Pipe Channel to Grotto** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.6	307	0.0190	8.13	6.38	**Pipe Channel, Pipe Channel to Grotto** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010 PVC, smooth interior
10.0	524	Total			

Summary for Reach E-1R: North Offsite

Inflow Area = 3.528 ac, 38.37% Impervious, Inflow Depth = 0.13" for 2-yr event
Inflow = 0.72 cfs @ 12.17 hrs, Volume= 0.038 af
Outflow = 0.72 cfs @ 12.17 hrs, Volume= 0.038 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach E-2R: East Offsite

Inflow Area = 1.063 ac, 35.47% Impervious, Inflow Depth = 1.52" for 2-yr event
Inflow = 2.12 cfs @ 12.23 hrs, Volume= 0.134 af
Outflow = 2.12 cfs @ 12.23 hrs, Volume= 0.134 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach E-3R: Storm Tunnel

Inflow Area = 11.797 ac, 57.73% Impervious, Inflow Depth = 1.77" for 2-yr event
Inflow = 18.36 cfs @ 12.19 hrs, Volume= 1.744 af
Outflow = 18.36 cfs @ 12.19 hrs, Volume= 1.744 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach E-4R: South Offsite

Inflow Area = 3.428 ac, 20.94% Impervious, Inflow Depth = 1.38" for 2-yr event
Inflow = 7.20 cfs @ 12.18 hrs, Volume= 0.394 af
Outflow = 7.20 cfs @ 12.18 hrs, Volume= 0.394 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach E-5R: West Offsite

Inflow Area = 5.988 ac, 25.40% Impervious, Inflow Depth = 1.25" for 2-yr event
Inflow = 11.45 cfs @ 12.18 hrs, Volume= 0.622 af
Outflow = 11.45 cfs @ 12.18 hrs, Volume= 0.622 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach E-6R: Grotto Pipe

Inflow Area = 2.647 ac, 64.89% Impervious, Inflow Depth = 2.00" for 2-yr event
Inflow = 8.01 cfs @ 12.17 hrs, Volume= 0.441 af
Outflow = 8.01 cfs @ 12.17 hrs, Volume= 0.441 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond E-APF: APF Treatment System

Inflow Area = 2.683 ac, 85.27% Impervious, Inflow Depth = 2.28" for 2-yr event
Inflow = 6.62 cfs @ 12.28 hrs, Volume= 0.511 af
Outflow = 2.83 cfs @ 12.58 hrs, Volume= 0.511 af, Atten= 57%, Lag= 17.8 min
Primary = 2.83 cfs @ 12.58 hrs, Volume= 0.511 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 854.32' @ 12.58 hrs Surf.Area= 4,435 sf Storage= 6,031 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 19.8 min (805.8 - 786.1)

Volume	Invert	Avail.Storage	Storage Description
#1	852.38'	11,310 cf	**48.0" Round Pipe Storage** x 5 L= 180.0' S= 0.0010 '/'
#2	852.38'	704 cf	**48.0" Round Pipe Storage** x 2 L= 28.0'
#3	856.38'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder**
#4	852.38'	1,448 cf	**24.0" Round Pipe Storage** L= 461.0' S= 0.0050 '/'
#5	854.67'	64 cf	**4.00'D x 5.10'H Vertical Cone/Cylinder**
#6	859.75'	505 cf	**Custom Stage Data**Listed below
		14,200 cf	Total Available Storage

Elevation (feet)	Cum.Store (cubic-feet)
859.75	0
860.75	505

Device	Routing	Invert	Outlet Devices
#1	Primary	848.70'	**24.0" Round Culvert** L= 56.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 848.70' / 848.50' S= 0.0036 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	852.38'	**0.80 cfs BayFilter at all elevations**
#3	Device 1	853.17'	**20.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600
#4	Device 1	857.30'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=2.83 cfs @ 12.58 hrs HW=854.32' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 2.83 cfs of 32.50 cfs potential flow)
  ├─**2=BayFilter** (Exfiltration Controls 0.80 cfs)
  ├─**3=Orifice/Grate** (Orifice Controls 2.03 cfs @ 4.86 fps)
  └─**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond E-SAF: SAF Treatment System

Inflow Area = 3.706 ac, 7.64% Impervious, Inflow Depth = 0.80" for 2-yr event
Inflow = 2.09 cfs @ 12.61 hrs, Volume= 0.248 af
Outflow = 0.76 cfs @ 13.31 hrs, Volume= 0.248 af, Atten= 63%, Lag= 42.4 min
Primary = 0.76 cfs @ 13.31 hrs, Volume= 0.248 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 855.70' @ 13.31 hrs Surf.Area= 0.170 ac Storage= 0.081 af

Plug-Flow detention time= 69.6 min calculated for 0.248 af (100% of inflow)
Center-of-Mass det. time= 69.0 min (934.1 - 865.1)

Volume	Invert	Avail.Storage	Storage Description
#1	854.80'	0.164 af	**39.50'W x 187.56'L x 4.50'H Field A** 0.765 af Overall - 0.219 af Embedded = 0.546 af x 30.0% Voids
#2	855.30'	0.219 af	**ADS_StormTech SC-740 +Cap** x 208 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 8 Rows of 26 Chambers
		0.383 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	854.80'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Secondary	860.00'	**110.0' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.76 cfs @ 13.31 hrs HW=855.70' TW=0.00' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Orifice Controls 0.76 cfs @ 3.90 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=854.80' TW=0.00' (Dynamic Tailwater)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond E-SCC: SCC Treatment System

Inflow Area = 3.277 ac, 37.00% Impervious, Inflow Depth = 1.59" for 2-yr event
Inflow = 5.84 cfs @ 12.30 hrs, Volume= 0.435 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 856.57' @ 25.16 hrs Surf.Area= 4,896 sf Storage= 18,935 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	859.00'	2,130 cf	**Above Ground - Overflow (Prismatic)** Listed below (Recalc)
#2	851.99'	321 cf	**35.4" Round CMP_Round 35.4" Header Row** L= 47.0'
#3	851.99'	120 cf	**35.4" Round CMP_Round 35.4" Header Connecters** L= 17.5'
#4	851.99'	30,685 cf	**94.5" Round CMP_Round 94.5"** L= 630.0'
		33,256 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
859.00	100	0	0
860.00	229	165	165
860.50	1,880	527	692
861.00	3,871	1,438	2,130

Device	Routing	Invert	Outlet Devices
#1	Primary	859.01'	**4.0' long x 5.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.35 2.51 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.69 2.73 2.77 2.86

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=851.99' TW=0.00' (Dynamic Tailwater)
↑**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E-1A: Summit Drive Runoff Area=10,911 sf 56.33% Impervious Runoff Depth=3.14"
Flow Length=145' Tc=9.5 min CN=90 Runoff=1.20 cfs 0.065 af

Subcatchment E-1B: SCC, North Area, NE Runoff Area=142,763 sf 37.00% Impervious Runoff Depth=2.85"
Flow Length=352' Tc=20.1 min CN=87 Runoff=10.34 cfs 0.778 af

Subcatchment E-2: East Offsite Runoff Area=46,306 sf 35.47% Impervious Runoff Depth=2.76"
Flow Length=75' Slope=0.0050 '/' Tc=14.5 min CN=86 Runoff=3.81 cfs 0.244 af

Subcatchment E-3A: Softball Bullpens, Runoff Area=235,584 sf 78.40% Impervious Runoff Depth=3.55"
Flow Length=670' Tc=10.8 min CN=94 Runoff=26.90 cfs 1.600 af

Subcatchment E-3B: FDC, APF, Alley, Runoff Area=116,878 sf 85.27% Impervious Runoff Depth=3.66"
Flow Length=558' Tc=19.8 min CN=95 Runoff=10.33 cfs 0.818 af

Subcatchment E-3C: South Athletic Fields Runoff Area=161,418 sf 7.64% Impervious Runoff Depth=1.77"
Flow Length=250' Slope=0.0120 '/' Tc=39.0 min CN=74 Runoff=4.92 cfs 0.546 af

Subcatchment E-4: South Offsite, SW Runoff Area=149,326 sf 20.94% Impervious Runoff Depth=2.57"
Flow Length=521' Tc=10.5 min CN=84 Runoff=13.34 cfs 0.736 af

Subcatchment E-5: BYR, IRL, BRA, Runoff Area=260,841 sf 25.40% Impervious Runoff Depth=2.40"
Flow Length=424' Slope=0.0540 '/' Tc=10.3 min CN=82 Runoff=22.03 cfs 1.198 af

Subcatchment E-6: West Drive, Parking Runoff Area=115,303 sf 64.89% Impervious Runoff Depth=3.34"
Flow Length=524' Tc=10.0 min CN=92 Runoff=13.01 cfs 0.737 af

Reach E-1R: North Offsite Inflow=1.20 cfs 0.170 af
Outflow=1.20 cfs 0.170 af

Reach E-2R: East Offsite Inflow=3.81 cfs 0.244 af
Outflow=3.81 cfs 0.244 af

Reach E-3R: Storm Tunnel Inflow=29.59 cfs 2.963 af
Outflow=29.59 cfs 2.963 af

Reach E-4R: South Offsite Inflow=13.34 cfs 0.736 af
Outflow=13.34 cfs 0.736 af

Reach E-5R: West Offsite Inflow=22.03 cfs 1.198 af
Outflow=22.03 cfs 1.198 af

Reach E-6R: Grotto Pipe Inflow=13.01 cfs 0.737 af
Outflow=13.01 cfs 0.737 af

Pond E-APF: APF Treatment System Peak Elev=855.48' Storage=10,975 cf Inflow=10.33 cfs 0.818 af
Outflow=3.77 cfs 0.818 af

Pond E-SAF: SAF Treatment System Peak Elev=856.92' Storage=0.234 af Inflow=4.92 cfs 0.546 af
Primary=1.29 cfs 0.545 af Secondary=0.00 cfs 0.000 af Outflow=1.29 cfs 0.545 af

Pond E-SCC: SCC Treatment System Peak Elev=859.09' Storage=29,589 cf Inflow=10.34 cfs 0.778 af
Outflow=0.23 cfs 0.105 af

Total Runoff Area = 28.451 ac Runoff Volume = 6.721 af Average Runoff Depth = 2.83"
56.07% Pervious = 15.953 ac 43.93% Impervious = 12.498 ac

Summary for Subcatchment E-1A: Summit Drive

Runoff = 1.20 cfs @ 12.17 hrs, Volume= 0.065 af, Depth= 3.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-yr Rainfall=4.23"

	Area (sf)	CN	Description
*	0	98	Constructed IMP
*	6,146	98	Existing IMP
	4,765	80	>75% Grass cover, Good, HSG D
	10,911	90	Weighted Average
	4,765		43.67% Pervious Area
	6,146		56.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	7	0.0340	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.1	7	0.0340	0.93		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
2.3	20	0.0340	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.2	16	0.0340	1.10		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
4.9	50	0.0340	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
1.0	45	0.0120	0.77		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.5	145	Total			

Summary for Subcatchment E-1B: SCC, North Area, NE Area

Runoff = 10.34 cfs @ 12.29 hrs, Volume= 0.778 af, Depth= 2.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-yr Rainfall=4.23"

	Area (sf)	CN	Description
*	0	98	Constructed IMP
*	52,819	98	Existing IMP
	89,944	80	>75% Grass cover, Good, HSG D
	142,763	87	Weighted Average
	89,944		63.00% Pervious Area
	52,819		37.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	66	0.0029	0.07		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
3.8	286	0.0061	1.26		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
20.1	352	Total			

Summary for Subcatchment E-2: East Offsite

Runoff = 3.81 cfs @ 12.23 hrs, Volume= 0.244 af, Depth= 2.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-yr Rainfall=4.23"

	Area (sf)	CN	Description
*	0	98	Constructed IMP
*	16,423	98	Existing IMP
	29,883	80	>75% Grass cover, Good, HSG D
	46,306	86	Weighted Average
	29,883		64.53% Pervious Area
	16,423		35.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	75	0.0050	0.09		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"

for Subcatchment E-3A: Softball Bullpens, McCarthy Gym, SCC Quad, OWS, OSS, South Parking Lot, G

Runoff = 26.90 cfs @ 12.18 hrs, Volume= 1.600 af, Depth= 3.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-yr Rainfall=4.23"

	Area (sf)	CN	Description
*	5,144	98	Constructed IMP
*	179,547	98	Existing IMP
	50,893	80	>75% Grass cover, Good, HSG D
	235,584	94	Weighted Average
	50,893		21.60% Pervious Area
	184,691		78.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	46	0.0150	0.98		**Sheet Flow, Pavement outside SCC** Smooth surfaces n= 0.011 P2= 2.80"
3.8	24	0.0150	0.11		**Sheet Flow, Pavement outside SCC** Grass: Short n= 0.150 P2= 2.80"
0.4	18	0.0150	0.81		**Sheet Flow, Pavement outside SCC** Smooth surfaces n= 0.011 P2= 2.80"
2.2	12	0.0150	0.09		**Sheet Flow, Pavement outside SCC** Grass: Short n= 0.150 P2= 2.80"
1.9	96	0.0150	0.86		**Shallow Concentrated Flow, Pervious Quad** Short Grass Pasture Kv= 7.0 fps
0.6	100	0.0050	2.78	2.18	**Pipe Channel, Pipe from Quad** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.015 Concrete sewer w/manholes & inlets
1.1	374	0.0087	5.82	18.29	**Pipe Channel, Pipe from Quad to Storm Tunnel** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Concrete sewer w/manholes & inlets
10.8	670	Total			

Summary for Subcatchment E-3B: FDC, APF, Alley, Grand, OWS Loading

Runoff = 10.33 cfs @ 12.28 hrs, Volume= 0.818 af, Depth= 3.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-yr Rainfall=4.23"

	Area (sf)	CN	Description
*	18,416	98	Constructed IMP
*	81,247	98	Existing IMP
	17,215	80	>75% Grass cover, Good, HSG D
	116,878	95	Weighted Average
	17,215		14.73% Pervious Area
	99,663		85.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.3	85	0.0080	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.80"
1.4	76	0.0170	0.91		**Shallow Concentrated Flow, East of OWS** Short Grass Pasture Kv= 7.0 fps
4.4	170	0.0010	0.64		**Shallow Concentrated Flow, Grand Ave** Paved Kv= 20.3 fps
0.1	15	0.0050	3.47	2.73	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Corrugated PP, smooth interior
0.4	138	0.0050	5.52	17.33	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012 Corrugated PP, smooth interior
0.2	74	0.0040	4.93	15.50	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'

n= 0.012 Corrugated PP, smooth interior		
19.8	558	Total

Summary for Subcatchment E-3C: South Athletic Fields

Runoff = 4.92 cfs @ 12.57 hrs, Volume= 0.546 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-yr Rainfall=4.23"

	Area (sf)	CN	Description
*	6,762	98	Constructed IMP
*	5,572	98	Existing IMP
	7,842	80	>75% Grass cover, Good, HSG D
*	141,242	72	Turf Field
	161,418	74	Weighted Average
	149,084		92.36% Pervious Area
	12,334		7.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.0	250	0.0120	0.11		**Sheet Flow, Grass Field** Grass: Dense n= 0.240 P2= 2.80"

Summary for Subcatchment E-4: South Offsite, SW Quad, BINZ Loading, GRA, CRE

Runoff = 13.34 cfs @ 12.18 hrs, Volume= 0.736 af, Depth= 2.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-yr Rainfall=4.23"

	Area (sf)	CN	Description
*	31,274	98	Existing IMP
	118,052	80	>75% Grass cover, Good, HSG D
	149,326	84	Weighted Average
	118,052		79.06% Pervious Area
	31,274		20.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.0890	0.29		**Sheet Flow, Arena South of Brady** Grass: Short n= 0.150 P2= 2.80"
0.0	8	0.0430	4.21		**Shallow Concentrated Flow, Area south of Brady** Paved Kv= 20.3 fps
4.7	413	0.0430	1.45		**Shallow Concentrated Flow, Area south of Brady** Short Grass Pasture Kv= 7.0 fps
10.5	521	Total			

Summary for Subcatchment E-5: BYR, IRL, BRA, Ravine, SER, NW Parking, West Drive

Runoff = 22.03 cfs @ 12.18 hrs, Volume= 1.198 af, Depth= 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-yr Rainfall=4.23"

	Area (sf)	CN	Description
*	0	98	Constructed IMP
*	66,259	98	Existing IMP
	99,447	73	Woods, Fair, HSG C
	95,135	80	>75% Grass cover, Good, HSG D
	260,841	82	Weighted Average
	194,582		74.60% Pervious Area
	66,259		25.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	100	0.0540	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
3.3	324	0.0540	1.63		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.3	424	Total			

Summary for Subcatchment E-6: West Drive, Parking Lots

Runoff = 13.01 cfs @ 12.17 hrs, Volume= 0.737 af, Depth= 3.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-yr Rainfall=4.23"

	Area (sf)	CN	Description
*	9,839	98	Constructed IMP
*	64,980	98	Existing IMP
	40,484	80	>75% Grass cover, Good, HSG D
	115,303	92	Weighted Average
	40,484		35.11% Pervious Area
	74,819		64.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	100	0.0440	0.22		**Sheet Flow, Grass Area south of SCC** Grass: Short n= 0.150 P2= 2.80"
0.8	56	0.0190	1.24		**Shallow Concentrated Flow, Sidewalk south of SCC** Cultivated Straight Rows Kv= 9.0 fps
0.9	33	0.0010	0.64		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	28	0.0100	5.36	4.21	**Pipe Channel, Pipe Channel to Grotto** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.6	307	0.0190	8.13	6.38	**Pipe Channel, Pipe Channel to Grotto** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010 PVC, smooth interior
10.0	524	Total			

Summary for Reach E-1R: North Offsite

Inflow Area = 3.528 ac, 38.37% Impervious, Inflow Depth = 0.58" for 10-yr event
Inflow = 1.20 cfs @ 12.17 hrs, Volume= 0.170 af
Outflow = 1.20 cfs @ 12.17 hrs, Volume= 0.170 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach E-2R: East Offsite

Inflow Area = 1.063 ac, 35.47% Impervious, Inflow Depth = 2.76" for 10-yr event
Inflow = 3.81 cfs @ 12.23 hrs, Volume= 0.244 af
Outflow = 3.81 cfs @ 12.23 hrs, Volume= 0.244 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach E-3R: Storm Tunnel

Inflow Area = 11.797 ac, 57.73% Impervious, Inflow Depth = 3.01" for 10-yr event
Inflow = 29.59 cfs @ 12.18 hrs, Volume= 2.963 af
Outflow = 29.59 cfs @ 12.18 hrs, Volume= 2.963 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach E-4R: South Offsite

Inflow Area = 3.428 ac, 20.94% Impervious, Inflow Depth = 2.57" for 10-yr event
Inflow = 13.34 cfs @ 12.18 hrs, Volume= 0.736 af
Outflow = 13.34 cfs @ 12.18 hrs, Volume= 0.736 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach E-5R: West Offsite

Inflow Area = 5.988 ac, 25.40% Impervious, Inflow Depth = 2.40" for 10-yr event
Inflow = 22.03 cfs @ 12.18 hrs, Volume= 1.198 af
Outflow = 22.03 cfs @ 12.18 hrs, Volume= 1.198 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach E-6R: Grotto Pipe

Inflow Area = 2.647 ac, 64.89% Impervious, Inflow Depth = 3.34" for 10-yr event
Inflow = 13.01 cfs @ 12.17 hrs, Volume= 0.737 af
Outflow = 13.01 cfs @ 12.17 hrs, Volume= 0.737 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond E-APF: APF Treatment System

Inflow Area = 2.683 ac, 85.27% Impervious, Inflow Depth = 3.66" for 10-yr event
Inflow = 10.33 cfs @ 12.28 hrs, Volume= 0.818 af
Outflow = 3.77 cfs @ 12.62 hrs, Volume= 0.818 af, Atten= 64%, Lag= 20.5 min
Primary = 3.77 cfs @ 12.62 hrs, Volume= 0.818 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 855.48' @ 12.62 hrs Surf.Area= 3,697 sf Storage= 10,975 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 26.7 min (803.9 - 777.1)

Volume	Invert	Avail.Storage	Storage Description
#1	852.38'	11,310 cf	**48.0" Round Pipe Storage** x 5 L= 180.0' S= 0.0010 '/'
#2	852.38'	704 cf	**48.0" Round Pipe Storage** x 2 L= 28.0'
#3	856.38'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder**
#4	852.38'	1,448 cf	**24.0" Round Pipe Storage** L= 461.0' S= 0.0050 '/'
#5	854.67'	64 cf	**4.00'D x 5.10'H Vertical Cone/Cylinder**
#6	859.75'	505 cf	**Custom Stage Data** Listed below
		14,200 cf	Total Available Storage

Elevation (feet)	Cum.Store (cubic-feet)
859.75	0
860.75	505

Device	Routing	Invert	Outlet Devices
#1	Primary	848.70'	**24.0" Round Culvert** L= 56.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 848.70' / 848.50' S= 0.0036 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	852.38'	**0.80 cfs BayFilter at all elevations**
#3	Device 1	853.17'	**20.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600
#4	Device 1	857.30'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=3.77 cfs @ 12.62 hrs HW=855.48' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 3.77 cfs of 36.37 cfs potential flow)
  ├─**2=BayFilter** (Exfiltration Controls 0.80 cfs)
  ├─**3=Orifice/Grate** (Orifice Controls 2.97 cfs @ 7.12 fps)
  └─**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond E-SAF: SAF Treatment System

Inflow Area = 3.706 ac, 7.64% Impervious, Inflow Depth = 1.77" for 10-yr event
Inflow = 4.92 cfs @ 12.57 hrs, Volume= 0.546 af
Outflow = 1.29 cfs @ 13.46 hrs, Volume= 0.545 af, Atten= 74%, Lag= 53.9 min
Primary = 1.29 cfs @ 13.46 hrs, Volume= 0.545 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 856.92' @ 13.46 hrs Surf.Area= 0.170 ac Storage= 0.234 af

Plug-Flow detention time= 97.7 min calculated for 0.545 af (100% of inflow)
Center-of-Mass det. time= 97.5 min (944.7 - 847.2)

Volume	Invert	Avail.Storage	Storage Description
#1	854.80'	0.164 af	**39.50'W x 187.56'L x 4.50'H Field A** 0.765 af Overall - 0.219 af Embedded = 0.546 af x 30.0% Voids
#2	855.30'	0.219 af	**ADS_StormTech SC-740 +Cap** x 208 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 8 Rows of 26 Chambers
		0.383 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	854.80'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Secondary	860.00'	**110.0' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.29 cfs @ 13.46 hrs HW=856.92' TW=0.00' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Orifice Controls 1.29 cfs @ 6.59 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=854.80' TW=0.00' (Dynamic Tailwater)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond E-SCC: SCC Treatment System

Inflow Area = 3.277 ac, 37.00% Impervious, Inflow Depth = 2.85" for 10-yr event
Inflow = 10.34 cfs @ 12.29 hrs, Volume= 0.778 af
Outflow = 0.23 cfs @ 16.47 hrs, Volume= 0.105 af, Atten= 98%, Lag= 250.6 min
Primary = 0.23 cfs @ 16.47 hrs, Volume= 0.105 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 859.09' @ 16.47 hrs Surf.Area= 3,060 sf Storage= 29,589 cf

Plug-Flow detention time= 472.3 min calculated for 0.105 af (13% of inflow)
Center-of-Mass det. time= 348.1 min (1,150.7 - 802.6)

Volume	Invert	Avail.Storage	Storage Description
#1	859.00'	2,130 cf	**Above Ground - Overflow (Prismatic)** Listed below (Recalc)
#2	851.99'	321 cf	**35.4" Round CMP_Round 35.4" Header Row** L= 47.0'
#3	851.99'	120 cf	**35.4" Round CMP_Round 35.4" Header Connecters** L= 17.5'
#4	851.99'	30,685 cf	**94.5" Round CMP_Round 94.5"** L= 630.0'
		33,256 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
859.00	100	0	0
860.00	229	165	165
860.50	1,880	527	692
861.00	3,871	1,438	2,130

Device	Routing	Invert	Outlet Devices
#1	Primary	859.01'	**4.0' long x 5.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.35 2.51 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.69 2.73 2.77 2.86

Primary OutFlow Max=0.23 cfs @ 16.47 hrs HW=859.09' TW=0.00' (Dynamic Tailwater)
↳**1=Broad-Crested Rectangular Weir** (Weir Controls 0.23 cfs @ 0.68 fps)

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E-1A: Summit Drive Runoff Area=10,911 sf 56.33% Impervious Runoff Depth=6.28"
Flow Length=145' Tc=9.5 min CN=90 Runoff=2.31 cfs 0.131 af

Subcatchment E-1B: SCC, North Area, NE Runoff Area=142,763 sf 37.00% Impervious Runoff Depth=5.93"
Flow Length=352' Tc=20.1 min CN=87 Runoff=20.89 cfs 1.621 af

Subcatchment E-2: East Offsite Runoff Area=46,306 sf 35.47% Impervious Runoff Depth=5.82"
Flow Length=75' Slope=0.0050 '/' Tc=14.5 min CN=86 Runoff=7.79 cfs 0.515 af

Subcatchment E-3A: Softball Bullpens, Runoff Area=235,584 sf 78.40% Impervious Runoff Depth=6.76"
Flow Length=670' Tc=10.8 min CN=94 Runoff=49.31 cfs 3.044 af

Subcatchment E-3B: FDC, APF, Alley, Runoff Area=116,878 sf 85.27% Impervious Runoff Depth=6.87"
Flow Length=558' Tc=19.8 min CN=95 Runoff=18.80 cfs 1.537 af

Subcatchment E-3C: South Athletic Fields Runoff Area=161,418 sf 7.64% Impervious Runoff Depth=4.45"
Flow Length=250' Slope=0.0120 '/' Tc=39.0 min CN=74 Runoff=12.66 cfs 1.376 af

Subcatchment E-4: South Offsite, SW Runoff Area=149,326 sf 20.94% Impervious Runoff Depth=5.59"
Flow Length=521' Tc=10.5 min CN=84 Runoff=28.02 cfs 1.596 af

Subcatchment E-5: BYR, IRL, BRA, Runoff Area=260,841 sf 25.40% Impervious Runoff Depth=5.36"
Flow Length=424' Slope=0.0540 '/' Tc=10.3 min CN=82 Runoff=47.78 cfs 2.674 af

Subcatchment E-6: West Drive, Parking Runoff Area=115,303 sf 64.89% Impervious Runoff Depth=6.52"
Flow Length=524' Tc=10.0 min CN=92 Runoff=24.38 cfs 1.438 af

Reach E-1R: North Offsite Inflow=18.30 cfs 1.079 af
Outflow=18.30 cfs 1.079 af

Reach E-2R: East Offsite Inflow=7.79 cfs 0.515 af
Outflow=7.79 cfs 0.515 af

Reach E-3R: Storm Tunnel Inflow=62.48 cfs 5.957 af
Outflow=62.48 cfs 5.957 af

Reach E-4R: South Offsite Inflow=28.02 cfs 1.596 af
Outflow=28.02 cfs 1.596 af

Reach E-5R: West Offsite Inflow=47.78 cfs 2.674 af
Outflow=47.78 cfs 2.674 af

Reach E-6R: Grotto Pipe Inflow=24.38 cfs 1.438 af
Outflow=24.38 cfs 1.438 af

Pond E-APF: APF Treatment System Peak Elev=858.48' Storage=13,569 cf Inflow=18.80 cfs 1.537 af
Outflow=29.53 cfs 1.537 af

Pond E-SAF: SAF Treatment System Peak Elev=860.13' Storage=0.383 af Inflow=12.66 cfs 1.376 af
Primary=2.13 cfs 1.038 af Secondary=14.39 cfs 0.337 af Outflow=16.52 cfs 1.375 af

Pond E-SCC: SCC Treatment System Peak Elev=860.41' Storage=31,665 cf Inflow=20.89 cfs 1.621 af
Outflow=17.59 cfs 0.948 af

Total Runoff Area = 28.451 ac Runoff Volume = 13.932 af Average Runoff Depth = 5.88"
56.07% Pervious = 15.953 ac 43.93% Impervious = 12.498 ac

Summary for Subcatchment E-1A: Summit Drive

Runoff = 2.31 cfs @ 12.17 hrs, Volume= 0.131 af, Depth= 6.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.47"

	Area (sf)	CN	Description
*	0	98	Constructed IMP
*	6,146	98	Existing IMP
	4,765	80	>75% Grass cover, Good, HSG D
	10,911	90	Weighted Average
	4,765		43.67% Pervious Area
	6,146		56.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	7	0.0340	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.1	7	0.0340	0.93		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
2.3	20	0.0340	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.2	16	0.0340	1.10		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
4.9	50	0.0340	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
1.0	45	0.0120	0.77		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.5	145	Total			

Summary for Subcatchment E-1B: SCC, North Area, NE Area

Runoff = 20.89 cfs @ 12.29 hrs, Volume= 1.621 af, Depth= 5.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.47"

	Area (sf)	CN	Description
*	0	98	Constructed IMP
*	52,819	98	Existing IMP
	89,944	80	>75% Grass cover, Good, HSG D
	142,763	87	Weighted Average
	89,944		63.00% Pervious Area
	52,819		37.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	66	0.0029	0.07		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
3.8	286	0.0061	1.26		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
20.1	352	Total			

Summary for Subcatchment E-2: East Offsite

Runoff = 7.79 cfs @ 12.22 hrs, Volume= 0.515 af, Depth= 5.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.47"

	Area (sf)	CN	Description
*	0	98	Constructed IMP
*	16,423	98	Existing IMP
	29,883	80	>75% Grass cover, Good, HSG D
	46,306	86	Weighted Average
	29,883		64.53% Pervious Area
	16,423		35.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	75	0.0050	0.09		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"

for Subcatchment E-3A: Softball Bullpens, McCarthy Gym, SCC Quad, OWS, OSS, South Parking Lot, G

Runoff = 49.31 cfs @ 12.18 hrs, Volume= 3.044 af, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.47"

	Area (sf)	CN	Description
*	5,144	98	Constructed IMP
*	179,547	98	Existing IMP
	50,893	80	>75% Grass cover, Good, HSG D
	235,584	94	Weighted Average
	50,893		21.60% Pervious Area
	184,691		78.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	46	0.0150	0.98		**Sheet Flow, Pavement outside SCC** Smooth surfaces n= 0.011 P2= 2.80"
3.8	24	0.0150	0.11		**Sheet Flow, Pavement outside SCC** Grass: Short n= 0.150 P2= 2.80"
0.4	18	0.0150	0.81		**Sheet Flow, Pavement outside SCC** Smooth surfaces n= 0.011 P2= 2.80"
2.2	12	0.0150	0.09		**Sheet Flow, Pavement outside SCC** Grass: Short n= 0.150 P2= 2.80"
1.9	96	0.0150	0.86		**Shallow Concentrated Flow, Pervious Quad** Short Grass Pasture Kv= 7.0 fps
0.6	100	0.0050	2.78	2.18	**Pipe Channel, Pipe from Quad** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.015 Concrete sewer w/manholes & inlets
1.1	374	0.0087	5.82	18.29	**Pipe Channel, Pipe from Quad to Storm Tunnel** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.015 Concrete sewer w/manholes & inlets
10.8	670	Total			

Summary for Subcatchment E-3B: FDC, APF, Alley, Grand, OWS Loading

Runoff = 18.80 cfs @ 12.28 hrs, Volume= 1.537 af, Depth= 6.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.47"

	Area (sf)	CN	Description
*	18,416	98	Constructed IMP
*	81,247	98	Existing IMP
	17,215	80	>75% Grass cover, Good, HSG D
	116,878	95	Weighted Average
	17,215		14.73% Pervious Area
	99,663		85.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.3	85	0.0080	0.11		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.80"
1.4	76	0.0170	0.91		**Shallow Concentrated Flow, East of OWS** Short Grass Pasture Kv= 7.0 fps
4.4	170	0.0010	0.64		**Shallow Concentrated Flow, Grand Ave** Paved Kv= 20.3 fps
0.1	15	0.0050	3.47	2.73	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Corrugated PP, smooth interior
0.4	138	0.0050	5.52	17.33	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012 Corrugated PP, smooth interior
0.2	74	0.0040	4.93	15.50	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'

n= 0.012 Corrugated PP, smooth interior

19.8	558	Total

Summary for Subcatchment E-3C: South Athletic Fields

Runoff = 12.66 cfs @ 12.53 hrs, Volume= 1.376 af, Depth= 4.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.47"

	Area (sf)	CN	Description
*	6,762	98	Constructed IMP
*	5,572	98	Existing IMP
	7,842	80	>75% Grass cover, Good, HSG D
*	141,242	72	Turf Field
	161,418	74	Weighted Average
	149,084		92.36% Pervious Area
	12,334		7.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.0	250	0.0120	0.11		**Sheet Flow, Grass Field** Grass: Dense n= 0.240 P2= 2.80"

Summary for Subcatchment E-4: South Offsite, SW Quad, BINZ Loading, GRA, CRE

Runoff = 28.02 cfs @ 12.18 hrs, Volume= 1.596 af, Depth= 5.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.47"

	Area (sf)	CN	Description
*	31,274	98	Existing IMP
	118,052	80	>75% Grass cover, Good, HSG D
	149,326	84	Weighted Average
	118,052		79.06% Pervious Area
	31,274		20.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.0890	0.29		**Sheet Flow, Arena South of Brady** Grass: Short n= 0.150 P2= 2.80"
0.0	8	0.0430	4.21		**Shallow Concentrated Flow, Area south of Brady** Paved Kv= 20.3 fps
4.7	413	0.0430	1.45		**Shallow Concentrated Flow, Area south of Brady** Short Grass Pasture Kv= 7.0 fps
10.5	521	Total			

Summary for Subcatchment E-5: BYR, IRL, BRA, Ravine, SER, NW Parking, West Drive

Runoff = 47.78 cfs @ 12.18 hrs, Volume= 2.674 af, Depth= 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.47"

	Area (sf)	CN	Description
*	0	98	Constructed IMP
*	66,259	98	Existing IMP
	99,447	73	Woods, Fair, HSG C
	95,135	80	>75% Grass cover, Good, HSG D
	260,841	82	Weighted Average
	194,582		74.60% Pervious Area
	66,259		25.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	100	0.0540	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
3.3	324	0.0540	1.63		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.3	424	Total			

Summary for Subcatchment E-6: West Drive, Parking Lots

Runoff = 24.38 cfs @ 12.17 hrs, Volume= 1.438 af, Depth= 6.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.47"

	Area (sf)	CN	Description
*	9,839	98	Constructed IMP
*	64,980	98	Existing IMP
	40,484	80	>75% Grass cover, Good, HSG D
	115,303	92	Weighted Average
	40,484		35.11% Pervious Area
	74,819		64.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	100	0.0440	0.22		**Sheet Flow, Grass Area south of SCC** Grass: Short n= 0.150 P2= 2.80"
0.8	56	0.0190	1.24		**Shallow Concentrated Flow, Sidewalk south of SCC** Cultivated Straight Rows Kv= 9.0 fps
0.9	33	0.0010	0.64		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	28	0.0100	5.36	4.21	**Pipe Channel, Pipe Channel to Grotto** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.6	307	0.0190	8.13	6.38	**Pipe Channel, Pipe Channel to Grotto** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010 PVC, smooth interior
10.0	524	Total			

Summary for Reach E-1R: North Offsite

Inflow Area = 3.528 ac, 38.37% Impervious, Inflow Depth = 3.67" for 100-yr event
Inflow = 18.30 cfs @ 12.39 hrs, Volume= 1.079 af
Outflow = 18.30 cfs @ 12.39 hrs, Volume= 1.079 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach E-2R: East Offsite

Inflow Area = 1.063 ac, 35.47% Impervious, Inflow Depth = 5.82" for 100-yr event
Inflow = 7.79 cfs @ 12.22 hrs, Volume= 0.515 af
Outflow = 7.79 cfs @ 12.22 hrs, Volume= 0.515 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach E-3R: Storm Tunnel

Inflow Area = 11.797 ac, 57.73% Impervious, Inflow Depth = 6.06" for 100-yr event
Inflow = 62.48 cfs @ 12.28 hrs, Volume= 5.957 af
Outflow = 62.48 cfs @ 12.28 hrs, Volume= 5.957 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach E-4R: South Offsite

Inflow Area = 3.428 ac, 20.94% Impervious, Inflow Depth = 5.59" for 100-yr event
Inflow = 28.02 cfs @ 12.18 hrs, Volume= 1.596 af
Outflow = 28.02 cfs @ 12.18 hrs, Volume= 1.596 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach E-5R: West Offsite

Inflow Area = 5.988 ac, 25.40% Impervious, Inflow Depth = 5.36" for 100-yr event
Inflow = 47.78 cfs @ 12.18 hrs, Volume= 2.674 af
Outflow = 47.78 cfs @ 12.18 hrs, Volume= 2.674 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach E-6R: Grotto Pipe

Inflow Area = 2.647 ac, 64.89% Impervious, Inflow Depth = 6.52" for 100-yr event
Inflow = 24.38 cfs @ 12.17 hrs, Volume= 1.438 af
Outflow = 24.38 cfs @ 12.17 hrs, Volume= 1.438 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond E-APF: APF Treatment System

Inflow Area = 2.683 ac, 85.27% Impervious, Inflow Depth = 6.87" for 100-yr event
Inflow = 18.80 cfs @ 12.28 hrs, Volume= 1.537 af
Outflow = 29.53 cfs @ 12.28 hrs, Volume= 1.537 af, Atten= 0%, Lag= 0.1 min
Primary = 29.53 cfs @ 12.28 hrs, Volume= 1.537 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 858.48' @ 12.28 hrs Surf.Area= 41 sf Storage= 13,569 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 24.9 min (791.2 - 766.3)

Volume	Invert	Avail.Storage	Storage Description
#1	852.38'	11,310 cf	**48.0" Round Pipe Storage** x 5 L= 180.0' S= 0.0010 '/'
#2	852.38'	704 cf	**48.0" Round Pipe Storage** x 2 L= 28.0'
#3	856.38'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder**
#4	852.38'	1,448 cf	**24.0" Round Pipe Storage** L= 461.0' S= 0.0050 '/'
#5	854.67'	64 cf	**4.00'D x 5.10'H Vertical Cone/Cylinder**
#6	859.75'	505 cf	**Custom Stage Data**Listed below
		14,200 cf	Total Available Storage

Elevation (feet)	Cum.Store (cubic-feet)
859.75	0
860.75	505

Device	Routing	Invert	Outlet Devices
#1	Primary	848.70'	**24.0" Round Culvert** L= 56.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 848.70' / 848.50' S= 0.0036 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	852.38'	**0.80 cfs BayFilter at all elevations**
#3	Device 1	853.17'	**20.0" W x 3.0" H Vert. Orifice/Grate** C= 0.600
#4	Device 1	857.30'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=28.35 cfs @ 12.28 hrs HW=858.44' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 28.35 cfs of 44.72 cfs potential flow)
  ├─**2=BayFilter** (Exfiltration Controls 0.80 cfs)
  ├─**3=Orifice/Grate** (Orifice Controls 4.55 cfs @ 10.92 fps)
  └─**4=Sharp-Crested Rectangular Weir** (Weir Controls 23.00 cfs @ 3.49 fps)

Summary for Pond E-SAF: SAF Treatment System

Inflow Area = 3.706 ac, 7.64% Impervious, Inflow Depth = 4.45" for 100-yr event
Inflow = 12.66 cfs @ 12.53 hrs, Volume= 1.376 af
Outflow = 16.52 cfs @ 12.60 hrs, Volume= 1.375 af, Atten= 0%, Lag= 4.2 min
Primary = 2.13 cfs @ 12.60 hrs, Volume= 1.038 af
Secondary = 14.39 cfs @ 12.60 hrs, Volume= 0.337 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 860.13' @ 12.60 hrs Surf.Area= 0.170 ac Storage= 0.383 af

Plug-Flow detention time= 86.2 min calculated for 1.375 af (100% of inflow)
Center-of-Mass det. time= 86.4 min (914.7 - 828.3)

Volume	Invert	Avail.Storage	Storage Description
#1	854.80'	0.164 af	**39.50'W x 187.56'L x 4.50'H Field A** 0.765 af Overall - 0.219 af Embedded = 0.546 af x 30.0% Voids
#2	855.30'	0.219 af	**ADS_StormTech SC-740 +Cap** x 208 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 8 Rows of 26 Chambers
		0.383 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	854.80'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Secondary	860.00'	**110.0' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=2.13 cfs @ 12.60 hrs HW=860.13' TW=0.00' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Orifice Controls 2.13 cfs @ 10.86 fps)

Secondary OutFlow Max=14.39 cfs @ 12.60 hrs HW=860.13' TW=0.00' (Dynamic Tailwater)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 14.39 cfs @ 0.98 fps)

Summary for Pond E-SCC: SCC Treatment System

Inflow Area = 3.277 ac, 37.00% Impervious, Inflow Depth = 5.93" for 100-yr event
Inflow = 20.89 cfs @ 12.29 hrs, Volume= 1.621 af
Outflow = 17.59 cfs @ 12.39 hrs, Volume= 0.948 af, Atten= 16%, Lag= 6.3 min
Primary = 17.59 cfs @ 12.39 hrs, Volume= 0.948 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 860.41' @ 12.39 hrs Surf.Area= 1,588 sf Storage= 31,665 cf

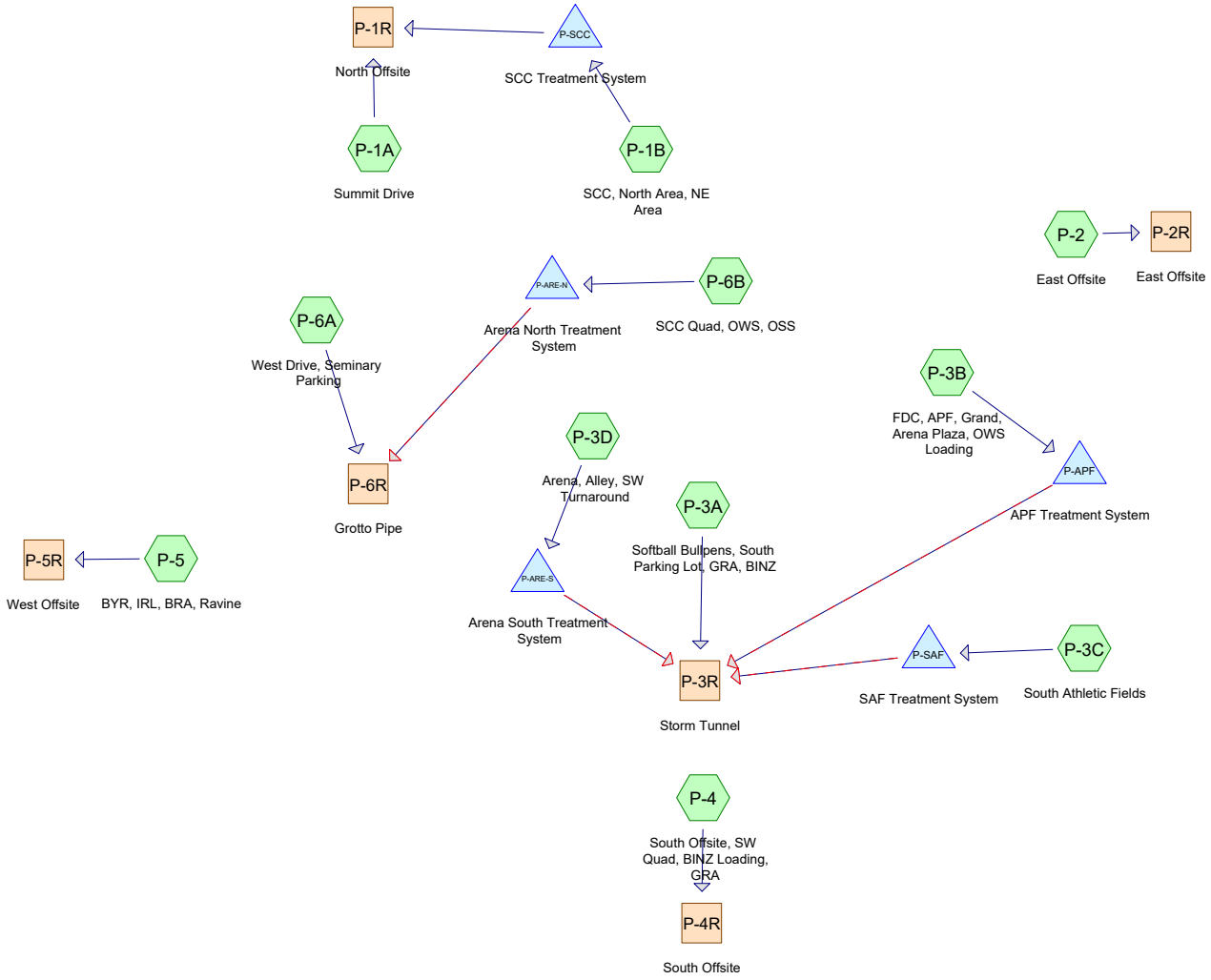
Plug-Flow detention time= 148.4 min calculated for 0.948 af (58% of inflow)
Center-of-Mass det. time= 72.1 min (860.2 - 788.1)

Volume	Invert	Avail.Storage	Storage Description
#1	859.00'	2,130 cf	**Above Ground - Overflow (Prismatic)** Listed below (Recalc)
#2	851.99'	321 cf	**35.4" Round CMP_Round 35.4" Header Row** L= 47.0'
#3	851.99'	120 cf	**35.4" Round CMP_Round 35.4" Header Connecters** L= 17.5'
#4	851.99'	30,685 cf	**94.5" Round CMP_Round 94.5"** L= 630.0'
		33,256 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
859.00	100	0	0
860.00	229	165	165
860.50	1,880	527	692
861.00	3,871	1,438	2,130

Device	Routing	Invert	Outlet Devices
#1	Primary	859.01'	**4.0' long x 5.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.35 2.51 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.69 2.73 2.77 2.86

Primary OutFlow Max=17.57 cfs @ 12.39 hrs HW=860.41' TW=0.00' (Dynamic Tailwater)
↑**1=Broad-Crested Rectangular Weir** (Weir Controls 17.57 cfs @ 3.14 fps)



Routing Diagram for UST Arena_Proposed Stormwater Management
Prepared by Ryan Companies US, INC., Printed 1/19/2024
HydroCAD® 10.00-22 s/n 02289 © 2018 HydroCAD Software Solutions LLC

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P-1A: Summit Drive Runoff Area=10,911 sf 56.61% Impervious Runoff Depth=1.83"
Flow Length=145' Tc=9.5 min CN=90 Runoff=0.72 cfs 0.038 af

Subcatchment P-1B: SCC, North Area, NE Runoff Area=142,763 sf 37.00% Impervious Runoff Depth=1.59"
Flow Length=352' Tc=20.1 min CN=87 Runoff=5.84 cfs 0.435 af

Subcatchment P-2: East Offsite Runoff Area=46,306 sf 37.43% Impervious Runoff Depth=1.59"
Flow Length=75' Slope=0.0050 '/' Tc=14.5 min CN=87 Runoff=2.22 cfs 0.141 af

Subcatchment P-3A: Softball Bullpens, Runoff Area=66,401 sf 88.27% Impervious Runoff Depth=2.38"
Flow Length=167' Tc=8.0 min CN=96 Runoff=5.66 cfs 0.303 af

Subcatchment P-3B: FDC, APF, Grand, Runoff Area=160,299 sf 85.91% Impervious Runoff Depth=2.28"
Flow Length=559' Tc=19.8 min CN=95 Runoff=9.07 cfs 0.700 af

Subcatchment P-3C: South Athletic Fields Runoff Area=159,049 sf 7.89% Impervious Runoff Depth=0.80"
Flow Length=250' Slope=0.0120 '/' Tc=39.0 min CN=74 Runoff=2.06 cfs 0.244 af

Subcatchment P-3D: Arena, Alley, SW Runoff Area=136,901 sf 95.26% Impervious Runoff Depth=2.49"
Flow Length=462' Tc=8.2 min CN=97 Runoff=11.85 cfs 0.652 af

Subcatchment P-4: South Offsite, SW Runoff Area=130,797 sf 19.62% Impervious Runoff Depth=1.38"
Flow Length=521' Tc=10.5 min CN=84 Runoff=6.31 cfs 0.345 af

Subcatchment P-5: BYR, IRL, BRA, Runoff Area=237,793 sf 23.26% Impervious Runoff Depth=1.25"
Flow Length=424' Slope=0.0540 '/' Tc=10.3 min CN=82 Runoff=10.44 cfs 0.567 af

Subcatchment P-6A: West Drive, Seminary Runoff Area=55,284 sf 57.96% Impervious Runoff Depth=1.83"
Flow Length=513' Tc=12.5 min CN=90 Runoff=3.24 cfs 0.193 af

Subcatchment P-6B: SCC Quad, OWS, Runoff Area=92,831 sf 64.59% Impervious Runoff Depth=2.00"
Flow Length=183' Tc=15.0 min CN=92 Runoff=5.45 cfs 0.355 af

Reach P-1R: North Offsite Inflow=0.72 cfs 0.038 af
Outflow=0.72 cfs 0.038 af

Reach P-2R: East Offsite Inflow=2.22 cfs 0.141 af
Outflow=2.22 cfs 0.141 af

Reach P-3R: Storm Tunnel Inflow=7.58 cfs 1.899 af
Outflow=7.58 cfs 1.899 af

Reach P-4R: South Offsite Inflow=6.31 cfs 0.345 af
Outflow=6.31 cfs 0.345 af

Reach P-5R: West Offsite Inflow=10.44 cfs 0.567 af
Outflow=10.44 cfs 0.567 af

Reach P-6R: Grotto Pipe Inflow=3.61 cfs 0.549 af
Outflow=3.61 cfs 0.549 af

Pond P-APF: APF Treatment System Peak Elev=857.56' Storage=13,531 cf Inflow=9.07 cfs 0.700 af
Outflow=3.32 cfs 0.700 af

Pond P-ARE-N: Arena North Treatment Peak Elev=852.58' Storage=0.146 af Inflow=5.45 cfs 0.355 af
Outflow=1.98 cfs 0.355 af

Pond P-ARE-S: Arena South Treatment Peak Elev=850.15' Storage=0.277 af Inflow=11.85 cfs 0.652 af
Outflow=1.25 cfs 0.652 af

Pond P-SAF: SAF Treatment System Peak Elev=855.69' Storage=0.080 af Inflow=2.06 cfs 0.244 af
Primary=0.76 cfs 0.244 af Secondary=0.00 cfs 0.000 af Outflow=0.76 cfs 0.244 af

Pond P-SCC: SCC Treatment System Peak Elev=856.57' Storage=18,935 cf Inflow=5.84 cfs 0.435 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 28.451 ac Runoff Volume = 3.974 af Average Runoff Depth = 1.68"
52.51% Pervious = 14.939 ac 47.49% Impervious = 13.512 ac

Summary for Subcatchment P-1A: Summit Drive

Runoff = 0.72 cfs @ 12.17 hrs, Volume= 0.038 af, Depth= 1.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.83"

	Area (sf)	CN	Description
*	5,048	98	Reconstructed IMP
*	1,129	98	Existing IMP
	4,734	80	>75% Grass cover, Good, HSG D
	10,911	90	Weighted Average
	4,734		43.39% Pervious Area
	6,177		56.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	7	0.0340	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.1	7	0.0340	0.93		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
2.3	20	0.0340	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.2	16	0.0340	1.10		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
4.9	50	0.0340	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
1.0	45	0.0120	0.77		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.5	145	Total			

Summary for Subcatchment P-1B: SCC, North Area, NE Area

Runoff = 5.84 cfs @ 12.30 hrs, Volume= 0.435 af, Depth= 1.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.83"

	Area (sf)	CN	Description
*	5	98	Reconstructed IMP
*	52,814	98	Existing IMP
	89,944	80	>75% Grass cover, Good, HSG D
	142,763	87	Weighted Average
	89,944		63.00% Pervious Area
	52,819		37.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	66	0.0029	0.07		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
3.8	286	0.0061	1.26		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
20.1	352	Total			

Summary for Subcatchment P-2: East Offsite

Runoff = 2.22 cfs @ 12.23 hrs, Volume= 0.141 af, Depth= 1.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.83"

	Area (sf)	CN	Description
*	1,144	98	Reconstructed IMP
*	16,189	98	Existing IMP
	28,973	80	>75% Grass cover, Good, HSG D
	46,306	87	Weighted Average
	28,973		62.57% Pervious Area
	17,333		37.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	75	0.0050	0.09		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"

Summary for Subcatchment P-3A: Softball Bullpens, South Parking Lot, GRA, BINZ

Runoff = 5.66 cfs @ 12.15 hrs, Volume= 0.303 af, Depth= 2.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.83"

	Area (sf)	CN	Description
*	22,597	98	Reconstructed IMP
*	36,017	98	Existing IMP
	7,787	80	>75% Grass cover, Good, HSG D
	66,401	96	Weighted Average
	7,787		11.73% Pervious Area
	58,614		88.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	51	0.0150	0.12		**Sheet Flow, South Lot** Grass: Short n= 0.150 P2= 2.80"
0.8	49	0.0150	0.99		**Sheet Flow, South Lot** Smooth surfaces n= 0.011 P2= 2.80"
0.2	20	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	47	0.0050	6.40	31.42	**Pipe Channel,** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.012 Corrugated PP, smooth interior
8.0	167	Total			

Summary for Subcatchment P-3B: FDC, APF, Grand, Arena Plaza, OWS Loading

Runoff = 9.07 cfs @ 12.28 hrs, Volume= 0.700 af, Depth= 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.83"

	Area (sf)	CN	Description
*	55,035	98	Reconstructed IMP
*	82,675	98	Existing IMP
	22,589	80	>75% Grass cover, Good, HSG D
	160,299	95	Weighted Average
	22,589		14.09% Pervious Area
	137,710		85.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.3	85	0.0080	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
1.4	77	0.0170	0.91		**Shallow Concentrated Flow, East of OWS** Short Grass Pasture Kv= 7.0 fps
4.4	170	0.0010	0.64		**Shallow Concentrated Flow, Grand Ave** Paved Kv= 20.3 fps
0.1	15	0.0050	3.79	2.98	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.4	138	0.0050	5.52	17.33	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012 Corrugated PP, smooth interior
0.2	74	0.0040	4.93	15.50	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012 Corrugated PP, smooth interior
19.8	559	Total			

Summary for Subcatchment P-3C: South Athletic Fields

Runoff = 2.06 cfs @ 12.61 hrs, Volume= 0.244 af, Depth= 0.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.83"

	Area (sf)	CN	Description
*	6,532	98	Reconstructed IMP
*	6,019	98	Existing IMP
	6,250	80	>75% Grass cover, Good, HSG D
*	140,248	72	Turf Field
	159,049	74	Weighted Average
	146,498		92.11% Pervious Area
	12,551		7.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.0	250	0.0120	0.11		**Sheet Flow, Grass Field** Grass: Dense n= 0.240 P2= 2.80"

Summary for Subcatchment P-3D: Arena, Alley, SW Turnaround

Runoff = 11.85 cfs @ 12.15 hrs, Volume= 0.652 af, Depth= 2.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.83"

	Area (sf)	CN	Description
*	130,360	98	Reconstructed IMP
*	54	98	Existing IMP
	6,487	80	>75% Grass cover, Good, HSG D
	136,901	97	Weighted Average
	6,487		4.74% Pervious Area
	130,414		95.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	15	0.0160	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.2	10	0.0130	0.68		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
2.0	10	0.0130	0.08		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.4	20	0.0150	0.83		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
2.5	187	0.0050	1.24	2.19	**Pipe Channel, Pipe to SW System** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.044
0.6	220	0.0050	6.02	18.90	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
8.2	462	Total			

Summary for Subcatchment P-4: South Offsite, SW Quad, BINZ Loading, GRA

Runoff = 6.31 cfs @ 12.18 hrs, Volume= 0.345 af, Depth= 1.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.83"

	Area (sf)	CN	Description
*	3,632	98	Reconstructed IMP
*	22,030	98	Existing IMP
	105,135	80	>75% Grass cover, Good, HSG D
	130,797	84	Weighted Average
	105,135		80.38% Pervious Area
	25,662		19.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.0890	0.29		**Sheet Flow, Area South of Brady** Grass: Short n= 0.150 P2= 2.80"
0.0	8	0.0430	4.21		**Shallow Concentrated Flow, Area South of Brady** Paved Kv= 20.3 fps
4.7	413	0.0430	1.45		**Shallow Concentrated Flow, Area South of Brady** Short Grass Pasture Kv= 7.0 fps
10.5	521	Total			

Summary for Subcatchment P-5: BYR, IRL, BRA, Ravine

Runoff = 10.44 cfs @ 12.18 hrs, Volume= 0.567 af, Depth= 1.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.83"

	Area (sf)	CN	Description
*	499	98	Reconstructed IMP
*	54,802	98	Existing IMP
	86,650	73	Woods, Fair, HSG C
	95,842	80	>75% Grass cover, Good, HSG D
	237,793	82	Weighted Average
	182,492		76.74% Pervious Area
	55,301		23.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	100	0.0540	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
3.3	324	0.0540	1.63		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.3	424	Total			

Summary for Subcatchment P-6A: West Drive, Seminary Parking

Runoff = 3.24 cfs @ 12.20 hrs, Volume= 0.193 af, Depth= 1.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.83"

	Area (sf)	CN	Description
*	23,774	98	Reconstructed IMP
*	8,267	98	Existing IMP
	23,243	80	>75% Grass cover, Good, HSG D
	55,284	90	Weighted Average
	23,243		42.04% Pervious Area
	32,041		57.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	60	0.0370	0.18		**Sheet Flow, Grass Area north of Arena** Grass: Short n= 0.150 P2= 2.80"
3.9	40	0.0370	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
1.9	90	0.0130	0.80		**Shallow Concentrated Flow, Grass Area in Quad** Short Grass Pasture Kv= 7.0 fps
0.2	50	0.0050	4.84	5.94	**Pipe Channel, Pipe Channel to Grotto** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.010 PVC, smooth interior
0.9	176	0.0050	3.23	3.96	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.015 Concrete sewer w/manholes & inlets
0.2	97	0.0190	7.86	9.65	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
12.5	513	Total			

Summary for Subcatchment P-6B: SCC Quad, OWS, OSS

Runoff = 5.45 cfs @ 12.23 hrs, Volume= 0.355 af, Depth= 2.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 2-yr Rainfall=2.83"

	Area (sf)	CN	Description
*	5,342	98	Reconstructed IMP
*	54,616	98	Existing IMP
	32,873	80	>75% Grass cover, Good, HSG D
	92,831	92	Weighted Average
	32,873		35.41% Pervious Area
	59,958		64.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	46	0.0130	0.93		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
4.6	21	0.0070	0.08		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
8.3	60	0.0130	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
1.3	56	0.0110	0.73		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
15.0	183	Total			

Summary for Reach P-1R: North Offsite

Inflow Area = 3.528 ac, 38.39% Impervious, Inflow Depth = 0.13" for 2-yr event
Inflow = 0.72 cfs @ 12.17 hrs, Volume= 0.038 af
Outflow = 0.72 cfs @ 12.17 hrs, Volume= 0.038 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach P-2R: East Offsite

Inflow Area = 1.063 ac, 37.43% Impervious, Inflow Depth = 1.59" for 2-yr event
Inflow = 2.22 cfs @ 12.23 hrs, Volume= 0.141 af
Outflow = 2.22 cfs @ 12.23 hrs, Volume= 0.141 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach P-3R: Storm Tunnel

Inflow Area = 11.998 ac, 64.92% Impervious, Inflow Depth = 1.90" for 2-yr event
Inflow = 7.58 cfs @ 12.15 hrs, Volume= 1.899 af
Outflow = 7.58 cfs @ 12.15 hrs, Volume= 1.899 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach P-4R: South Offsite

Inflow Area = 3.003 ac, 19.62% Impervious, Inflow Depth = 1.38" for 2-yr event
Inflow = 6.31 cfs @ 12.18 hrs, Volume= 0.345 af
Outflow = 6.31 cfs @ 12.18 hrs, Volume= 0.345 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach P-5R: West Offsite

Inflow Area = 5.459 ac, 23.26% Impervious, Inflow Depth = 1.25" for 2-yr event
Inflow = 10.44 cfs @ 12.18 hrs, Volume= 0.567 af
Outflow = 10.44 cfs @ 12.18 hrs, Volume= 0.567 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach P-6R: Grotto Pipe

Inflow Area = 3.400 ac, 62.11% Impervious, Inflow Depth = 1.94" for 2-yr event
Inflow = 3.61 cfs @ 12.21 hrs, Volume= 0.549 af
Outflow = 3.61 cfs @ 12.21 hrs, Volume= 0.549 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Pond P-APF: APF Treatment System

Inflow Area = 3.680 ac, 85.91% Impervious, Inflow Depth = 2.28" for 2-yr event
Inflow = 9.07 cfs @ 12.28 hrs, Volume= 0.700 af
Outflow = 3.32 cfs @ 12.70 hrs, Volume= 0.700 af, Atten= 63%, Lag= 25.1 min
Primary = 3.32 cfs @ 12.70 hrs, Volume= 0.700 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 857.56' @ 12.70 hrs Surf.Area= 41 sf Storage= 13,531 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 129.6 min (915.7 - 786.1)

Volume	Invert	Avail.Storage	Storage Description
#1	852.38'	11,310 cf	**48.0" Round Pipe Storage** x 5 L= 180.0' S= 0.0010 '/'
#2	852.38'	704 cf	**48.0" Round Pipe Storage** x 2 L= 28.0'
#3	856.38'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder**
#4	852.38'	1,448 cf	**24.0" Round Pipe Storage** L= 461.0' S= 0.0050 '/'
#5	854.67'	64 cf	**4.00'D x 5.10'H Vertical Cone/Cylinder**
#6	859.75'	505 cf	**Custom Stage Data** Listed below
		14,200 cf	Total Available Storage

Elevation (feet)	Cum.Store (cubic-feet)
859.75	0
860.75	505

Device	Routing	Invert	Outlet Devices
#1	Primary	848.70'	**24.0" Round Culvert** L= 56.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 848.70' / 848.50' S= 0.0036 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	852.38'	**0.80 cfs BayFilter at all elevations**
#3	Device 1	857.30'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=3.23 cfs @ 12.70 hrs HW=857.55' TW=0.00' (Dynamic Tailwater)
↑**1=Culvert** (Passes 3.23 cfs of 42.38 cfs potential flow)
↑**2=BayFilter** (Exfiltration Controls 0.80 cfs)
3=Sharp-Crested Rectangular Weir (Weir Controls 2.43 cfs @ 1.63 fps)

Summary for Pond P-ARE-N: Arena North Treatment System

Inflow Area = 2.131 ac, 64.59% Impervious, Inflow Depth = 2.00" for 2-yr event
Inflow = 5.45 cfs @ 12.23 hrs, Volume= 0.355 af
Outflow = 1.98 cfs @ 12.51 hrs, Volume= 0.355 af, Atten= 64%, Lag= 17.1 min
Primary = 1.98 cfs @ 12.51 hrs, Volume= 0.355 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 852.58' @ 12.51 hrs Surf.Area= 0.038 ac Storage= 0.146 af

Plug-Flow detention time= 105.8 min calculated for 0.355 af (100% of inflow)
Center-of-Mass det. time= 105.8 min (899.9 - 794.1)

Volume	Invert	Avail.Storage	Storage Description
#1	847.87'	0.263 af	**108.0" Round Pipe Storage** L= 180.0'
#2	845.34'	0.007 af	**8.00'W x 6.00'L x 6.00'H StormFilter**
		0.269 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	844.59'	**15.0" Round Culvert** L= 47.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 844.59' / 844.36' S= 0.0049 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.23 sf
#2	Device 1	844.84'	**Tube/Siphon/Float Valve X 9.00** Starts@847.59' Breaks@845.69' 0.798" Diameter, C= 0.600, 0.263" Trickle Diameter
#3	Device 1	851.87'	**15.0" Round Culvert** L= 25.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 851.87' / 851.75' S= 0.0048 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.23 sf

Primary OutFlow Max=1.98 cfs @ 12.51 hrs HW=852.58' TW=0.00' (Dynamic Tailwater)
↑**1=Culvert** (Passes 1.98 cfs of 16.04 cfs potential flow)
↑**2=Tube/Siphon/Float Valve** (Orifice Controls 0.42 cfs @ 13.40 fps)
3=Culvert (Barrel Controls 1.56 cfs @ 3.12 fps)

Summary for Pond P-ARE-S: Arena South Treatment System

Inflow Area = 3.143 ac, 95.26% Impervious, Inflow Depth = 2.49" for 2-yr event
Inflow = 11.85 cfs @ 12.15 hrs, Volume= 0.652 af
Outflow = 1.25 cfs @ 12.66 hrs, Volume= 0.652 af, Atten= 89%, Lag= 30.2 min
Primary = 1.25 cfs @ 12.66 hrs, Volume= 0.652 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 850.15' @ 12.66 hrs Surf.Area= 0.086 ac Storage= 0.277 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 79.4 min (843.2 - 763.7)

Volume	Invert	Avail.Storage	Storage Description
#1	846.00'	0.530 af	**120.0" Round CMP_Round 120"** x 6 L= 49.0'
#2	846.00'	0.135 af	**120.0" Round CMP_Round 120"** L= 75.0'
#3	843.49'	0.015 af	**8.00'W x 14.00'L x 6.00'H StormFilter**
		0.681 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	841.71'	**30.0" Round Culvert** L= 41.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 841.71' / 841.50' S= 0.0051 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 4.91 sf
#2	Device 1	842.99'	**Tube/Siphon/Float Valve X 28.00** Starts@845.74' Breaks@843.84' 0.798" Diameter, C= 0.600, 0.263" Trickle Diameter
#3	Device 1	853.00'	**30.0" Round Culvert** L= 50.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 853.00' / 852.75' S= 0.0050 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 4.91 sf

Primary OutFlow Max=1.25 cfs @ 12.66 hrs HW=850.15' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 1.25 cfs of 63.38 cfs potential flow)
  └─**2=Tube/Siphon/Float Valve** (Orifice Controls 1.25 cfs @ 12.89 fps)
  └─**3=Culvert** (Controls 0.00 cfs)

Summary for Pond P-SAF: SAF Treatment System

Inflow Area = 3.651 ac, 7.89% Impervious, Inflow Depth = 0.80" for 2-yr event
Inflow = 2.06 cfs @ 12.61 hrs, Volume= 0.244 af
Outflow = 0.76 cfs @ 13.31 hrs, Volume= 0.244 af, Atten= 63%, Lag= 42.1 min
Primary = 0.76 cfs @ 13.31 hrs, Volume= 0.244 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 855.69' @ 13.31 hrs Surf.Area= 0.170 ac Storage= 0.080 af

Plug-Flow detention time= 69.3 min calculated for 0.244 af (100% of inflow)
Center-of-Mass det. time= 68.8 min (933.9 - 865.1)

Volume	Invert	Avail.Storage	Storage Description
#1	854.80'	0.164 af	**39.50'W x 187.56'L x 4.50'H Field A** 0.765 af Overall - 0.219 af Embedded = 0.546 af x 30.0% Voids
#2	855.30'	0.219 af	**ADS_StormTech SC-740 +Cap** x 208 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 8 Rows of 26 Chambers
		0.383 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	854.80'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Secondary	860.00'	**110.0' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.76 cfs @ 13.31 hrs HW=855.69' TW=0.00' (Dynamic Tailwater)
└─**1=Orifice/Grate** (Orifice Controls 0.76 cfs @ 3.86 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=854.80' TW=0.00' (Dynamic Tailwater)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond P-SCC: SCC Treatment System

Inflow Area = 3.277 ac, 37.00% Impervious, Inflow Depth = 1.59" for 2-yr event
Inflow = 5.84 cfs @ 12.30 hrs, Volume= 0.435 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 856.57' @ 25.16 hrs Surf.Area= 4,896 sf Storage= 18,935 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	859.00'	2,130 cf	**Above Ground - Overflow (Prismatic)** Listed below (Recalc)
#2	851.99'	321 cf	**35.4" Round CMP_Round 35.4" Header Row** L= 47.0'
#3	851.99'	120 cf	**35.4" Round CMP_Round 35.4" Header Connecters** L= 17.5'
#4	851.99'	30,685 cf	**94.5" Round CMP_Round 94.5"** L= 630.0'
		33,256 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
859.00	100	0	0
860.00	229	165	165
860.50	1,880	527	692
861.00	3,871	1,438	2,130

Device	Routing	Invert	Outlet Devices
#1	Primary	859.01'	**4.0' long x 5.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.35 2.51 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.69 2.73 2.77 2.86

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=851.99' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P-1A: Summit Drive Runoff Area=10,911 sf 56.61% Impervious Runoff Depth=3.14"
Flow Length=145' Tc=9.5 min CN=90 Runoff=1.20 cfs 0.065 af

Subcatchment P-1B: SCC, North Area, NE Runoff Area=142,763 sf 37.00% Impervious Runoff Depth=2.85"
Flow Length=352' Tc=20.1 min CN=87 Runoff=10.34 cfs 0.778 af

Subcatchment P-2: East Offsite Runoff Area=46,306 sf 37.43% Impervious Runoff Depth=2.85"
Flow Length=75' Slope=0.0050 '/' Tc=14.5 min CN=87 Runoff=3.93 cfs 0.252 af

Subcatchment P-3A: Softball Bullpens, Runoff Area=66,401 sf 88.27% Impervious Runoff Depth=3.77"
Flow Length=167' Tc=8.0 min CN=96 Runoff=8.69 cfs 0.479 af

Subcatchment P-3B: FDC, APF, Grand, Runoff Area=160,299 sf 85.91% Impervious Runoff Depth=3.66"
Flow Length=559' Tc=19.8 min CN=95 Runoff=14.17 cfs 1.122 af

Subcatchment P-3C: South Athletic Fields Runoff Area=159,049 sf 7.89% Impervious Runoff Depth=1.77"
Flow Length=250' Slope=0.0120 '/' Tc=39.0 min CN=74 Runoff=4.85 cfs 0.538 af

Subcatchment P-3D: Arena, Alley, SW Runoff Area=136,901 sf 95.26% Impervious Runoff Depth=3.88"
Flow Length=462' Tc=8.2 min CN=97 Runoff=18.02 cfs 1.016 af

Subcatchment P-4: South Offsite, SW Runoff Area=130,797 sf 19.62% Impervious Runoff Depth=2.57"
Flow Length=521' Tc=10.5 min CN=84 Runoff=11.69 cfs 0.644 af

Subcatchment P-5: BYR, IRL, BRA, Runoff Area=237,793 sf 23.26% Impervious Runoff Depth=2.40"
Flow Length=424' Slope=0.0540 '/' Tc=10.3 min CN=82 Runoff=20.08 cfs 1.092 af

Subcatchment P-6A: West Drive, Seminary Runoff Area=55,284 sf 57.96% Impervious Runoff Depth=3.14"
Flow Length=513' Tc=12.5 min CN=90 Runoff=5.43 cfs 0.332 af

Subcatchment P-6B: SCC Quad, OWS, Runoff Area=92,831 sf 64.59% Impervious Runoff Depth=3.34"
Flow Length=183' Tc=15.0 min CN=92 Runoff=8.88 cfs 0.593 af

Reach P-1R: North Offsite Inflow=1.20 cfs 0.170 af
Outflow=1.20 cfs 0.170 af

Reach P-2R: East Offsite Inflow=3.93 cfs 0.252 af
Outflow=3.93 cfs 0.252 af

Reach P-3R: Storm Tunnel Inflow=29.19 cfs 3.154 af
Outflow=29.19 cfs 3.154 af

Reach P-4R: South Offsite Inflow=11.69 cfs 0.644 af
Outflow=11.69 cfs 0.644 af

Reach P-5R: West Offsite Inflow=20.08 cfs 1.092 af
Outflow=20.08 cfs 1.092 af

Reach P-6R: Grotto Pipe Inflow=9.74 cfs 0.925 af
Outflow=9.74 cfs 0.925 af

Pond P-APF: APF Treatment System Peak Elev=858.46' Storage=13,568 cf Inflow=14.17 cfs 1.122 af
Outflow=24.21 cfs 1.122 af

Pond P-ARE-N: Arena North Treatment Peak Elev=853.63' Storage=0.184 af Inflow=8.88 cfs 0.593 af
Outflow=6.08 cfs 0.593 af

Pond P-ARE-S: Arena South Treatment Peak Elev=852.58' Storage=0.480 af Inflow=18.02 cfs 1.016 af
Outflow=1.45 cfs 1.016 af

Pond P-SAF: SAF Treatment System Peak Elev=856.89' Storage=0.230 af Inflow=4.85 cfs 0.538 af
Primary=1.28 cfs 0.537 af Secondary=0.00 cfs 0.000 af Outflow=1.28 cfs 0.537 af

Pond P-SCC: SCC Treatment System Peak Elev=859.09' Storage=29,589 cf Inflow=10.34 cfs 0.778 af
Outflow=0.23 cfs 0.105 af

Total Runoff Area = 28.451 ac Runoff Volume = 6.912 af Average Runoff Depth = 2.92"
52.51% Pervious = 14.939 ac 47.49% Impervious = 13.512 ac

Summary for Subcatchment P-1A: Summit Drive

Runoff = 1.20 cfs @ 12.17 hrs, Volume= 0.065 af, Depth= 3.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-yr Rainfall=4.23"

	Area (sf)	CN	Description
*	5,048	98	Reconstructed IMP
*	1,129	98	Existing IMP
	4,734	80	>75% Grass cover, Good, HSG D
	10,911	90	Weighted Average
	4,734		43.39% Pervious Area
	6,177		56.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	7	0.0340	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.1	7	0.0340	0.93		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
2.3	20	0.0340	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.2	16	0.0340	1.10		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
4.9	50	0.0340	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
1.0	45	0.0120	0.77		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.5	145	Total			

Summary for Subcatchment P-1B: SCC, North Area, NE Area

Runoff = 10.34 cfs @ 12.29 hrs, Volume= 0.778 af, Depth= 2.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-yr Rainfall=4.23"

	Area (sf)	CN	Description
*	5	98	Reconstructed IMP
*	52,814	98	Existing IMP
	89,944	80	>75% Grass cover, Good, HSG D
	142,763	87	Weighted Average
	89,944		63.00% Pervious Area
	52,819		37.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	66	0.0029	0.07		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
3.8	286	0.0061	1.26		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
20.1	352	Total			

Summary for Subcatchment P-2: East Offsite

Runoff = 3.93 cfs @ 12.23 hrs, Volume= 0.252 af, Depth= 2.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-yr Rainfall=4.23"

	Area (sf)	CN	Description
*	1,144	98	Reconstructed IMP
*	16,189	98	Existing IMP
	28,973	80	>75% Grass cover, Good, HSG D
	46,306	87	Weighted Average
	28,973		62.57% Pervious Area
	17,333		37.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	75	0.0050	0.09		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"

Summary for Subcatchment P-3A: Softball Bullpens, South Parking Lot, GRA, BINZ

Runoff = 8.69 cfs @ 12.15 hrs, Volume= 0.479 af, Depth= 3.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-yr Rainfall=4.23"

	Area (sf)	CN	Description
*	22,597	98	Reconstructed IMP
*	36,017	98	Existing IMP
	7,787	80	>75% Grass cover, Good, HSG D
	66,401	96	Weighted Average
	7,787		11.73% Pervious Area
	58,614		88.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	51	0.0150	0.12		**Sheet Flow, South Lot** Grass: Short n= 0.150 P2= 2.80"
0.8	49	0.0150	0.99		**Sheet Flow, South Lot** Smooth surfaces n= 0.011 P2= 2.80"
0.2	20	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	47	0.0050	6.40	31.42	**Pipe Channel,** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.012 Corrugated PP, smooth interior
8.0	167	Total			

Summary for Subcatchment P-3B: FDC, APF, Grand, Arena Plaza, OWS Loading

Runoff = 14.17 cfs @ 12.28 hrs, Volume= 1.122 af, Depth= 3.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-yr Rainfall=4.23"

	Area (sf)	CN	Description
*	55,035	98	Reconstructed IMP
*	82,675	98	Existing IMP
	22,589	80	>75% Grass cover, Good, HSG D
	160,299	95	Weighted Average
	22,589		14.09% Pervious Area
	137,710		85.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.3	85	0.0080	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
1.4	77	0.0170	0.91		**Shallow Concentrated Flow, East of OWS** Short Grass Pasture Kv= 7.0 fps
4.4	170	0.0010	0.64		**Shallow Concentrated Flow, Grand Ave** Paved Kv= 20.3 fps
0.1	15	0.0050	3.79	2.98	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.4	138	0.0050	5.52	17.33	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012 Corrugated PP, smooth interior
0.2	74	0.0040	4.93	15.50	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012 Corrugated PP, smooth interior
19.8	559	Total			

Summary for Subcatchment P-3C: South Athletic Fields

Runoff = 4.85 cfs @ 12.57 hrs, Volume= 0.538 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-yr Rainfall=4.23"

	Area (sf)	CN	Description
*	6,532	98	Reconstructed IMP
*	6,019	98	Existing IMP
	6,250	80	>75% Grass cover, Good, HSG D
*	140,248	72	Turf Field
	159,049	74	Weighted Average
	146,498		92.11% Pervious Area
	12,551		7.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.0	250	0.0120	0.11		**Sheet Flow, Grass Field** Grass: Dense n= 0.240 P2= 2.80"

Summary for Subcatchment P-3D: Arena, Alley, SW Turnaround

Runoff = 18.02 cfs @ 12.15 hrs, Volume= 1.016 af, Depth= 3.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-yr Rainfall=4.23"

	Area (sf)	CN	Description
*	130,360	98	Reconstructed IMP
*	54	98	Existing IMP
	6,487	80	>75% Grass cover, Good, HSG D
	136,901	97	Weighted Average
	6,487		4.74% Pervious Area
	130,414		95.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	15	0.0160	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.2	10	0.0130	0.68		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
2.0	10	0.0130	0.08		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.4	20	0.0150	0.83		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
2.5	187	0.0050	1.24	2.19	**Pipe Channel, Pipe to SW System** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.044
0.6	220	0.0050	6.02	18.90	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
8.2	462	Total			

Summary for Subcatchment P-4: South Offsite, SW Quad, BINZ Loading, GRA

Runoff = 11.69 cfs @ 12.18 hrs, Volume= 0.644 af, Depth= 2.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-yr Rainfall=4.23"

	Area (sf)	CN	Description
*	3,632	98	Reconstructed IMP
*	22,030	98	Existing IMP
	105,135	80	>75% Grass cover, Good, HSG D
	130,797	84	Weighted Average
	105,135		80.38% Pervious Area
	25,662		19.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.0890	0.29		**Sheet Flow, Area South of Brady** Grass: Short n= 0.150 P2= 2.80"
0.0	8	0.0430	4.21		**Shallow Concentrated Flow, Area South of Brady** Paved Kv= 20.3 fps
4.7	413	0.0430	1.45		**Shallow Concentrated Flow, Area South of Brady** Short Grass Pasture Kv= 7.0 fps
10.5	521	Total			

Summary for Subcatchment P-5: BYR, IRL, BRA, Ravine

Runoff = 20.08 cfs @ 12.18 hrs, Volume= 1.092 af, Depth= 2.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-yr Rainfall=4.23"

	Area (sf)	CN	Description
*	499	98	Reconstructed IMP
*	54,802	98	Existing IMP
	86,650	73	Woods, Fair, HSG C
	95,842	80	>75% Grass cover, Good, HSG D
	237,793	82	Weighted Average
	182,492		76.74% Pervious Area
	55,301		23.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	100	0.0540	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
3.3	324	0.0540	1.63		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.3	424	Total			

Summary for Subcatchment P-6A: West Drive, Seminary Parking

Runoff = 5.43 cfs @ 12.20 hrs, Volume= 0.332 af, Depth= 3.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-yr Rainfall=4.23"

	Area (sf)	CN	Description
*	23,774	98	Reconstructed IMP
*	8,267	98	Existing IMP
	23,243	80	>75% Grass cover, Good, HSG D
	55,284	90	Weighted Average
	23,243		42.04% Pervious Area
	32,041		57.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	60	0.0370	0.18		**Sheet Flow, Grass Area north of Arena** Grass: Short n= 0.150 P2= 2.80"
3.9	40	0.0370	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
1.9	90	0.0130	0.80		**Shallow Concentrated Flow, Grass Area in Quad** Short Grass Pasture Kv= 7.0 fps
0.2	50	0.0050	4.84	5.94	**Pipe Channel, Pipe Channel to Grotto** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.010 PVC, smooth interior
0.9	176	0.0050	3.23	3.96	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.015 Concrete sewer w/manholes & inlets
0.2	97	0.0190	7.86	9.65	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
12.5	513	Total			

Summary for Subcatchment P-6B: SCC Quad, OWS, OSS

Runoff = 8.88 cfs @ 12.22 hrs, Volume= 0.593 af, Depth= 3.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 10-yr Rainfall=4.23"

	Area (sf)	CN	Description
*	5,342	98	Reconstructed IMP
*	54,616	98	Existing IMP
	32,873	80	>75% Grass cover, Good, HSG D
	92,831	92	Weighted Average
	32,873		35.41% Pervious Area
	59,958		64.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	46	0.0130	0.93		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
4.6	21	0.0070	0.08		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
8.3	60	0.0130	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
1.3	56	0.0110	0.73		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
15.0	183	Total			

Summary for Reach P-1R: North Offsite

Inflow Area = 3.528 ac, 38.39% Impervious, Inflow Depth = 0.58" for 10-yr event
Inflow = 1.20 cfs @ 12.17 hrs, Volume= 0.170 af
Outflow = 1.20 cfs @ 12.17 hrs, Volume= 0.170 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach P-2R: East Offsite

Inflow Area = 1.063 ac, 37.43% Impervious, Inflow Depth = 2.85" for 10-yr event
Inflow = 3.93 cfs @ 12.23 hrs, Volume= 0.252 af
Outflow = 3.93 cfs @ 12.23 hrs, Volume= 0.252 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach P-3R: Storm Tunnel

Inflow Area = 11.998 ac, 64.92% Impervious, Inflow Depth = 3.15" for 10-yr event
Inflow = 29.19 cfs @ 12.32 hrs, Volume= 3.154 af
Outflow = 29.19 cfs @ 12.32 hrs, Volume= 3.154 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach P-4R: South Offsite

Inflow Area = 3.003 ac, 19.62% Impervious, Inflow Depth = 2.57" for 10-yr event
Inflow = 11.69 cfs @ 12.18 hrs, Volume= 0.644 af
Outflow = 11.69 cfs @ 12.18 hrs, Volume= 0.644 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach P-5R: West Offsite

Inflow Area = 5.459 ac, 23.26% Impervious, Inflow Depth = 2.40" for 10-yr event
Inflow = 20.08 cfs @ 12.18 hrs, Volume= 1.092 af
Outflow = 20.08 cfs @ 12.18 hrs, Volume= 1.092 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach P-6R: Grotto Pipe

Inflow Area = 3.400 ac, 62.11% Impervious, Inflow Depth = 3.26" for 10-yr event
Inflow = 9.74 cfs @ 12.28 hrs, Volume= 0.925 af
Outflow = 9.74 cfs @ 12.28 hrs, Volume= 0.925 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Pond P-APF: APF Treatment System

Inflow Area = 3.680 ac, 85.91% Impervious, Inflow Depth = 3.66" for 10-yr event
Inflow = 14.17 cfs @ 12.28 hrs, Volume= 1.122 af
Outflow = 24.21 cfs @ 12.32 hrs, Volume= 1.122 af, Atten= 0%, Lag= 2.4 min
Primary = 24.21 cfs @ 12.32 hrs, Volume= 1.122 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 858.46' @ 12.32 hrs Surf.Area= 41 sf Storage= 13,568 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 99.3 min (876.5 - 777.1)

Volume	Invert	Avail.Storage	Storage Description
#1	852.38'	11,310 cf	**48.0" Round Pipe Storage** x 5 L= 180.0' S= 0.0010 '/'
#2	852.38'	704 cf	**48.0" Round Pipe Storage** x 2 L= 28.0'
#3	856.38'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder**
#4	852.38'	1,448 cf	**24.0" Round Pipe Storage** L= 461.0' S= 0.0050 '/'
#5	854.67'	64 cf	**4.00'D x 5.10'H Vertical Cone/Cylinder**
#6	859.75'	505 cf	**Custom Stage Data** Listed below
		14,200 cf	Total Available Storage

Elevation (feet)	Cum.Store (cubic-feet)
859.75	0
860.75	505

Device	Routing	Invert	Outlet Devices
#1	Primary	848.70'	**24.0" Round Culvert** L= 56.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 848.70' / 848.50' S= 0.0036 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	852.38'	**0.80 cfs BayFilter at all elevations**
#3	Device 1	857.30'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=23.08 cfs @ 12.32 hrs HW=858.42' TW=0.00' (Dynamic Tailwater)
↑**1=Culvert** (Passes 23.08 cfs of 44.66 cfs potential flow)
↑**2=BayFilter** (Exfiltration Controls 0.80 cfs)
3=Sharp-Crested Rectangular Weir (Weir Controls 22.28 cfs @ 3.45 fps)

Summary for Pond P-ARE-N: Arena North Treatment System

Inflow Area = 2.131 ac, 64.59% Impervious, Inflow Depth = 3.34" for 10-yr event
Inflow = 8.88 cfs @ 12.22 hrs, Volume= 0.593 af
Outflow = 6.08 cfs @ 12.35 hrs, Volume= 0.593 af, Atten= 31%, Lag= 7.7 min
Primary = 6.08 cfs @ 12.35 hrs, Volume= 0.593 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 853.63' @ 12.35 hrs Surf.Area= 0.037 ac Storage= 0.184 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 82.2 min (866.2 - 784.0)

Volume	Invert	Avail.Storage	Storage Description
#1	847.87'	0.263 af	**108.0" Round Pipe Storage** L= 180.0'
#2	845.34'	0.007 af	**8.00'W x 6.00'L x 6.00'H StormFilter**
		0.269 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	844.59'	**15.0" Round Culvert** L= 47.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 844.59' / 844.36' S= 0.0049 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.23 sf
#2	Device 1	844.84'	**Tube/Siphon/Float Valve X 9.00** Starts@847.59' Breaks@845.69' 0.798" Diameter, C= 0.600, 0.263" Trickle Diameter
#3	Device 1	851.87'	**15.0" Round Culvert** L= 25.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 851.87' / 851.75' S= 0.0048 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.23 sf

Primary OutFlow Max=6.08 cfs @ 12.35 hrs HW=853.63' TW=0.00' (Dynamic Tailwater)
↑**1=Culvert** (Passes 6.08 cfs of 17.14 cfs potential flow)
↑**2=Tube/Siphon/Float Valve** (Orifice Controls 0.45 cfs @ 14.27 fps)
3=Culvert (Barrel Controls 5.64 cfs @ 4.59 fps)

Summary for Pond P-ARE-S: Arena South Treatment System

Inflow Area = 3.143 ac, 95.26% Impervious, Inflow Depth = 3.88" for 10-yr event
Inflow = 18.02 cfs @ 12.15 hrs, Volume= 1.016 af
Outflow = 1.45 cfs @ 12.90 hrs, Volume= 1.016 af, Atten= 92%, Lag= 44.8 min
Primary = 1.45 cfs @ 12.90 hrs, Volume= 1.016 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 852.58' @ 12.90 hrs Surf.Area= 0.083 ac Storage= 0.480 af

Plug-Flow detention time= 125.9 min calculated for 1.016 af (100% of inflow)
Center-of-Mass det. time= 125.9 min (882.1 - 756.2)

Volume	Invert	Avail.Storage	Storage Description
#1	846.00'	0.530 af	**120.0" Round CMP_Round 120"** x 6 L= 49.0'
#2	846.00'	0.135 af	**120.0" Round CMP_Round 120"** L= 75.0'
#3	843.49'	0.015 af	**8.00'W x 14.00'L x 6.00'H StormFilter**
		0.681 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	841.71'	**30.0" Round Culvert** L= 41.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 841.71' / 841.50' S= 0.0051 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 4.91 sf
#2	Device 1	842.99'	**Tube/Siphon/Float Valve X 28.00** Starts@845.74' Breaks@843.84' 0.798" Diameter, C= 0.600, 0.263" Trickle Diameter
#3	Device 1	853.00'	**30.0" Round Culvert** L= 50.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 853.00' / 852.75' S= 0.0050 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 4.91 sf

Primary OutFlow Max=1.45 cfs @ 12.90 hrs HW=852.58' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 1.45 cfs of 73.31 cfs potential flow)
  └**2=Tube/Siphon/Float Valve** (Orifice Controls 1.45 cfs @ 14.91 fps)
  └**3=Culvert** (Controls 0.00 cfs)

Summary for Pond P-SAF: SAF Treatment System

Inflow Area = 3.651 ac, 7.89% Impervious, Inflow Depth = 1.77" for 10-yr event
Inflow = 4.85 cfs @ 12.57 hrs, Volume= 0.538 af
Outflow = 1.28 cfs @ 13.46 hrs, Volume= 0.537 af, Atten= 74%, Lag= 53.6 min
Primary = 1.28 cfs @ 13.46 hrs, Volume= 0.537 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 856.89' @ 13.46 hrs Surf.Area= 0.170 ac Storage= 0.230 af

Plug-Flow detention time= 97.1 min calculated for 0.537 af (100% of inflow)
Center-of-Mass det. time= 96.8 min (944.0 - 847.2)

Volume	Invert	Avail.Storage	Storage Description
#1	854.80'	0.164 af	**39.50'W x 187.56'L x 4.50'H Field A** 0.765 af Overall - 0.219 af Embedded = 0.546 af x 30.0% Voids
#2	855.30'	0.219 af	**ADS_StormTech SC-740 +Cap** x 208 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 8 Rows of 26 Chambers
		0.383 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	854.80'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Secondary	860.00'	**110.0' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.28 cfs @ 13.46 hrs HW=856.89' TW=0.00' (Dynamic Tailwater)
└**1=Orifice/Grate** (Orifice Controls 1.28 cfs @ 6.53 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=854.80' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond P-SCC: SCC Treatment System

Inflow Area = 3.277 ac, 37.00% Impervious, Inflow Depth = 2.85" for 10-yr event
Inflow = 10.34 cfs @ 12.29 hrs, Volume= 0.778 af
Outflow = 0.23 cfs @ 16.47 hrs, Volume= 0.105 af, Atten= 98%, Lag= 250.6 min
Primary = 0.23 cfs @ 16.47 hrs, Volume= 0.105 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 859.09' @ 16.47 hrs Surf.Area= 3,060 sf Storage= 29,589 cf

Plug-Flow detention time= 472.3 min calculated for 0.105 af (13% of inflow)
Center-of-Mass det. time= 348.1 min (1,150.7 - 802.6)

Volume	Invert	Avail.Storage	Storage Description
#1	859.00'	2,130 cf	**Above Ground - Overflow (Prismatic)** Listed below (Recalc)
#2	851.99'	321 cf	**35.4" Round CMP_Round 35.4" Header Row** L= 47.0'
#3	851.99'	120 cf	**35.4" Round CMP_Round 35.4" Header Connecters** L= 17.5'
#4	851.99'	30,685 cf	**94.5" Round CMP_Round 94.5"** L= 630.0'
		33,256 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
859.00	100	0	0
860.00	229	165	165
860.50	1,880	527	692
861.00	3,871	1,438	2,130

Device	Routing	Invert	Outlet Devices
#1	Primary	859.01'	**4.0' long x 5.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.35 2.51 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.69 2.73 2.77 2.86

Primary OutFlow Max=0.23 cfs @ 16.47 hrs HW=859.09' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.23 cfs @ 0.68 fps)

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P-1A: Summit Drive Runoff Area=10,911 sf 56.61% Impervious Runoff Depth=6.28"
Flow Length=145' Tc=9.5 min CN=90 Runoff=2.31 cfs 0.131 af

Subcatchment P-1B: SCC, North Area, NE Runoff Area=142,763 sf 37.00% Impervious Runoff Depth=5.93"
Flow Length=352' Tc=20.1 min CN=87 Runoff=20.89 cfs 1.621 af

Subcatchment P-2: East Offsite Runoff Area=46,306 sf 37.43% Impervious Runoff Depth=5.93"
Flow Length=75' Slope=0.0050 '/' Tc=14.5 min CN=87 Runoff=7.90 cfs 0.526 af

Subcatchment P-3A: Softball Bullpens, Runoff Area=66,401 sf 88.27% Impervious Runoff Depth=6.99"
Flow Length=167' Tc=8.0 min CN=96 Runoff=15.63 cfs 0.888 af

Subcatchment P-3B: FDC, APF, Grand, Runoff Area=160,299 sf 85.91% Impervious Runoff Depth=6.87"
Flow Length=559' Tc=19.8 min CN=95 Runoff=25.78 cfs 2.108 af

Subcatchment P-3C: South Athletic Fields Runoff Area=159,049 sf 7.89% Impervious Runoff Depth=4.45"
Flow Length=250' Slope=0.0120 '/' Tc=39.0 min CN=74 Runoff=12.48 cfs 1.355 af

Subcatchment P-3D: Arena, Alley, SW Runoff Area=136,901 sf 95.26% Impervious Runoff Depth=7.11"
Flow Length=462' Tc=8.2 min CN=97 Runoff=32.17 cfs 1.862 af

Subcatchment P-4: South Offsite, SW Runoff Area=130,797 sf 19.62% Impervious Runoff Depth=5.59"
Flow Length=521' Tc=10.5 min CN=84 Runoff=24.55 cfs 1.398 af

Subcatchment P-5: BYR, IRL, BRA, Runoff Area=237,793 sf 23.26% Impervious Runoff Depth=5.36"
Flow Length=424' Slope=0.0540 '/' Tc=10.3 min CN=82 Runoff=43.56 cfs 2.437 af

Subcatchment P-6A: West Drive, Seminary Runoff Area=55,284 sf 57.96% Impervious Runoff Depth=6.28"
Flow Length=513' Tc=12.5 min CN=90 Runoff=10.46 cfs 0.665 af

Subcatchment P-6B: SCC Quad, OWS, Runoff Area=92,831 sf 64.59% Impervious Runoff Depth=6.52"
Flow Length=183' Tc=15.0 min CN=92 Runoff=16.69 cfs 1.158 af

Reach P-1R: North Offsite Inflow=18.30 cfs 1.079 af
Outflow=18.30 cfs 1.079 af

Reach P-2R: East Offsite Inflow=7.90 cfs 0.526 af
Outflow=7.90 cfs 0.526 af

Reach P-3R: Storm Tunnel Inflow=55.39 cfs 6.214 af
Outflow=55.39 cfs 6.214 af

Reach P-4R: South Offsite Inflow=24.55 cfs 1.398 af
Outflow=24.55 cfs 1.398 af

Reach P-5R: West Offsite Inflow=43.56 cfs 2.437 af
Outflow=43.56 cfs 2.437 af

Reach P-6R: Grotto Pipe Inflow=20.84 cfs 1.822 af
Outflow=20.84 cfs 1.822 af

Pond P-APF: APF Treatment System Peak Elev=858.51' Storage=13,570 cf Inflow=25.78 cfs 2.108 af
Outflow=25.86 cfs 2.108 af

Pond P-ARE-N: Arena North Treatment Peak Elev=856.84' Storage=0.269 af Inflow=16.69 cfs 1.158 af
Outflow=12.84 cfs 1.158 af

Pond P-ARE-S: Arena South Treatment Peak Elev=855.19' Storage=0.655 af Inflow=32.17 cfs 1.862 af
Outflow=20.03 cfs 1.862 af

Pond P-SAF: SAF Treatment System Peak Elev=860.17' Storage=0.383 af Inflow=12.48 cfs 1.355 af
Primary=2.14 cfs 1.029 af Secondary=20.29 cfs 0.326 af Outflow=22.43 cfs 1.355 af

Pond P-SCC: SCC Treatment System Peak Elev=860.41' Storage=31,665 cf Inflow=20.89 cfs 1.621 af
Outflow=17.59 cfs 0.948 af

Total Runoff Area = 28.451 ac Runoff Volume = 14.150 af Average Runoff Depth = 5.97"
52.51% Pervious = 14.939 ac 47.49% Impervious = 13.512 ac

Summary for Subcatchment P-1A: Summit Drive

Runoff = 2.31 cfs @ 12.17 hrs, Volume= 0.131 af, Depth= 6.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.47"

	Area (sf)	CN	Description
*	5,048	98	Reconstructed IMP
*	1,129	98	Existing IMP
	4,734	80	>75% Grass cover, Good, HSG D
	10,911	90	Weighted Average
	4,734		43.39% Pervious Area
	6,177		56.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.0	7	0.0340	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.1	7	0.0340	0.93		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
2.3	20	0.0340	0.14		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.2	16	0.0340	1.10		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
4.9	50	0.0340	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
1.0	45	0.0120	0.77		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.5	145	Total			

Summary for Subcatchment P-1B: SCC, North Area, NE Area

Runoff = 20.89 cfs @ 12.29 hrs, Volume= 1.621 af, Depth= 5.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.47"

	Area (sf)	CN	Description
*	5	98	Reconstructed IMP
*	52,814	98	Existing IMP
	89,944	80	>75% Grass cover, Good, HSG D
	142,763	87	Weighted Average
	89,944		63.00% Pervious Area
	52,819		37.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	66	0.0029	0.07		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
3.8	286	0.0061	1.26		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
20.1	352	Total			

Summary for Subcatchment P-2: East Offsite

Runoff = 7.90 cfs @ 12.22 hrs, Volume= 0.526 af, Depth= 5.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.47"

	Area (sf)	CN	Description
*	1,144	98	Reconstructed IMP
*	16,189	98	Existing IMP
	28,973	80	>75% Grass cover, Good, HSG D
	46,306	87	Weighted Average
	28,973		62.57% Pervious Area
	17,333		37.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	75	0.0050	0.09		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"

Summary for Subcatchment P-3A: Softball Bullpens, South Parking Lot, GRA, BINZ

Runoff = 15.63 cfs @ 12.15 hrs, Volume= 0.888 af, Depth= 6.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.47"

	Area (sf)	CN	Description
*	22,597	98	Reconstructed IMP
*	36,017	98	Existing IMP
	7,787	80	>75% Grass cover, Good, HSG D
	66,401	96	Weighted Average
	7,787		11.73% Pervious Area
	58,614		88.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	51	0.0150	0.12		**Sheet Flow, South Lot** Grass: Short n= 0.150 P2= 2.80"
0.8	49	0.0150	0.99		**Sheet Flow, South Lot** Smooth surfaces n= 0.011 P2= 2.80"
0.2	20	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	47	0.0050	6.40	31.42	**Pipe Channel,** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.012 Corrugated PP, smooth interior
8.0	167	Total			

Summary for Subcatchment P-3B: FDC, APF, Grand, Arena Plaza, OWS Loading

Runoff = 25.78 cfs @ 12.28 hrs, Volume= 2.108 af, Depth= 6.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.47"

	Area (sf)	CN	Description
*	55,035	98	Reconstructed IMP
*	82,675	98	Existing IMP
	22,589	80	>75% Grass cover, Good, HSG D
	160,299	95	Weighted Average
	22,589		14.09% Pervious Area
	137,710		85.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.3	85	0.0080	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
1.4	77	0.0170	0.91		**Shallow Concentrated Flow, East of OWS** Short Grass Pasture Kv= 7.0 fps
4.4	170	0.0010	0.64		**Shallow Concentrated Flow, Grand Ave** Paved Kv= 20.3 fps
0.1	15	0.0050	3.79	2.98	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.011 Concrete pipe, straight & clean
0.4	138	0.0050	5.52	17.33	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012 Corrugated PP, smooth interior
0.2	74	0.0040	4.93	15.50	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.012 Corrugated PP, smooth interior
19.8	559	Total			

Summary for Subcatchment P-3C: South Athletic Fields

Runoff = 12.48 cfs @ 12.53 hrs, Volume= 1.355 af, Depth= 4.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.47"

	Area (sf)	CN	Description
*	6,532	98	Reconstructed IMP
*	6,019	98	Existing IMP
	6,250	80	>75% Grass cover, Good, HSG D
*	140,248	72	Turf Field
	159,049	74	Weighted Average
	146,498		92.11% Pervious Area
	12,551		7.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.0	250	0.0120	0.11		**Sheet Flow, Grass Field** Grass: Dense n= 0.240 P2= 2.80"

Summary for Subcatchment P-3D: Arena, Alley, SW Turnaround

Runoff = 32.17 cfs @ 12.15 hrs, Volume= 1.862 af, Depth= 7.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.47"

	Area (sf)	CN	Description
*	130,360	98	Reconstructed IMP
*	54	98	Existing IMP
	6,487	80	>75% Grass cover, Good, HSG D
	136,901	97	Weighted Average
	6,487		4.74% Pervious Area
	130,414		95.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	15	0.0160	0.10		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.2	10	0.0130	0.68		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
2.0	10	0.0130	0.08		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
0.4	20	0.0150	0.83		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
2.5	187	0.0050	1.24	2.19	**Pipe Channel, Pipe to SW System** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.044
0.6	220	0.0050	6.02	18.90	**Pipe Channel,** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
8.2	462	Total			

Summary for Subcatchment P-4: South Offsite, SW Quad, BINZ Loading, GRA

Runoff = 24.55 cfs @ 12.18 hrs, Volume= 1.398 af, Depth= 5.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.47"

	Area (sf)	CN	Description
*	3,632	98	Reconstructed IMP
*	22,030	98	Existing IMP
	105,135	80	>75% Grass cover, Good, HSG D
	130,797	84	Weighted Average
	105,135		80.38% Pervious Area
	25,662		19.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.8	100	0.0890	0.29		**Sheet Flow, Area South of Brady** Grass: Short n= 0.150 P2= 2.80"
0.0	8	0.0430	4.21		**Shallow Concentrated Flow, Area South of Brady** Paved Kv= 20.3 fps
4.7	413	0.0430	1.45		**Shallow Concentrated Flow, Area South of Brady** Short Grass Pasture Kv= 7.0 fps
10.5	521	Total			

Summary for Subcatchment P-5: BYR, IRL, BRA, Ravine

Runoff = 43.56 cfs @ 12.18 hrs, Volume= 2.437 af, Depth= 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.47"

	Area (sf)	CN	Description
*	499	98	Reconstructed IMP
*	54,802	98	Existing IMP
	86,650	73	Woods, Fair, HSG C
	95,842	80	>75% Grass cover, Good, HSG D
	237,793	82	Weighted Average
	182,492		76.74% Pervious Area
	55,301		23.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.0	100	0.0540	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
3.3	324	0.0540	1.63		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
10.3	424	Total			

Summary for Subcatchment P-6A: West Drive, Seminary Parking

Runoff = 10.46 cfs @ 12.20 hrs, Volume= 0.665 af, Depth= 6.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.47"

	Area (sf)	CN	Description
*	23,774	98	Reconstructed IMP
*	8,267	98	Existing IMP
	23,243	80	>75% Grass cover, Good, HSG D
	55,284	90	Weighted Average
	23,243		42.04% Pervious Area
	32,041		57.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	60	0.0370	0.18		**Sheet Flow, Grass Area north of Arena** Grass: Short n= 0.150 P2= 2.80"
3.9	40	0.0370	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
1.9	90	0.0130	0.80		**Shallow Concentrated Flow, Grass Area in Quad** Short Grass Pasture Kv= 7.0 fps
0.2	50	0.0050	4.84	5.94	**Pipe Channel, Pipe Channel to Grotto** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.010 PVC, smooth interior
0.9	176	0.0050	3.23	3.96	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.015 Concrete sewer w/manholes & inlets
0.2	97	0.0190	7.86	9.65	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
12.5	513	Total			

Summary for Subcatchment P-6B: SCC Quad, OWS, OSS

Runoff = 16.69 cfs @ 12.22 hrs, Volume= 1.158 af, Depth= 6.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
MSE 24-hr 3 100-yr Rainfall=7.47"

	Area (sf)	CN	Description
*	5,342	98	Reconstructed IMP
*	54,616	98	Existing IMP
	32,873	80	>75% Grass cover, Good, HSG D
	92,831	92	Weighted Average
	32,873		35.41% Pervious Area
	59,958		64.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	46	0.0130	0.93		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 2.80"
4.6	21	0.0070	0.08		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
8.3	60	0.0130	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
1.3	56	0.0110	0.73		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
15.0	183	Total			

Summary for Reach P-1R: North Offsite

Inflow Area = 3.528 ac, 38.39% Impervious, Inflow Depth = 3.67" for 100-yr event
Inflow = 18.30 cfs @ 12.39 hrs, Volume= 1.079 af
Outflow = 18.30 cfs @ 12.39 hrs, Volume= 1.079 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach P-2R: East Offsite

Inflow Area = 1.063 ac, 37.43% Impervious, Inflow Depth = 5.93" for 100-yr event
Inflow = 7.90 cfs @ 12.22 hrs, Volume= 0.526 af
Outflow = 7.90 cfs @ 12.22 hrs, Volume= 0.526 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach P-3R: Storm Tunnel

Inflow Area = 11.998 ac, 64.92% Impervious, Inflow Depth = 6.21" for 100-yr event
Inflow = 55.39 cfs @ 12.23 hrs, Volume= 6.214 af
Outflow = 55.39 cfs @ 12.23 hrs, Volume= 6.214 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach P-4R: South Offsite

Inflow Area = 3.003 ac, 19.62% Impervious, Inflow Depth = 5.59" for 100-yr event
Inflow = 24.55 cfs @ 12.18 hrs, Volume= 1.398 af
Outflow = 24.55 cfs @ 12.18 hrs, Volume= 1.398 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach P-5R: West Offsite

Inflow Area = 5.459 ac, 23.26% Impervious, Inflow Depth = 5.36" for 100-yr event
Inflow = 43.56 cfs @ 12.18 hrs, Volume= 2.437 af
Outflow = 43.56 cfs @ 12.18 hrs, Volume= 2.437 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Reach P-6R: Grotto Pipe

Inflow Area = 3.400 ac, 62.11% Impervious, Inflow Depth = 6.43" for 100-yr event
Inflow = 20.84 cfs @ 12.24 hrs, Volume= 1.822 af
Outflow = 20.84 cfs @ 12.24 hrs, Volume= 1.822 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Summary for Pond P-APF: APF Treatment System

Inflow Area = 3.680 ac, 85.91% Impervious, Inflow Depth = 6.87" for 100-yr event
Inflow = 25.78 cfs @ 12.28 hrs, Volume= 2.108 af
Outflow = 25.86 cfs @ 12.27 hrs, Volume= 2.108 af, Atten= 0%, Lag= 0.0 min
Primary = 25.86 cfs @ 12.27 hrs, Volume= 2.108 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 858.51' @ 12.27 hrs Surf.Area= 41 sf Storage= 13,570 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 73.9 min (840.2 - 766.3)

Volume	Invert	Avail.Storage	Storage Description
#1	852.38'	11,310 cf	**48.0" Round Pipe Storage** x 5 L= 180.0' S= 0.0010 '/'
#2	852.38'	704 cf	**48.0" Round Pipe Storage** x 2 L= 28.0'
#3	856.38'	170 cf	**6.00'D x 6.00'H Vertical Cone/Cylinder**
#4	852.38'	1,448 cf	**24.0" Round Pipe Storage** L= 461.0' S= 0.0050 '/'
#5	854.67'	64 cf	**4.00'D x 5.10'H Vertical Cone/Cylinder**
#6	859.75'	505 cf	**Custom Stage Data** Listed below
		14,200 cf	Total Available Storage

Elevation (feet)	Cum.Store (cubic-feet)
859.75	0
860.75	505

Device	Routing	Invert	Outlet Devices
#1	Primary	848.70'	**24.0" Round Culvert** L= 56.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 848.70' / 848.50' S= 0.0036 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 3.14 sf
#2	Device 1	852.38'	**0.80 cfs BayFilter at all elevations**
#3	Device 1	857.30'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=25.82 cfs @ 12.27 hrs HW=858.51' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 25.82 cfs of 44.90 cfs potential flow)
  ├─**2=BayFilter** (Exfiltration Controls 0.80 cfs)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 25.02 cfs @ 3.60 fps)

Summary for Pond P-ARE-N: Arena North Treatment System

Inflow Area = 2.131 ac, 64.59% Impervious, Inflow Depth = 6.52" for 100-yr event
Inflow = 16.69 cfs @ 12.22 hrs, Volume= 1.158 af
Outflow = 12.84 cfs @ 12.33 hrs, Volume= 1.158 af, Atten= 23%, Lag= 6.1 min
Primary = 12.84 cfs @ 12.33 hrs, Volume= 1.158 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 856.84' @ 12.33 hrs Surf.Area= 0.005 ac Storage= 0.269 af

Plug-Flow detention time= 63.7 min calculated for 1.158 af (100% of inflow)
Center-of-Mass det. time= 63.7 min (835.0 - 771.3)

Volume	Invert	Avail.Storage	Storage Description
#1	847.87'	0.263 af	**108.0" Round Pipe Storage** L= 180.0'
#2	845.34'	0.007 af	**8.00'W x 6.00'L x 6.00'H StormFilter**
		0.269 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	844.59'	**15.0" Round Culvert** L= 47.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 844.59' / 844.36' S= 0.0049 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.23 sf
#2	Device 1	844.84'	**Tube/Siphon/Float Valve X 9.00** Starts@847.59' Breaks@845.69' 0.798" Diameter, C= 0.600, 0.263" Trickle Diameter
#3	Device 1	851.87'	**15.0" Round Culvert** L= 25.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 851.87' / 851.75' S= 0.0048 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.23 sf

Primary OutFlow Max=12.83 cfs @ 12.33 hrs HW=856.84' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Passes 12.83 cfs of 20.14 cfs potential flow)
↑—**2=Tube/Siphon/Float Valve** (Orifice Controls 0.52 cfs @ 16.68 fps)
—**3=Culvert** (Inlet Controls 12.31 cfs @ 10.03 fps)

Summary for Pond P-ARE-S: Arena South Treatment System

Inflow Area = 3.143 ac, 95.26% Impervious, Inflow Depth = 7.11" for 100-yr event
Inflow = 32.17 cfs @ 12.15 hrs, Volume= 1.862 af
Outflow = 20.03 cfs @ 12.24 hrs, Volume= 1.862 af, Atten= 38%, Lag= 5.0 min
Primary = 20.03 cfs @ 12.24 hrs, Volume= 1.862 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 855.19' @ 12.24 hrs Surf.Area= 0.049 ac Storage= 0.655 af

Plug-Flow detention time= 102.4 min calculated for 1.862 af (100% of inflow)
Center-of-Mass det. time= 102.4 min (849.8 - 747.4)

Volume	Invert	Avail.Storage	Storage Description
#1	846.00'	0.530 af	**120.0" Round CMP_Round 120"** x 6 L= 49.0'
#2	846.00'	0.135 af	**120.0" Round CMP_Round 120"** L= 75.0'
#3	843.49'	0.015 af	**8.00'W x 14.00'L x 6.00'H StormFilter**
		0.681 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	841.71'	**30.0" Round Culvert** L= 41.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 841.71' / 841.50' S= 0.0051 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 4.91 sf
#2	Device 1	842.99'	**Tube/Siphon/Float Valve X 28.00** Starts@845.74' Breaks@843.84' 0.798" Diameter, C= 0.600, 0.263" Trickle Diameter
#3	Device 1	853.00'	**30.0" Round Culvert** L= 50.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 853.00' / 852.75' S= 0.0050 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 4.91 sf

Primary OutFlow Max=19.99 cfs @ 12.24 hrs HW=855.19' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 19.99 cfs of 82.64 cfs potential flow)
  └**2=Tube/Siphon/Float Valve** (Orifice Controls 1.64 cfs @ 16.82 fps)
  └**3=Culvert** (Barrel Controls 18.36 cfs @ 5.38 fps)

Summary for Pond P-SAF: SAF Treatment System

Inflow Area = 3.651 ac, 7.89% Impervious, Inflow Depth = 4.45" for 100-yr event
Inflow = 12.48 cfs @ 12.53 hrs, Volume= 1.355 af
Outflow = 22.43 cfs @ 12.61 hrs, Volume= 1.355 af, Atten= 0%, Lag= 4.8 min
Primary = 2.14 cfs @ 12.61 hrs, Volume= 1.029 af
Secondary = 20.29 cfs @ 12.61 hrs, Volume= 0.326 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 860.17' @ 12.61 hrs Surf.Area= 0.170 ac Storage= 0.383 af

Plug-Flow detention time= 87.2 min calculated for 1.355 af (100% of inflow)
Center-of-Mass det. time= 87.1 min (915.4 - 828.3)

Volume	Invert	Avail.Storage	Storage Description
#1	854.80'	0.164 af	**39.50'W x 187.56'L x 4.50'H Field A** 0.765 af Overall - 0.219 af Embedded = 0.546 af x 30.0% Voids
#2	855.30'	0.219 af	**ADS_StormTech SC-740 +Cap** x 208 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 8 Rows of 26 Chambers
		0.383 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	854.80'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Secondary	860.00'	**110.0' long x 30.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=2.14 cfs @ 12.61 hrs HW=860.17' TW=0.00' (Dynamic Tailwater)
└**1=Orifice/Grate** (Orifice Controls 2.14 cfs @ 10.89 fps)

Secondary OutFlow Max=20.29 cfs @ 12.61 hrs HW=860.17' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 20.29 cfs @ 1.10 fps)

Summary for Pond P-SCC: SCC Treatment System

Inflow Area = 3.277 ac, 37.00% Impervious, Inflow Depth = 5.93" for 100-yr event
Inflow = 20.89 cfs @ 12.29 hrs, Volume= 1.621 af
Outflow = 17.59 cfs @ 12.39 hrs, Volume= 0.948 af, Atten= 16%, Lag= 6.3 min
Primary = 17.59 cfs @ 12.39 hrs, Volume= 0.948 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3

Peak Elev= 860.41' @ 12.39 hrs Surf.Area= 1,588 sf Storage= 31,665 cf

Plug-Flow detention time= 148.4 min calculated for 0.948 af (58% of inflow)
Center-of-Mass det. time= 72.1 min (860.2 - 788.1)

Volume	Invert	Avail.Storage	Storage Description
#1	859.00'	2,130 cf	**Above Ground - Overflow (Prismatic)** Listed below (Recalc)
#2	851.99'	321 cf	**35.4" Round CMP_Round 35.4" Header Row** L= 47.0'
#3	851.99'	120 cf	**35.4" Round CMP_Round 35.4" Header Connecters** L= 17.5'
#4	851.99'	30,685 cf	**94.5" Round CMP_Round 94.5"** L= 630.0'
		33,256 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
859.00	100	0	0
860.00	229	165	165
860.50	1,880	527	692
861.00	3,871	1,438	2,130

Device	Routing	Invert	Outlet Devices
#1	Primary	859.01'	**4.0' long x 5.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.35 2.51 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.69 2.73 2.77 2.86

Primary OutFlow Max=17.57 cfs @ 12.39 hrs HW=860.41' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 17.57 cfs @ 3.14 fps)

APPENDIX F

CONTECH®
ENGINEERED SOLUTIONS

Project Name:	UST Hockey		
Site Designation:	North StormFilter	**Date:**	10/24/23
County or Independent City:	St. Paul	**Designer:**	GRB
State:	MN		

Mass Loading Calculations:

Peak Design Flow (cfs)	TBD
Water Quality Flow (cfs)	
Annual Rainfall (inches)	32
Total Drainage Area, A (ac)	1.13
Post Development Impervious Area, A_I (ac)	1.13
Pervious Area, A_P (ac)	0.00
Impervious Runoff Coefficient, Rv	0.95
Pervious Runoff Coefficient, Rv	0.25
% Impervious	100%
Runoff Coefficient, Rc	0.95
TSS Removal By Pretreatment	0%
Agency Required TSS % Removal	90%
Required TSS Removal Efficiency of Filter	90%
Percent Runoff Capture	90%
Mean Annual Runoff, V_t (ft^3)	112,228
Event Mean Concentration of Pollutant, EMC (mg/L)	70
Annual Mass Load, M_{total} (lbs)	490.14

Mass Based Filter Sizing:

Mass to be Captured by System (lbs)	441.13
Filter Type	StormFilter
Structure Type	Vault
Cartridge Height	27''
Media Type	Phosphosorb
Cartridge Flow Rate, gpm/sf	1.00 gpm/sf
Allowable Load Per Cartridge (lbs)	54
Cartridges Required	9
Recommended Model	8'x6' Vault
TSS Treatment Capacity (lbs)	486.00
Maximum Water Quality Flow	0.23 cfs

CONTECH®
ENGINEERED SOLUTIONS

Project Name:	UST Hockey		
Site Designation:	North StormFilter	**Date:**	10/24/23
County or Independent City:	St. Paul	**Designer:**	GRB
State:	MN		

Mass Loading Calculations:

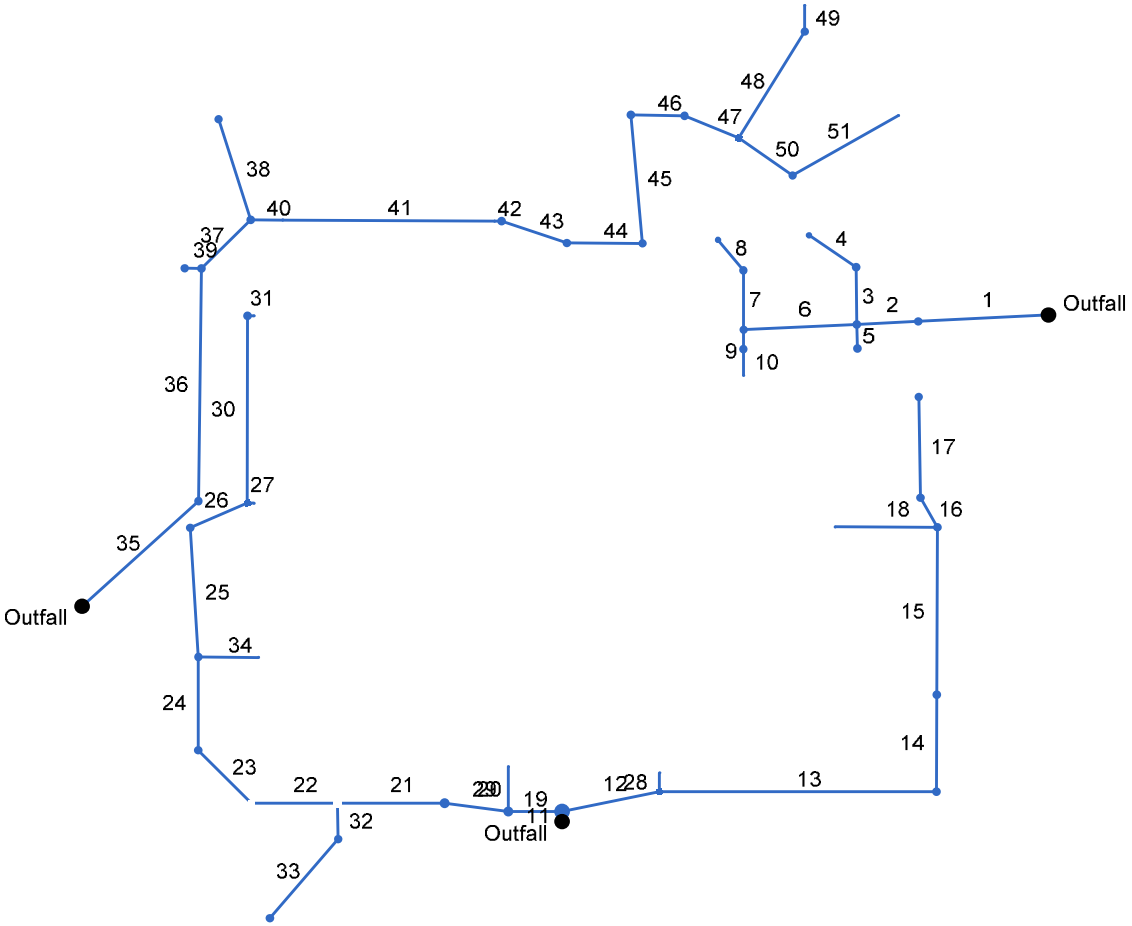
Peak Design Flow (cfs)	TBD
Water Quality Flow (cfs)	
Annual Rainfall (inches)	32
Total Drainage Area, A (ac)	3.80
Post Development Impervious Area, A_I (ac)	3.80
Pervious Area, A_P (ac)	0.00
Impervious Runoff Coefficient, Rv	0.95
Pervious Runoff Coefficient, Rv	0.25
% Impervious	100%
Runoff Coefficient, Rc	0.95
TSS Removal By Pretreatment	0%
Agency Required TSS % Removal	90%
Required TSS Removal Efficiency of Filter	90%
Percent Runoff Capture	90%
Mean Annual Runoff, V_t (ft^3)	377,404
Event Mean Concentration of Pollutant, EMC (mg/L)	70
Annual Mass Load, M_{total} (lbs)	1648.26

Mass Based Filter Sizing:

Mass to be Captured by System (lbs)	1483.43
Filter Type	StormFilter
Structure Type	Vault
Cartridge Height	27''
Media Type	Phosphosorb
Cartridge Flow Rate, gpm/sf	1.00 gpm/sf
Allowable Load Per Cartridge (lbs)	54
Cartridges Required	28
Recommended Model	8'x14' Vault
TSS Treatment Capacity (lbs)	1512.00
Maximum Water Quality Flow	0.70 cfs

APPENDIX G

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



Project File: UST Arena_100% SD SET Routing.stm	Number of lines: 51	Date: 9/11/2023

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	Pipe - (309)	5.41	24	Cir	92.353	853.70	854.00	0.325	854.52	854.96	0.03	854.99	End	Manhole
2	Pipe - (312)	5.51	24	Cir	43.684	854.20	854.31	0.252	855.18	855.29	0.20	855.49	1	Manhole
3	Pipe - (344)	1.20	12	Cir	40.675	857.58	858.00	1.033	857.98	858.46	n/a	858.46	2	Combination
4	Pipe - (138)	0.38	12	Cir	40.424	858.10	858.50	0.990	858.46	858.75	n/a	858.75 j	3	Grate
5	Pipe - (343)	0.55	12	Cir	17.089	857.83	858.00	0.995	858.10	858.31	n/a	858.31	2	Combination
6	Pipe - (342)	4.02	24	Cir	80.207	854.31	854.50	0.237	855.49	855.54	0.09	855.63	2	Manhole
7	Pipe - (345)	1.69	12	Cir	42.186	857.19	857.62	1.019	857.67	858.17	0.23	858.17	6	Grate
8	Pipe - (339)	0.73	12	Cir	28.233	857.72	858.00	0.992	858.17	858.36	n/a	858.36 j	7	Grate
9	Pipe - (311)	2.43	12	Cir	13.830	854.90	855.04	1.012	855.63	855.71	n/a	855.71 j	6	Grate
10	Pipe - (310)	1.22	12	Cir	18.521	855.04	855.23	1.026	855.71	855.69	n/a	855.69 j	9	None
11	Pipe - (360)	26.39	42	Cir	7.162	846.00	846.04	0.500	847.58	847.62	0.61	847.62	End	Manhole
12	Pipe - (171)	9.08	24	Cir	70.296	853.48	853.83	0.500	854.56	854.91	0.42	855.33	11	Manhole
13	Pipe - (293)	4.98	18	Cir	196.332	854.33	855.31	0.499	855.33	856.17	0.35	856.52	12	Manhole
14	Pipe - (292)	5.03	18	Cir	69.000	855.49	855.77	0.406	856.52	856.75	0.13	856.88	13	Grate
15	Pipe - (170)	4.61	18	Cir	119.062	855.87	856.46	0.496	856.88	857.29	0.33	857.62	14	Manhole
16	Pipe - (300)	0.70	12	Cir	24.189	856.96	857.20	0.992	857.62	857.55	0.10	857.55	15	Grate
17	Pipe - (169)	0.26	12	Cir	71.728	857.30	858.02	1.004	857.55	858.23	n/a	858.23 j	16	Grate
18	Pipe - (302)	4.46	12	Cir	72.448	857.24	858.33	1.505	858.08	859.21	n/a	859.21	15	None
19	Pipe - (357)	19.73	36	Cir	38.092	846.54	846.73	0.500	847.89	848.15	0.55	848.15	11	Manhole
20	Pipe - (356)	16.02	30	Cir	45.507	848.27	848.50	0.500	849.60	849.85	n/a	849.85	19	Manhole
21	Pipe - (291)	16.25	30	Cir	75.890	849.79	850.17	0.500	851.13	851.53	0.55	851.53	20	Manhole
22	Pipe - (174) (1)	13.68	24	Cir	61.194	850.67	850.98	0.500	852.10	852.40	0.38	852.79	21	Manhole
23	Pipe - (186)	13.78	24	Cir	53.059	851.08	851.35	0.509	852.79	852.93	0.47	853.40	22	Combination
24	Pipe - (347)	13.38	24	Cir	66.422	851.45	851.78	0.497	853.40	853.57	0.47	854.05	23	Combination

Project File: UST Arena_100% SD SET Routing.stm | Number of lines: 51 | Run Date: 9/11/2023

NOTES: Return period = 10 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
25	Pipe - (340)	8.90	18	Cir	91.971	852.28	852.74	0.500	854.05*	854.71*	0.56	855.27	24	Combination
26	Pipe - (363)	8.22	18	Cir	44.112	852.84	853.06	0.500	855.27*	855.54*	0.31	855.85	25	Manhole
27	Pipe - (219)	4.27	12	Cir	4.587	856.91	857.00	1.962	857.62	857.87	0.54	857.87	26	None
28	Pipe - (214)	5.14	12	Cir	13.162	856.74	857.00	1.976	857.59	857.92	0.71	857.92	12	None
29	Pipe - (298)	4.14	12	Cir	31.873	856.36	857.00	2.008	857.05	857.86	n/a	857.86	19	None
30	Pipe - (362)	4.08	12	Cir	133.219	853.56	854.89	1.000	855.85*	857.60*	0.42	858.02	26	Manhole
31	Pipe - (361)	4.08	12	Cir	4.449	854.99	855.08	2.024	858.02*	858.08*	0.42	858.50	30	None
32	Pipe - (364)	2.76	18	Cir	25.670	853.40	853.53	0.506	854.03	854.16	n/a	854.42 j	21	Combination
33	Pipe - (327)	2.33	18	Cir	74.158	853.63	854.00	0.499	854.42	854.58	0.21	854.79	32	Combination
34	Pipe - (220)	4.08	12	Cir	42.516	853.31	854.16	1.999	854.05	855.01	0.51	855.01	24	None
35	Pipe - (366)	11.64	15	Cir	111.345	837.96	840.10	1.918	839.17*	842.60*	1.08	843.68	End	Manhole
36	Pipe - (181) (1)	11.73	15	Cir	165.528	845.19	846.02	0.500	846.44*	851.90*	1.42	853.32	35	Manhole
37	Pipe - (181)	10.50	15	Cir	49.092	846.12	846.37	0.509	853.32*	854.62*	1.92	856.54	36	Grate
38	Pipe - (180)	2.34	12	Cir	75.155	854.76	855.51	0.998	856.54*	856.87*	0.14	857.01	37	Combination
39	Pipe - (481)	1.74	12	Cir	11.990	856.88	857.00	1.001	857.37	857.56	n/a	857.56	36	Combination
40	Pipe - (355)	7.57	12	Cir	22.691	846.87	847.10	1.000	856.54*	857.57*	0.22	857.79	37	None
41	Pipe - (354)	10.72	84	Cir	150.000	847.10	847.85	0.500	857.79*	857.79*	0.00	857.79	40	None
42	Pipe - (142)	10.73	24	Cir	5.008	847.83	847.85	0.399	857.79*	857.80*	0.10	857.90	41	Grate
43	Pipe - (143)	9.13	24	Cir	48.838	847.95	848.19	0.491	857.90*	857.98*	0.07	858.05	42	Grate
44	Pipe - (144)	8.52	18	Cir	53.574	848.69	848.96	0.500	858.05*	858.40*	0.36	858.76	43	Manhole
45	Pipe - (159)	8.66	18	Cir	91.746	849.06	849.52	0.501	858.76*	859.30*	0.56	859.86	44	Grate
46	Pipe - (158)	7.96	18	Cir	38.086	852.35	852.54	0.499	859.86*	860.04*	0.20	860.24	45	Grate
47	Pipe - (157)	7.41	18	Cir	41.585	852.54	852.75	0.505	860.24*	860.42*	0.40	860.82	46	Grate
48	Pipe - (156)	2.87	10	Cir	88.938	854.00	855.50	1.687	860.82*	862.12*	0.38	862.50	47	Grate

Project File: UST Arena_100% SD SET Routing.stm | Number of lines: 51 | Run Date: 9/11/2023

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
49	Pipe - (155)	2.56	6	Cir	18.601	855.80	856.18	2.043	862.50*	865.80*	2.64	868.44	48	None
50	Pipe - (161)	4.39	12	Cir	46.499	854.00	854.60	1.290	860.82*	861.42*	0.67	862.09	47	Grate
51	Pipe - (160)	3.58	10	Cir	86.240	854.60	856.10	1.739	862.09*	864.06*	0.67	864.73	50	None

Project File: UST Arena_100% SD SET Routing.stm | Number of lines: 51 | Run Date: 9/11/2023

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
1	24	5.41	853.70	854.52	0.82	1.21	4.46	0.31	854.83	0.461	92.353	854.00	854.96	0.96	1.49	3.63	0.21	855.16	0.264	0.362	0.335	0.15	0.03
2	24	5.51	854.20	855.18	0.98*	1.54	3.58	0.20	855.38	0.252	43.684	854.31	855.29	0.98	1.54	3.59	0.20	855.49	0.252	0.252	0.110	1.00	0.20
3	12	1.20	857.58	857.98	0.40*	0.29	4.14	0.18	858.16	0.000	40.675	858.00	858.46	0.46**	0.35	3.39	0.18	858.64	0.000	0.000	n/a	1.28	n/a
4	12	0.38	858.10	858.46	0.36	0.16	1.47	0.09	858.55	0.000	40.424	858.50	858.75 j	0.25**	0.16	2.41	0.09	858.84	0.000	0.000	n/a	1.00	n/a
5	12	0.55	857.83	858.10	0.27*	0.17	3.28	0.11	858.21	0.000	17.089	858.00	858.31	0.31**	0.21	2.68	0.11	858.42	0.000	0.000	n/a	1.00	n/a
6	24	4.02	854.31	855.49	1.18	1.93	2.08	0.07	855.56	0.073	80.207	854.50	855.54	1.04	1.66	2.42	0.09	855.63	0.110	0.091	0.073	1.00	0.09
7	12	1.69	857.19	857.67	0.48*	0.37	4.50	0.22	857.90	0.000	42.186	857.62	858.17	0.55**	0.44	3.80	0.22	858.40	0.000	0.000	n/a	1.03	0.23
8	12	0.73	857.72	858.17	0.45	0.25	2.11	0.13	858.30	0.000	28.233	858.00	858.36 j	0.36**	0.25	2.90	0.13	858.49	0.000	0.000	n/a	1.00	0.13
9	12	2.43	854.90	855.63	0.73	0.56	3.93	0.30	855.93	0.000	13.830	855.04	855.71 j	0.67**	0.56	4.37	0.30	856.00	0.000	0.000	n/a	0.50	0.15
10	12	1.22	855.04	855.71	0.67	0.36	2.18	0.18	855.89	0.000	18.521	855.23	855.69 j	0.46**	0.36	3.40	0.18	855.87	0.000	0.000	n/a	1.00	n/a
11	42	26.39	846.00	847.58	1.58	4.22	6.26	0.61	848.19	0.000	7.162	846.04	847.62	1.58**	4.22	6.26	0.61	848.23	0.000	0.000	n/a	1.00	0.61
12	24	9.08	853.48	854.56	1.08*	1.72	5.25	0.43	854.99	0.500	70.296	853.83	854.91	1.08**	1.73	5.25	0.43	855.34	0.499	0.499	0.351	0.98	0.42
13	18	4.98	854.33	855.33	1.00	1.04	3.98	0.25	855.58	0.366	196.332	855.31	856.17	0.86**	1.05	4.74	0.35	856.52	0.571	0.469	0.920	1.00	0.35
14	18	5.03	855.49	856.52	1.03	1.30	3.89	0.23	856.76	0.344	69.000	855.77	856.75	0.98	1.22	4.14	0.27	857.01	0.401	0.372	0.257	0.50	0.13
15	18	4.61	855.87	856.88	1.01	0.99	3.64	0.21	857.09	0.306	119.062	856.46	857.29	0.83**	1.00	4.61	0.33	857.62	0.556	0.431	0.513	1.00	0.33
16	12	0.70	856.96	857.62	0.66	0.24	1.28	0.13	857.75	0.000	24.189	857.20	857.55	0.35**	0.24	2.88	0.13	857.68	0.000	0.000	n/a	0.81	0.10
17	12	0.26	857.30	857.55	0.25	0.12	1.67	0.07	857.62	0.000	71.728	858.02	858.23 j	0.21**	0.12	2.17	0.07	858.30	0.000	0.000	n/a	1.00	0.07
18	12	4.46	857.24	858.08	0.84*	0.70	6.33	0.57	858.65	0.000	72.448	858.33	859.21	0.88**	0.73	6.08	0.57	859.79	0.000	0.000	n/a	1.00	n/a
19	36	19.73	846.54	847.89	1.35*	3.10	6.37	0.55	848.45	0.000	38.092	846.73	848.15	1.42**	3.31	5.97	0.55	848.71	0.000	0.000	n/a	1.00	0.55
20	30	16.02	848.27	849.60	1.33*	2.65	6.05	0.55	850.14	0.000	45.507	848.50	849.85	1.35**	2.71	5.92	0.55	850.40	0.000	0.000	n/a	0.16	n/a
21	30	16.25	849.79	851.13	1.34*	2.67	6.07	0.55	851.68	0.000	75.890	850.17	851.53	1.36**	2.73	5.95	0.55	852.08	0.000	0.000	n/a	1.00	0.55
22	24	13.68	850.67	852.10	1.42*	2.39	5.72	0.51	852.61	0.500	61.194	850.98	852.40	1.42	2.39	5.72	0.51	852.91	0.500	0.500	0.306	0.75	0.38

Project File: UST Arena_100% SD SET Routing.stm | Number of lines: 51 | Run Date: 9/11/2023

Notes: * depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
23	24	13.78	851.08	852.79	1.71	2.85	4.83	0.36	853.15	0.348	53.059	851.35	852.93	1.58	2.66	5.18	0.42	853.35	0.399	0.374	0.198	1.12	0.47
24	24	13.38	851.45	853.40	1.95	3.12	4.29	0.29	853.68	0.310	66.422	851.78	853.57	1.79	2.97	4.51	0.32	853.89	0.309	0.309	0.205	1.50	0.47
25	18	8.90	852.28	854.05	1.50	1.77	5.04	0.39	854.44	0.718	91.971	852.74	854.71	1.50	1.77	5.04	0.39	855.10	0.718	0.718	0.661	1.43	0.56
26	18	8.22	852.84	855.27	1.50	1.77	4.65	0.34	855.61	0.613	44.112	853.06	855.54	1.50	1.77	4.65	0.34	855.88	0.612	0.613	0.270	0.93	0.31
27	12	4.27	856.91	857.62	0.71*	0.60	7.14	0.54	858.16	0.000	4.587	857.00	857.87	0.87**	0.72	5.89	0.54	858.41	0.000	0.000	n/a	1.00	0.54
28	12	5.14	856.74	857.59	0.85*	0.71	7.25	0.71	858.30	0.000	13.162	857.00	857.92	0.92**	0.76	6.78	0.71	858.64	0.000	0.000	n/a	1.00	0.71
29	12	4.14	856.36	857.05	0.69*	0.58	7.17	0.52	857.57	0.000	31.873	857.00	857.86	0.86**	0.72	5.77	0.52	858.38	0.000	0.000	n/a	1.00	n/a
30	12	4.08	853.56	855.85	1.00	0.79	5.19	0.42	856.27	1.311	133.219	854.89	857.60	1.00	0.79	5.19	0.42	858.02	1.310	1.310	1.746	1.00	0.42
31	12	4.08	854.99	858.02	1.00	0.79	5.19	0.42	858.44	1.312	4.449	855.08	858.08	1.00	0.79	5.19	0.42	858.50	1.312	1.312	0.058	1.00	0.42
32	18	2.76	853.40	854.03	0.63*	0.70	3.91	0.24	854.27	0.506	25.670	853.53	854.16 j	0.63**	0.71	3.89	0.24	854.40	0.499	0.502	0.129	1.07	0.25
33	18	2.33	853.63	854.42	0.79	0.63	2.49	0.10	854.51	0.169	74.158	854.00	854.58	0.58**	0.63	3.69	0.21	854.79	0.490	0.329	0.244	1.00	0.21
34	12	4.08	853.31	854.05	0.74	0.62	6.57	0.51	854.55	0.000	42.516	854.16	855.01	0.85**	0.71	5.71	0.51	855.52	0.000	0.000	n/a	1.00	0.51
35	15	11.64	837.96	839.17	1.21*	1.22	9.57	1.42	840.60	2.861	111.345	840.10	842.60	1.25	1.23	9.49	1.40	844.00	3.251	3.056	3.403	0.77	1.08
36	15	11.73	845.19	846.44	1.25*	1.23	9.56	1.42	847.86	3.300	165.528	846.02	851.90	1.25	1.23	9.56	1.42	853.32	3.299	3.299	5.462	1.00	1.42
37	15	10.50	846.12	853.32	1.25	1.23	8.55	1.14	854.46	2.643	49.092	846.37	854.62	1.25	1.23	8.55	1.14	855.76	2.642	2.643	1.297	1.69	1.92
38	12	2.34	854.76	856.54	1.00	0.79	2.98	0.14	856.68	0.432	75.155	855.51	856.87	1.00	0.79	2.98	0.14	857.01	0.432	0.432	0.325	1.00	0.14
39	12	1.74	856.88	857.37	0.49*	0.39	4.51	0.23	857.60	0.000	11.990	857.00	857.56	0.56**	0.45	3.84	0.23	857.79	0.000	0.000	n/a	1.00	n/a
40	12	7.57	846.87	856.54	1.00	0.79	9.64	1.45	857.99	4.523	22.691	847.10	857.57	1.00	0.79	9.64	1.45	859.02	4.521	4.522	1.026	0.15	0.22
41	84	10.72	847.10	857.79	7.00	38.48	0.28	0.00	857.79	0.000	150.000	847.85	857.79	7.00	38.48	0.28	0.00	857.79	0.000	0.000	0.000	0.15	0.00
42	24	10.73	847.83	857.79	2.00	3.14	3.42	0.18	857.97	0.225	5.008	847.85	857.80	2.00	3.14	3.41	0.18	857.98	0.225	0.225	0.011	0.54	0.10
43	24	9.13	847.95	857.90	2.00	3.14	2.91	0.13	858.03	0.163	48.838	848.19	857.98	2.00	3.14	2.91	0.13	858.11	0.163	0.163	0.080	0.55	0.07
44	18	8.52	848.69	858.05	1.50	1.77	4.82	0.36	858.41	0.659	53.574	848.96	858.40	1.50	1.77	4.82	0.36	858.76	0.659	0.659	0.353	1.00	0.36

Project File: UST Arena_100% SD SET Routing.stm | Number of lines: 51 | Run Date: 9/11/2023

Notes: * depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
45	18	8.66	849.06	858.76	1.50	1.77	4.90	0.37	859.14	0.579	91.746	849.52	859.30	1.50	1.77	4.90	0.37	859.67	0.579	0.579	0.531	1.50	0.56
46	18	7.96	852.35	859.86	1.50	1.77	4.51	0.32	860.17	0.490	38.086	852.54	860.04	1.50	1.77	4.51	0.32	860.36	0.490	0.490	0.187	0.63	0.20
47	18	7.41	852.54	860.24	1.50	1.77	4.19	0.27	860.51	0.424	41.585	852.75	860.42	1.50	1.77	4.19	0.27	860.69	0.424	0.424	0.176	1.48	0.40
48	10	2.87	854.00	860.82	0.83	0.55	5.26	0.43	861.25	1.462	88.938	855.50	862.12	0.83	0.55	5.26	0.43	862.55	1.461	1.462	1.300	0.88	0.38
49	6	2.56	855.80	862.50	0.50	0.20	13.03	2.64	865.14	17.747	18.601	856.18	865.80	0.50**	0.20	13.03	2.64	868.44	17.740	17.744	3.300	1.00	2.64
50	12	4.39	854.00	860.82	1.00	0.79	5.59	0.49	861.31	1.293	46.499	854.60	861.42	1.00	0.79	5.58	0.48	861.91	1.293	1.293	0.601	1.38	0.67
51	10	3.58	854.60	862.09	0.83	0.55	6.57	0.67	862.76	2.281	86.240	856.10	864.06	0.83	0.55	6.57	0.67	864.73	2.280	2.280	1.966	1.00	0.67

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Notes: * depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

APPENDIX H

STORMWATER BEST MANAGEMENT PRACTICES (BMP) OPERATIONS & MAINTENANCE PLAN

Project: Lee & Penny Anderson Multipurpose Arena
2260 Summit Ave
St. Paul, MN 55105

Owner: University of St. Thomas
2115 Summit Ave
St Paul, MN 55105

Party Responsible for Maintenance: University of St. Thomas
2115 Summit Ave
St Paul, MN 55105
651-962-6595
Jim.brummer@stthomas.edu

Prepared by:

Ryan A+E, Inc.
Project No. 701480

~~October 30, 2023~~
(November 17, 2023 Updated)

I hereby certify that this plan, specification or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Jared B. Olson, P.E.,
Minnesota License No. 42340

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INTRODUCTION

This stormwater BMP operations and maintenance plan was created for the Lee & Penny Anderson Multipurpose Arena project located at 2260 Summit Ave in St. Paul, MN. As part of the permitting process for the project, the Capitol Region Watershed District (CRWD) required that a Declaration for Maintenance of Stormwater Facilities be filed with Ramsey County. The City of St. Paul (City) also required that a Maintenance Agreement be filed with Ramsey County. The agreements constitute covenants to run with the Property, and further declares that the Property shall be owned, used, occupied, and conveyed subject to the covenants and restrictions set forth therein. The declaration generally identifies parameters for inspecting and maintaining the facilities and defines reporting requirements. A copy of the agreements are included in Appendix A-B for reference.

This plan further identifies specific procedures for inspecting and maintaining the stormwater facilities. Implementing these procedures into the overall maintenance of the property is necessary in order to comply with the declaration and to preserve the integrity and intended function of the facilities.

DESCRIPTION

In general, the stormwater facility is comprised of the following components:

- Storm sewer system for stormwater conveyance
- Sump manholes with SAFL Baffle for runoff pretreatment
- Underground detention systems for runoff control
- Stormwater treatment filter systems for volume management and water quality

Storm Sewer System

The storm sewer system consists of manholes and pipe that convey rooftop and site runoff to the Arena stormwater treatment systems for pre-treatment, filtration and rate control. The storm sewer system is designed to route surface runoff to the sump manholes for pretreatment before ultimately draining to the underground detention systems for rate control, finally routing through the stormwater treatment filter systems providing volume management and water quality measures. The storm sewer system pipe materials include Reinforced Concrete Pipe (RCP), Corrugated Metal Pipe (CMP), High Density Polyethylene Pipe (HPDE), and Polyvinyl Chloride Pipe (PVC). The storm sewer system manhole structures include concrete manhole structures.

Sump Manholes

The sump manholes are located upstream of the underground detention systems for pretreatment and are proposed as 4’ in depth to capture large sediment and other debris. A SAFL Baffle is included within each sump structure to capture large floatables and sediment. The sump manholes are concrete manhole structures.

Underground Detention System

The underground detention systems function as rate control practices to control the runoff rate to the City storm sewer system. They also hold back the necessary water for the volume management requirements. The southern detention system consists of six rows of 120" diameter CMP with a 120" CMP header row. The northern detention system consists of one row of 108" CMP directly in line with the storm sewer conveyance pipe. The primary outlets towards the stormwater treatment filter systems are set at the invert elevations of the detention systems with the secondary outlets towards downstream storm sewer conveyance pipes set at the water quality volume elevations higher up.

Stormwater Treatment Filter System

The underground manufactured treatment devices (MTDs) function both as a volume management and water quality practice through enhanced filtration. The systems utilized for the project are the StormFilter stormwater filtration system with Phosphosorb filtration media and was purchased directly from the manufacturer:

Contech
9100 Centre Pointe Drive
West Chester, OH 45069
1-800-338-1122
https://www.conteches.com/StormFilter

The southern stormwater treatment filter system consists of an 8'x14' concrete vault with 28 filter cartridges. The northern stormwater treatment filter system consists of an 8'x6' concrete vault with 9 filter cartridges.

INSPECTION ACTIVITIES

Table 1.1 – Storm Sewer System Inspection Activities

Inspection Activity	Inspection Frequency	Actions
Visual inspection in structures for trash and debris	Monitor annually and remove sediment as needed	Notify maintenance staff/contractor of need for site clean-up
Inspect structural components	As part of all inspection visits	Notify maintenance staff/contractor of any observed structural damage

Table 1.2 – Sump Manhole Inspection Activities

Inspection Activity	Inspection Frequency	Actions
Visual inspection for trash and debris	Three times per year for first two years, once per year following	Notify maintenance staff/contractor of need for site clean-up
Sump Cleaning	One per year, unless visual inspection indicates more frequent cleanings required	Notify maintenance staff/contractor of need for site clean-up
Inspect structural components	As part of all inspection visits	Notify maintenance staff/contractor of any observed structural damage

Table 1.3 – Underground Detention System Inspection Activities

Inspection Activity	Inspection Frequency	Actions
Visual inspection for trash and debris	Two times per year for first two years, once per year following	Notify maintenance staff/contractor of need for site clean-up
Inspect structural components	As part of all inspection visits	Notify maintenance staff/contractor of any observed structural damage

Table 1.4 – Stormwater Treatment Filter Inspection Activities

Inspection Activity	Inspection Frequency	Actions
Visual inspection for trash and debris. Note accumulations of liquids and solids. Record level of sediment build-up on the floor of the vault, in the forebay, and on top of the cartridges.	Two times per year for first two years, once per year following (fall)	Notify maintenance staff/contractor of need for site clean-up
Sediment accumulation	Two times per year for first two years, once per year following	Notify maintenance staff/contractor of need to remove sediment when drainage capabilities are reduced
Inspect structural components	As part of all inspection visits	Notify maintenance staff/contractor of any observed structural damage
Dewatering	Annually and following large storm events	Notify maintenance staff/contractor if there is standing water at the surface or in observation wells 48 hours after a storm event

MAINTENANCE ACTIVITIES

Table 2.1 – Storm Sewer System Maintenance Activities

Maintenance Activity	Maintenance Frequency	Notes/Additional Actions	Maintenance By
Trash and debris removal from structures	As needed based upon inspection	Handwork	By Owner, unless designated
Repair structural components	As needed based upon inspection	Dependent on type of damage; Repair structure per manufacturer's recommendations	By Owner, unless designated

Equipment and tools needed to perform maintenance:

- Shovel or rake
- Vacuum truck with jet power washer

Table 2.2 – Sump Manhole Maintenance Activities

Maintenance Activity	Maintenance Frequency	Notes/Additional Actions	Maintenance By
Trash and debris removal. Quantify amount with a tape measure.	As needed based upon inspection. System should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated.	Handwork for measuring debris. Vac Truck in dry weather conditions for removal of pollutants from the system. Clean screen if pollutant build-up exists.	By Owner, unless designated
Sump Cleaning. Quantify amount with a tape measure.	At least once per year. The structure is full and needs sump cleaning when sediment is within one foot of the bottom of the outlet pipe.		
Repair structural components	As needed based upon inspection	Dependent on type of damage; Repair structure per manufacturer's recommendations	By Owner, unless designated

Equipment and tools needed to perform maintenance:

- Shovel or rake

- Tape measure
- Vacuum truck with jet power washer

Table 2.3 – Underground Detention System Maintenance Activities

Maintenance Activity	Maintenance Frequency	Notes/Additional Actions	Maintenance By
Trash and debris removal. Quantify amount with a tape measure.	As needed based upon inspection. System should be cleaned when sediment and trash have accumulated to clog the discharge pipe/orifice.	Handwork for measuring debris. Vac Truck in dry weather conditions for removal of pollutants from the system.	By Owner, unless designated
Repair structural components	As needed based upon inspection	Dependent on type of damage; Repair structure per manufacturer's recommendations	By Owner, unless designated

Equipment and tools needed to perform maintenance:

- Shovel or rake
- Tape measure
- Vacuum truck with jet power washer

Table 1.4 – Stormwater Treatment Filter Maintenance Activities

Maintenance Activity	Maintenance Frequency	Notes/Additional Actions	Maintenance By
Trash and debris removal	As needed based upon inspection	Handwork for measuring debris. Vac Truck in dry weather conditions for removal of pollutants from the system.	By Owner, unless designated

Maintenance Activity	Maintenance Frequency	Notes/Additional Actions	Maintenance By
Sediment removal	As required when filtration is reduced. If >4" sediment accumulated on the floor of the vault. If >1/4" sediment accumulated on top of the cartridge. If >4" static water above cartridge bottom for more than 24 hours after end of rain event.	Handwork (remove sediment, debris, and oil/grease build-up) in dry weather	By Owner, unless designated
Dewatering	As needed based upon failure to drain within 48 hours of a rainfall of 0.5 inch or greater	Handwork (sediment removal; surface raking; core/disc aeration; punching holes in filter fabric lining, etc.)	By Owner, unless designated
Repair structural components	As needed based upon inspection	Dependent on type of damage; Repair structure per manufacturer's recommendations	By Owner, unless designated
Filtration media replacement	As needed based upon inspection. The cartridges were designed for media replacement once per year, however based on supplier's experience the maintenance interval is typically 18-24 months. The estimated cost for system maintenance is $350/cartridge.	Replacement of filter media should be completed in dry weather conditions.	By Owner, unless designated

Equipment and tools needed to perform maintenance:

- Shovel or rake
- Tape measure
- Vacuum truck with jet power washer

APPENDIX A

Doc No **A05015662**

Certified, filed and/or recorded on
Feb 2, 2024 9:03 AM

Office of the County Recorder
Ramsey County, Minnesota
Todd J. Uecker, County Recorder
Tracy M. West, County Auditor and Treasurer

Deputy 317 Pkg ID 1604062E

Document Recording Fee Abstract	$46.00
Document Total	$46.00

This cover sheet is now a permanent part of the recorded document.

MAINTENANCE AGREEMENT

This Maintenance Agreement (this "Agreement") is made this 25th day of January, 2024, by and between the **University of St. Thomas**, a Minnesota non-profit corporation (hereinafter referred to as "Owner"), and the **City of Saint Paul**, a municipal corporation under the laws of the State of Minnesota (hereinafter referred to as the "City") to provide for the maintenance of the stormwater facilities (hereinafter referred to as the "Facilities") constructed pursuant to City of Saint Paul Project **SPR23-079985**.

1. Owner owns the property legally described on Exhibit "A" attached hereto (the "Property"); and

2. Owner is intending to construct certain storm water facilities on the Property as depicted in Exhibit "B" attached hereto (the "Facilities"); and

In order to meet the City's permitting requirements, said Facilities are necessary and it is reasonable for the City to require Owner and all subsequent owners of said parcel to inspect and maintain the Facilities on a regular basis to ensure that the Facilities function as intended.

3. Now, therefore, it is mutually agreed by and between all parties:

A. Owner, at its expense, shall be responsible for the inspection and maintenance of the Facilities so that the Facilities function properly.

i. Owner shall inspect the Facilities at least annually.

ii. Owner shall maintain and repair the Facilities:

a. In the case of basins and other facilities where sediment collects, to preserve the storage or capacity at or above the design volume or, where no design storage volume or capacity is incorporated into the permit, the volume or capacity recommended by the manufacturer.

b. In the case of conveyances and other structures, to preserve design hydraulic capacity.

c. In the case of facilities relying on soils and vegetation for stormwater management or treatment, to preserve healthy vegetation and design soil permeability.

d. In the case of all facilities, as necessary to preserve the integrity and intended function of the facility.

iii. On an annual basis, Owner shall submit a report to the City that includes the inspection date(s) of the Facilities, conditions of the Facilities, and any corrective actions taken.

B. The City shall have discretion to determine the need to clean the Facilities, either in conjunction with the annual inspection or more often as deemed necessary. The City shall notify the Owner in writing if it reasonably determines that the Facilities require cleaning. The Owner shall clean the Facilities within sixty (60) days of receipt of notice from the City or District. The City shall act reasonably in exercising said discretion.

In the event Owner fails to clean said Facilities in accordance with the City's request, the City may have the Facilities cleaned either through its own employees or through an outside third party, the cost of which shall be the responsibility of Owner. Owner shall indemnify the for any and all costs incurred by the City for cleaning the Facilities, as well as for costs and fees incurred by the City to enforce this Agreement.

C. This Agreement shall be binding on the Owner of said real estate as described in the Exhibit "A" attached hereto, and its representatives, heirs, transferors, successors and/or assigns. This Agreement shall run with the land.

[Signature page(s) follow]

DATE: 12/19/2023

CITY OF SAINT PAUL

By: Andrew Hogg
Andrew Hogg, its Water Resources Coordinator

STATE OF MINNESOTA)
) ss.
COUNTY OF Ramsey)

The foregoing instrument was acknowledged before me this 19 day of December, 2023, by Andrew Hogg, the Water Resource Coor. of the City of Saint Paul, a municipal corporation under the laws of the State of Minnesota, on behalf of said municipal corporation.

ANGELIA MARIE CRUZ
Notary Public-Minnesota
My Commission Expires Jan 31, 2022

Notary Public

IN WITNESS WHEREOF, the parties hereto execute this Maintenance Agreement.

DATE: 1/25/2024

OWNER

University of St. Thomas,
a Minnesota non-profit corporation

By: _____
Name: James Brummer
Its: Vice President for Facilities Management

STATE OF MINNESOTA)
) ss.
COUNTY OF Ramsey)

The foregoing instrument was acknowledged before me this 25th day of January, 2024 by James Brummer as Vice President for Facilities Management for University of St. Thomas, a Minnesota non-profit corporation.

_____
Notary Public

MELISSA J. TOFTE
Notary Public-Minnesota
My Commission Expires Jan 31, 2024

Drafted by:
Fredrikson & Byron, P.A. (JGP)
60 South Sixth Street, Suite 1500
Minneapolis, MN 55402

Exhibit A
to Maintenance Agreement

Legal Description of the Property

Lot 2, Block 1, St. Paul Seminary Addition

Exhibit B
to Maintenance Agreement

Depiction of Facilities

SUMMIT AVENUE

MISSISSIPPI RIVER BOULEVARD

MISSISSIPPI RIVER BOULEVARD

PROPOSED BUILDING
SCHOENECKER CENTER (SCC)
FFE= 883.5

O'SHAUGHNESSY SCIENCE HALL (OSS)

OWENS SCIENCE HALL (OWS)

ST MARYS CHAPEL (SMC)

SCHOOL OF DIVINITY (SOD)

SEMINARY RESIDENCE (SEM)

NORTH STORMFILTER (8'x6')

108" CMP STORMWATER SYSTEM (180 LF OF PIPE)

48" SUMP MANHOLE WITH SAFL BAFFLE

FACILITIES & DESIGN CENTER (FDC)

ANDERSON PARKING FACILITY (APF)

PROPOSED BUILDING

128,804± SF

ARCHBISHOP IRELAND MEMORIAL LIBRARY (IRL)

BYRNE RESIDENCE (BYR)

60" SUMP MANHOLE WITH SAFL BAFFLE

SOUTH STORMFILTER (8'x14')

120" CMP STORMWATER SYSTEM (369 LF OF PIPE)

SOUTH ATHLETIC FIELDS (SAF)

BRADY EDUCATION CENTER (BEC)

GRACE HALL (GRA)

BINZ REFECTORY (BIN)

CRETIN AVENUE

CRETIN AVENUE

ALLEY

GRAND AVENUE

CRETIN AVENUE

LINCOLN AVENUE

N

0 60 120

SCALE IN FEET

RYAN

APPENDIX B

Doc No **A05010469**

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Dec 7, 2023 2:20 PM

Office of the County Recorder
Ramsey County, Minnesota
Todd J. Uecker, County Recorder
Tracy M. West, County Auditor and Treasurer

Deputy 316 Pkg ID 1597905E

Document Recording Fee Abstract	$46.00
Document Total	$46.00

This cover sheet is now a permanent part of the recorded document.

DECLARATION OF
OPERATIONS AND MAINTENANCE OBLIGATIONS
FOR STORMWATER FACILITIES

THIS DECLARATION is made this **6th** day of **December** 2023, by the **University of St. Thomas**, a Minnesota on-profit corporation at **2260 Summit Ave St. Paul, MN**, ("Declarant"), in favor of the Capitol Region Watershed District, a body with powers pursuant to Minnesota Chapters 103B and 103D ("CRWD").

WHEREAS, Declarant(s) hold(s) fee interest in real property within the City of **St. Paul**, Ramsey County, Minnesota, platted and legally described as:

Lot 2, Block 1, St. Paul Seminary Addition

WHEREAS, no one other than Declarant(s) possess(es) any right, title or interest in the Property;

WHEREAS, the facilities on or to be located on the Property to which the maintenance requirements in the Declaration apply as labeled on the scaled site plan **Attachment A** are as follows (the Facilities):

Sump Manholes
Corrugated Metal Pipe Underground Cistern Systems
StormFilter Filtration Systems

WHEREAS, Declarant desires to subject the Property to certain conditions and restrictions imposed by the CRWD as a condition to issuance of CRWD Permit **#23-023** for the mutual benefit of the CRWD and Declarant.

NOW THEREFORE Declarant makes this declaration and hereby declares that this declaration shall constitute covenants to run with the Property, and further declares that the Property shall be

owned, used, occupied, and conveyed subject to the covenants and restrictions set forth in this Declaration, all of which shall be binding in perpetuity on all persons owning or acquiring any right, title or interest in the Property, and their heirs, successors, personal representatives and assigns, but only during the period of ownership of that right, title or interest.

1. Declarant will inspect the Facilities at least annually.

2. Declarant will maintain and repair the facilities:

   a. In the case of basins and other facilities where sediment collects, to preserve storage or capacity at or above the design volume or, where no design storage volume or capacity is incorporated into the permit, the volume or capacity recommended by the manufacturer.

   b. In the case of conveyances and other structures, to preserve design hydraulic capacity.

   c. In the case of facilities relying on soils and vegetation for stormwater management or treatment, to preserve healthy vegetation and design soil permeability.

   d. In the case of all facilities, as necessary to preserve the integrity and intended function of the facility.

   e. In accordance with the site-specific maintenance plan **Attachment B** and all subsequent revisions.

3. Declarant will submit annually, a report to include inspection dates, facility conditions, and corrective actions taken.

4. If Declarant fails to perform required maintenance to stormwater facilities resulting in deviation from the designed treatment performance or efficiency, the CRWD may notify Declarant of this deficiency. If Declarant has not completed or scheduled corrective action within 60 days of receipt of notification, the CRWD may perform any action deemed necessary to return full design function and treatment performance to the stormwater treatment facility. The Declarant shall be responsible for reimbursement of all costs incurred from such activity including but not limited to administrative overhead and attorney's fees.

5. Any notice under this Declaration shall be sent by certified mail, return receipt requested, or delivered to the following address:

James Brummer
University of St. Thomas
2115 Summit Ave
St. Paul, MN 55105

Declarant may change this address by a certified letter to the CRWD referencing the permit number.

6. If the use of the Property is materially changed so that the Facilities which are the subject of this Declaration are rendered unnecessary, the Declarant may request a partial or full release of this Declaration by CRWD, approval of which will not be unreasonably withheld.

7. If the Facilities which are the subject of this Declaration are completely replaced by other Facilities approved by CRWD, its successors or assigns, this Declaration shall become void and of no further force or effect.

8. The Property may not be subdivided in any way without approval of the subdivision by CRWD. Nothing herein shall be interpreted to prevent the encumbrance of a portion of the Property by a mortgage or other lien, provided that the mortgage, lien, or similar encumbrance is subject to the prohibition of subdivision without approval of CRWD. Subdivision includes any split of the Property into two or more parcels, regardless of whether the Property, as a whole, was created by a combination of parcels, tracts, or lots which had previously been separate from one another.

9. An executed copy of this Declaration shall be filed with Ramsey County Registrar or Ramsey County Recorder, filing cost to be borne by the Declarant. This Declaration will be unlimited in duration without being re-recorded.

DECLARANT:

University of St. Thomas,
a Minnesota non-profit corporation

By: _____
Name: James Brummer
Its: Vice President for Facilities Management

MELISSA J. TOFTE
Notary Public-Minnesota
My Commission Expires Jan 31, 2024

STATE OF MINNESOTA)
) ss.
COUNTY OF RAMSEY)

The foregoing instrument was acknowledged before me this 7th day of December, 2023 by James Brummer as Vice President for Facilities Management for University of St. Thomas, a Minnesota non-profit corporation.

_____
Notary Public

This instrument was drafted by:

Anthony Adams, PE
Ryan Companies US, Inc.
533 S Third St, Suite 100 Minneapolis, MN 55415

SUMMIT AVENUE

MISSISSIPPI RIVER BOULEVARD

MISSISSIPPI RIVER BOULEVARD

PROPOSED BUILDING
SCHOENECKER CENTER (SCC)
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LINCOLN AVENUE

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0 60 120

SCALE IN FEET

RYAN

APPENDIX C

BMP MAINTENANCE & INSPECTION ANNUAL REPORTING FORM

BMP ID		**Location**	
Owner		**Inspector**	
Inspection Date		**Inspection Time**	

Inspection/ Maintenance Item	Present	Location	Notes
Trash/Debris	Yes / No		
Erosion	Yes / No		
Sediment	Yes / No		
Vegetation	Yes / No		
Additional	Yes / No		

Maintenance Completed Date		**Maintenance Contractor**	
Maintenance Comments			

BMP LOCATION MAP

[Insert location map, to scale, showing all BMP names/ID, locations, and access routes]

APPENDIX D

Contech® CMP Detention Inspection and Maintenance Guide

Underground stormwater detention and infiltration systems must be inspected and maintained at regular intervals for purposes of performance and longevity.

Inspection

Inspection is the key to effective maintenance of CMP detention systems and is easily performed. Contech recommends ongoing, annual inspections. Sites with high trash load or small outlet control orifices may need more frequent inspections. The rate at which the system collects pollutants will depend more on-site specific activities rather than the size or configuration of the system.

Inspections should be performed more often in equipment washdown areas, in climates where sanding and/or salting operations take place, and in other various instances in which one would expect higher accumulations of sediment or abrasive/corrosive conditions. A record of each inspection is to be maintained for the life of the system.

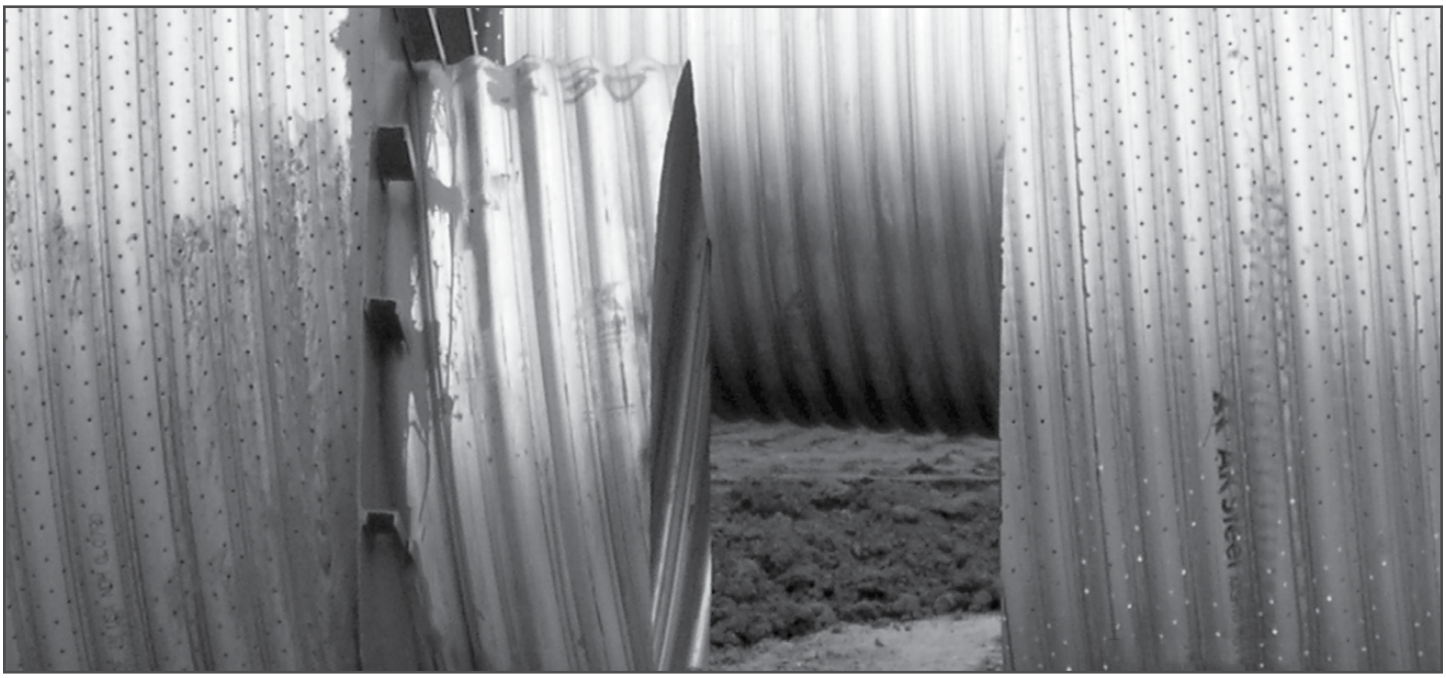
Maintenance

CMP detention systems should be cleaned when an inspection reveals accumulated sediment or trash is clogging the discharge orifice. Accumulated sediment and trash can typically be evacuated through the manhole over the outlet orifice. If maintenance is not performed as recommended, sediment and trash may accumulate in front of the outlet orifice. Manhole covers should be securely seated following cleaning activities. Contech suggests that all systems be designed with an access/inspection manhole situated at or near the inlet and the outlet orifice. Should it be necessary to get inside the system to perform maintenance activities, all appropriate precautions regarding confined space entry and OSHA regulations should be followed.

Annual inspections are best practice for all underground systems. During this inspection if evidence of salting/de-icing agents is observed within the system, it is best practice for the system to be rinsed, including above the spring line soon after the spring thaw as part of the maintenance program for the system.

Maintaining an underground detention or infiltration system is easiest when there is no flow entering the system. For this reason, it is a good idea to schedule the cleanout during dry weather.

The foregoing inspection and maintenance efforts help ensure underground pipe systems used for stormwater storage continue to function as intended by identifying recommended regular inspection and maintenance practices. Inspection and maintenance related to the structural integrity of the pipe or the soundness of pipe joint connections is beyond the scope of this guide.



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CONTECH®
CMP DETENTION SYSTEMS

CONTECH®
ENGINEERED SOLUTIONS

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APPENDIX E

CONTECH®
ENGINEERED SOLUTIONS

StormFilter Inspection and Maintenance Procedures

The Stormwater Management StormFilter®

Maintenance Guidelines

The primary purpose of the Stormwater Management StormFilter® is to filter and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance activities may be required in the event of a chemical spill or due to excessive sediment loading from site erosion or extreme storms. It is a good practice to inspect the system after major storm events.

Maintenance Procedures

Although there are many effective maintenance options, we believe the following procedure to be efficient, using common equipment and existing maintenance protocols. The following two-step procedure is recommended::

1. **Inspection**
   - Inspection of the vault interior to determine the need for maintenance.
2. **Maintenance**
   - Cartridge replacement
   - Sediment removal

Inspection and Maintenance Timing

At least one scheduled inspection should take place per year with maintenance following as warranted.

First, an inspection should be done before the winter season. During the inspection the need for maintenance should be determined and, if disposal during maintenance will be required, samples of the accumulated sediments and media should be obtained.

Second, if warranted, a maintenance (replacement of the filter cartridges and removal of accumulated sediments) should be performed during periods of dry weather.

In addition to these two activities, it is important to check the condition of the StormFilter unit after major storms for potential damage caused by high flows and for high sediment accumulation that may be caused by localized erosion in the drainage area. It may be necessary to adjust the inspection/ maintenance schedule depending on the actual operating conditions encountered by the system. In general, inspection activities can be conducted at any time, and maintenance should occur, if warranted, during dryer months in late summer to early fall.

Maintenance Frequency

The primary factor for determining frequency of maintenance for the StormFilter is sediment loading.

A properly functioning system will remove solids from water by trapping particulates in the porous structure of the filter media inside the cartridges. The flow through the system will naturally decrease as more and more particulates are trapped. Eventually the flow through the cartridges will be low enough to require replacement. It may be possible to extend the usable span of the cartridges by removing sediment from upstream trapping devices on a routine as-needed basis, in order to prevent material from being re-suspended and discharged to the StormFilter treatment system.

The average maintenance lifecycle is approximately 1-5 years. Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction may need to be inspected and maintained more often than those with fully stabilized surface conditions.

Regulatory requirements or a chemical spill can shift maintenance timing as well. The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after major storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual StormFilter system or site. It is recommended that the site owner develop a database to properly manage StormFilter inspection and maintenance programs..

Inspection Procedures

The primary goal of an inspection is to assess the condition of the cartridges relative to the level of visual sediment loading as it relates to decreased treatment capacity. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, then typically large amounts of sediments will be present and very little flow will be discharged from the drainage pipes. If this is the case, then maintenance is warranted and the cartridges need to be replaced.

Warning: In the case of a spill, the worker should abort inspection activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct an inspection:

Important: Inspection should be performed by a person who is familiar with the operation and configuration of the StormFilter treatment unit and the unit's role, relative to detention or retention facilities onsite.

1. If applicable, set up safety equipment to protect and notify surrounding vehicle and pedestrian traffic.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the access portals to the vault and allow the system vent.
4. Without entering the vault, visually inspect the inside of the unit, and note accumulations of liquids and solids.
5. Be sure to record the level of sediment build-up on the floor of the vault, in the forebay, and on top of the cartridges. If flow is occurring, note the flow of water per drainage pipe. Record all observations. Digital pictures are valuable for historical documentation.
6. Close and fasten the access portals.
7. Remove safety equipment.
8. If appropriate, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
9. Discuss conditions that suggest maintenance and make decision as to whether or not maintenance is needed.

Maintenance Decision Tree

The need for maintenance is typically based on results of the inspection. The following Maintenance Decision Tree should be used as a general guide. (Other factors, such as Regulatory Requirements, may need to be considered).

Please note Stormwater Management StormFilter devices installed downstream of, or integrated within, a stormwater storage facility typically have different operational parameters (i.e. draindown time). In these cases, the inspector must understand the relationship between the retention/detention facility and the treatment system by evaluating site specific civil engineering plans, or contacting the engineer of record, and make adjustments to the below guidance as necessary. Sediment deposition depths and patterns within the StormFilter are likely to be quite different compared to systems without upstream storage and therefore shouldn't be used exclusively to evaluate a need for maintenance.

1. Sediment loading on the vault floor.
   a. If >4" of accumulated sediment, maintenance is required.
2. Sediment loading on top of the cartridge.
   a. If >1/4" of accumulation, maintenance is required.
3. Submerged cartridges.
   a. If >4" of static water above cartridge bottom for more than 24 hours after end of rain event, maintenance is required. (Catch basins have standing water in the cartridge bay.)
4. Plugged media.
   a. While not required in all cases, inspection of the media within the cartridge may provide valuable additional information.
   b. If pore space between media granules is absent, maintenance is required.
5. Bypass condition.
   a. If inspection is conducted during an average rain fall event and StormFilter remains in bypass condition (water over the internal outlet baffle wall or submerged cartridges), maintenance is required.
6. Hazardous material release.
   a. If hazardous material release (automotive fluids or other) is reported, maintenance is required.
7. Pronounced scum line.
   a. If pronounced scum line (say ≥ 1/4" thick) is present above top cap, maintenance is required.

Maintenance

Depending on the configuration of the particular system, maintenance personnel will be required to enter the vault to perform the maintenance.

Important: If vault entry is required, OSHA rules for confined space entry must be followed.

Filter cartridge replacement should occur during dry weather. It may be necessary to plug the filter inlet pipe if base flows is occurring.

Replacement cartridges can be delivered to the site or customers facility. Information concerning how to obtain the replacement cartridges is available from Contech Engineered Solutions.

Warning: In the case of a spill, the maintenance personnel should abort maintenance activities until the proper guidance is obtained. Notify the local hazard control agency and Contech Engineered Solutions immediately.

To conduct cartridge replacement and sediment removal maintenance:

1. If applicable, set up safety equipment to protect maintenance personnel and pedestrians from site hazards.
2. Visually inspect the external condition of the unit and take notes concerning defects/problems.
3. Open the doors (access portals) to the vault and allow the system to vent.
4. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
5. Make notes about the external and internal condition of the vault. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
6. Using appropriate equipment offload the replacement cartridges (up to 150 lbs. each) and set aside.
7. Remove used cartridges from the vault using one of the following methods:

Method 1:

A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

   Using appropriate hoisting equipment, attach a cable from the boom, crane, or tripod to the loose cartridge. Contact Contech Engineered Solutions for suggested attachment devices.

B. Remove the used cartridges (up to 250 lbs. each) from the vault.

Important: Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner.

C. Set the used cartridge aside or load onto the hauling truck.

D. Continue steps a through c until all cartridges have been removed.

Method 2:

A. This activity will require that maintenance personnel enter the vault to remove the cartridges from the under drain manifold and place them under the vault opening for lifting (removal). Disconnect each filter cartridge from the underdrain connector by rotating counterclockwise 1/4 of a turn. Roll the loose cartridge, on edge, to a convenient spot beneath the vault access.

B. Unscrew the cartridge cap.

C. Remove the cartridge hood and float.

D. At location under structure access, tip the cartridge on its side.

E. Empty the cartridge onto the vault floor. Reassemble the empty cartridge.

F. Set the empty, used cartridge aside or load onto the hauling truck.

G. Continue steps a through e until all cartridges have been removed.

8. Remove accumulated sediment from the floor of the vault and from the forebay. This can most effectively be accomplished by use of a vacuum truck.
9. Once the sediments are removed, assess the condition of the vault and the condition of the connectors.
10. Using the vacuum truck boom, crane, or tripod, lower and install the new cartridges. Once again, take care not to damage connections.
11. Close and fasten the door.
12. Remove safety equipment.
13. Finally, dispose of the accumulated materials in accordance with applicable regulations. Make arrangements to return the used **empty** cartridges to Contech Engineered Solutions.

Material Disposal

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in accordance with regulatory protocols. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads.

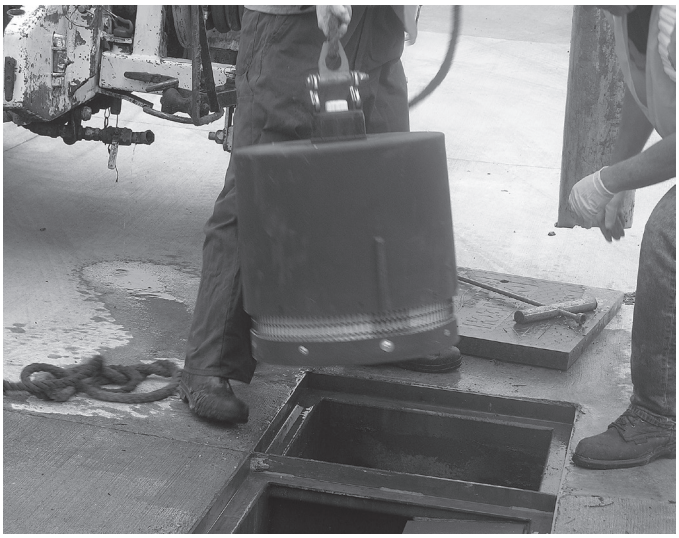
Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. This typically requires coordination with a local landfill for solid waste disposal. For liquid waste disposal a number of options are available including a municipal vacuum truck decant facility, local waste water treatment plant or on-site treatment and discharge.

Related Maintenance Activities - Performed on an as-needed basis

StormFilter units are often just one of many structures in a more comprehensive stormwater drainage and treatment system.

In order for maintenance of the StormFilter to be successful, it is imperative that all other components be properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities.

In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil loading, and discharges of inappropriate materials.



Inspection Report

Date: _____ Personnel: _____

Location: _____ System Size: _____ Months in Service: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other: _____

Sediment Thickness in Forebay: _____ Date: _____

Sediment Depth on Vault Floor: _____

Sediment Depth on Cartridge Top(s): _____

Structural Damage: _____

Estimated Flow from Drainage Pipes (if available): _____

Cartridges Submerged: Yes ☐ No ☐ Depth of Standing Water: _____

StormFilter Maintenance Activities (check off if done and give description)

☐ Trash and Debris Removal: _____

☐ Minor Structural Repairs: _____

☐ Drainage Area Report _____

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

Items Needing Further Work: _____

Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals.

Other Comments:

_____

_____

_____

_____

_____

_____

_____

_____

Review the condition reports from the previous inspection visits.

StormFilter Maintenance Report

Date: _____ Personnel: _____

Location: _____ System Size: _____

System Type: Vault ☐ Cast-In-Place ☐ Linear Catch Basin ☐ Manhole ☐ Other: _____

List Safety Procedures and Equipment Used: _____

_____

_____

System Observations

Months in Service: _____

Oil in Forebay (if present): Yes ☐ No ☐

Sediment Depth in Forebay (if present): _____

Sediment Depth on Vault Floor: _____

Sediment Depth on Cartridge Top(s): _____

Structural Damage: _____

Drainage Area Report

Excessive Oil Loading: Yes ☐ No ☐ Source: _____

Sediment Accumulation on Pavement: Yes ☐ No ☐ Source: _____

Erosion of Landscaped Areas: Yes ☐ No ☐ Source: _____

StormFilter Cartridge Replacement Maintenance Activities

Remove Trash and Debris: Yes ☐ No ☐ Details: _____

Replace Cartridges: Yes ☐ No ☐ Details: _____

Sediment Removed: Yes ☐ No ☐ Details: _____

Quantity of Sediment Removed (estimate?):

Minor Structural Repairs: Yes ☐ No ☐ Details: _____

Residuals (debris, sediment) Disposal Methods: _____

Notes:

_____

_____

_____

_____

_____

_____

_____

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Support

- Drawings and specifications are available at www.conteches.com.
- Site-specific design support is available from our engineers.

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APPENDIX I

Stormwater Pollution Prevention Plan

Created For:

Lee & Penny Anderson Multipurpose Arena
2260 Summit Ave
St. Paul, MN 55105

Operator/Owner:

University of St. Thomas
2115 Summit Ave
St Paul, MN 55105
(651) 962-5000

Contractor:

Ryan Companies US, Inc.
533 South Third Street, Suite 100
Minneapolis, MN 55415
Phone Number: (612) 492-4000

Stormwater Manager and SWPPP Contact(s):

Ryan Companies US, Inc.
Ryan Kelly
533 South Third Street, Suite 100
Minneapolis, MN 55415
612-751-1680

SWPPP Preparation Date:

10/30/2023
Estimated Project Dates:

Estimated Start of Construction: 12/26/2023
Estimated Completion of Construction: 08/31/2025

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SECTION 1: SITE EVALUATION, ASSESSMENT, AND PLANNING

1.1 Project/Site Information

Project/Site Name: Lee & Penny Anderson Multipurpose Arena

Project Street/Location: 2260 Summit Ave

City: St. Paul State: MN Zip Code: 55105

County: Ramsey County

Latitude/Longitude (Use **one** of three possible formats, and specify method)

Latitude:

44 º 56 ' 23.50" N (degrees, minutes, seconds)

Longitude:
93 º 11 ' 40.70 " W (degrees, minutes, seconds)

Method for determining latitude/longitude:

☐ USGS topographic map (specify scale: _____) ☐ EPA Web site ☐ GPS

☒Other (please specify): Google Earth

Is the project located in Indian country land, or area of cultural significance for an Indian Tribe	☐Yes	☒ No
Is the project considered a federal facility?	☐Yes	☒ No
Is the scope of work in response to a public emergency?	☐Yes	☒ No

NPDES project or permit tracking number: C00068427

(This is the unique identifying number assigned to your project by your permitting authority after you have applied for coverage under the appropriate NPDES construction general permit.)

1.2 Contact Information/Responsible Parties

Operator:
University of St. Thomas
2115 Summit Ave
St Paul, MN 55105
(651) 962-5000

Project Manager:
Aaron Sundberg
Ryan Companies US, Inc.
533 South Third Street, Suite 100
Minneapolis, MN 55415
Phone: (612) 492-4636

Stormwater Manager and SWPPP Contact:
Ryan Kelly
533 South Third Street, Suite 100
Minneapolis, MN 55415
Cell: (612) 751-1680

SWPPP Prepared By:
Anthony Adams
Ryan Companies US, Inc.
533 South Third Street, Suite 100
Minneapolis, MN 55415
Phone: (612) 492-4741

Subcontractor(s):
TBD

Emergency 24 hour contact:
Ryan Kelly
Cell: (612) 751-1680

1.3 Nature and Sequence of Construction Activity

Describe the general scope of the work for the project, major phases of construction, etc:

The Lee & Penny Anderson Multipurpose Arena Project (Project) is a proposed redevelopment of an approximately six-acre portion of the University of St. Thomas (St. Thomas) South Campus bordered by Summit Ave to the north, Cretin Ave to the east, Goodrich Ave to the south, and Mississippi River Blvd to the west. The Project will include a multipurpose competition venue for St. Thomas' hockey and basketball programs with capacity for approximately 4,000 to 5,500 spectators. The Project also includes practice facilities, coaching offices, locker rooms, student athlete support services and other university events.

The Project is expected to begin construction in January of 2024 with project completion in August of 2025 so the venue can be utilized for the 2025-2026 hockey and basketball seasons. There are three existing buildings (McCarthy Gymnasium, Service Center, and Cretin Residence Hall) with adjacent surface parking lots that will be demolished on site with early utility infrastructure work required at the start of the project before the existing buildings can be removed. The Facilities and Design Center will adjoin the proposed building directly to the north and there will be some minor improvements to the Anderson Parking Facility for electrical and parking circulation needs.

What is the function of the construction activity?

☐ Residential ☐ Commercial ☐ Industrial ☐ Road Construction

☐ Linear Utility ☒ Other (please specify): Institutional – Sports Arena

The following is a description of the intended sequence of construction activities which will disturb soils for major portions of the construction site:

1. Install perimeter sediment control measures including for stockpiles and downstream drainage ways.
2. Selective vegetation removal for silt fence installation
3. Silt fence installation
4. Stabilized construction entrance
5. Clear and grub
6. Grade site
7. Install storm sewer, sanitary sewer, water main and associated inlet & outlet protection
8. Temporarily stabilize all areas including lots that have reached mass grade
9. Construct buildings
10. Install pavement
11. Permanently stabilize lot
12. Remove all temporary soil erosion and sediment control measures after the site is stabilized with vegetation

1.4 Soils, Slopes, Vegetation, and Current Drainage Patterns

Soil type(s):

- 0 - 7 feet of fill, which is mostly silty sands, gravel, and dark brown soil.
- 2 – 4 feet of clayey sand, which is mostly gravel, laminations of silty sand.
- 3 – 6 feet of weathered shale below the sands, gray descriptions.
- Large parts the site are impervious areas with 3”-6” of bituminous pavement at the surface. See Erosion Control plans and Geotech report for boring locations and boring details.

Slopes (describe current slopes and note any changes due to grading or fill activities):

- The existing site is relatively flat, with highpoints toward the northern edge of the proposed site boundary between 862’ and 863’. There is only roughly 5’-8’ of grade change from the highest point onsite to the lowest point onsite. As a whole the site slopes towards the south across a variety of pervious and impervious areas. The low point onsite is in the southern portion near 857.5’.
- The proposed site will contain a large building with a finished floor elevation of 862’ with a parking lot and drive aisles that slope tie into the existing grades around the building. The low point of the site is on the southern side in the SW turnaround and the southern parking lot with the finished grade around 857.5’. Just north of the arena will be a drainage swale that collects stormwater from the quad and directs water to the underground system. There will be an access off of Cretin Ave that will tie into the existing grades on the eastern side of the APF ramp as well.

Vegetation:

- The existing site has trees, some areas of mixed vegetation around some buildings and within the parking islands, grass areas within some of the open spaces for students, native grasses for vegetation, and some extremely large and mature trees near the grotto area.
- The proposed site will remove some of the existing trees but will provide new trees in some slightly different locations around the proposed building. This will contain mostly the same types of vegetation in some new landscape areas to tie in with the building.

Drainage Patterns (describe current drainage patterns and note any changes dues to grading or fill activities):

- The existing site is relatively flat, including three buildings near the middle of the project that will be demolished. These areas include primarily impervious surfaces which drain to existing catch basins within the ground. The northern and northwest portion of the site drains to catch basins that direct water to “the Grotto” which has an overland flow and discharge to the Mississippi River. The remainder of the site, through various catch basins and other

forms of stormwater treatment, ultimately discharge water to a 5' wide storm tunnel roughly 100' beneath the surface. This storm tunnel then discharges into the Mississippi River as well.

- The proposed building will send stormwater to the large storm tunnel on the southern portion of the site. The majority of the stormwater onsite travels to a large underground treatment system in the southern parking lot. Water travels from all roof drains and around 3 sides of the building to reach the outfall in the south. Other site areas to the north and west of the arena will direct water to the Grotto, attempting to match current conditions and flow rates. There is a portion of the site to the northeast of the arena that will tie into the existing storm lines beneath Grand Ave, which directs water to the APF storm treatment system. This water is treated, and then discharged to the same large storm tunnel, but a little but further upstream of where our arena treatment system ties into the tunnel. See grading plans for further details on stormwater routing and drainage.

1.5 Construction Site Estimates

The following are estimates of the construction site:

Total Project Area	7.48 acres
Total Property Area	27.45 acres
Impervious Area before Construction	5.16 acres
Impervious Area after Construction	5.94 acres
Percentage Impervious Area before Construction	70.0 %
Percentage Impervious Area after Construction	80.1 %

1.6 Design Precipitation Estimates

The estimates of the expected precipitation on site during construction were used for the design of the project's BMPs. This was based on the 2 year, 24 hour rainfall event and/or the calculation of 1,800 CF of storage per acre draining to the BMP.

1.7 Receiving Waters

Does the project discharge to a Municipal Separate Storm Sewer System?	☒Yes	☐ No
Are there any waters of the U.S. within 50ft of the construction limits?	☒Yes	☐ No

Description of receiving waters: The ultimate outfall from the site is the Mississippi River. The stormwater will discharge to the river through the Grotto area to the west of the site and the deep storm tunnel that runs to the south of the site.

Description of storm sewer systems: There is existing storm sewer infrastructure, primarily at the outfall to the Grotto and the Storm tunnel, that will remain in place and be tied into the new storm sewer system. There are 6 building stubs to provide adequate drainage from the roof of the building, 19 proposed catch basins of rectangular and circular variety, and 13 proposed storm manholes. These structures collect the stormwater and direct it to one of two locations, the grotto to the west or the storm tunnel to the south.

Description of impaired waters or waters subject to TMDLs: The Mississippi River is an impaired water and has a listed TMDL. The impairments listed are for Aluminum, Fecal Coliform, Mercury in fish tissue, Mercury in water column, Nutrients, PCB in fish tissue, PFOS in fish tissue, PFOS in water column, and Total Suspended Solids. The critical condition for the TMDL is very high to high flow conditions, which specifically increased the reductions needed to address the critical condition.

1.8 Potential Sources of Pollution

Potential sources of pollution associated with the construction activity may include:

- Sediment from disturbed soils
- Portable sanitary stations
- Fuel tanks
- Staging areas
- Waste containers
- Chemical storage areas
- Oil or other petroleum products
- Adhesives
- Tar
- Paint
- Solvents
- Detergents
- Fertilizers
- Raw materials (e.g., bagged Portland cement)
- Construction debris
- Landscape waste
- Concrete and concrete trucks
- Litter
- Dewatering operations

1.9 Site Features and Sensitive Areas to be Protected

Instructions:

- *Describe unique site features including streams, stream buffers, wetlands, specimen trees, natural vegetation, steep slopes, or highly erodible soils that are to be preserved.*
- *Describe measures to protect these features.*
- *Include these features and areas should be shown on the site maps.*

Description of unique features and measures to protect them:

There is a small ravine area just to the west of the proposed construction limits that the University of St. Thomas refers to as “The Grotto”. There is significant grade change, a few extremely mature trees, and some existing infrastructure that must be maintained throughout the construction process.

1.10 Safe Drinking Water Act Underground Injection Control Requirements

Will infiltration systems be installed that direct stormwater to any bored, drilled, driven shaft or dug hole that is deeper than its widest surface dimension, or has subsurface fluid distribution?	☐Yes	☒ No
Will drywells, seepage pits, or improved sinkholes be installed?	☐Yes	☒ No

If yes, documentation of contact between owner/contractor/developer and EPA Regional Office responsible for implementing the requirements for underground injection wells should be obtained.

1.11 Endangered Species Certification

Instructions:

- Before commencing construction, determine whether endangered or threatened species or their critical habitats are on or near your site.
- Adapt this section as needed for state or tribal endangered species requirements.

Are endangered or threatened species and critical habitats on or near the project area?

☒ Yes ☐ No

Describe how this determination was made: An EAW was completed for the site.

If yes, describe the species and/or critical habitat and what approvals have been obtained (may require documentation records): A review of the DNR’s Natural Heritage Inventory System (NHIS) was conducted per license agreement LA-1074 for the project site and the area within approximately one mile of the project site. The database includes known occurrences of any state endangered, threatened, or special concern species. The review identified 20 records of 7 species that may be found near this area. Refer to EAW for specific table of species onsite.

1.12 Plan Sheets Included

Included within this SWPPP are the following plan sheets:

1. Notes
2. Survey Sheets
3. Existing Conditions Plans
4. Phase 1 & Phase 2 Removals Plans
5. Phase 1 & Phase 2 Erosion Control Plans
6. Phase 1 & Phase 2 Site Plans
7. Grading Plans
8. Phase 1 & Phase 2 Utility Plans
9. Civil Details

SECTION 2: EROSION, SEDIMENT, AND BMP CONTROLS

2.1 Control Implementation Schedule

Best Management Practices will be implemented on an as-needed basis to protect water quality. Perimeter controls of the site should be installed prior to soil disturbance (excluding soil disturbance necessary to install the controls), including demolition activities. Perimeter controls, including the silt fence, should be actively maintained until final stabilization of those portions of the site upward of the perimeter control. Stabilized construction entrance(s) and sediment traps should be installed as described in the intended sequence of construction activities. The contractor is responsible for the adequate protection (including sediment control) of existing sewers and sewer structures during construction operations. As necessary, the appropriate sediment control measure should be installed prior to land disturbing activities.

Stabilization measures should be initiated where construction activities have temporarily or permanently ceased, in accordance with Local and State requirements, as described below. Once construction activity in an area has permanently ceased, that area should be permanently stabilized. Temporary perimeter controls should be removed after final stabilization of those portions of the site upward of the perimeter control.

2.2 Erosion and Sediment Controls

The appropriate soil erosion and sediment controls should be implemented on site and should be modified to reflect the current phase of construction. All temporary sediment and erosion control measures should be repaired or replaced within 24 hours of discovery to maintain NPDES compliance. Permittee or an authorized agent is

responsible for inspecting all sediment and erosion control measures per section 5 of this report.

Extra care will be taken to minimize soil compaction and preserve top soil when feasible throughout the site. Disturbance of steep slopes (identified on the Project Site Map) shall also be minimized. Unless infeasible, discharges from stormwater controls shall be directed towards vegetated areas. Conveyance channels will be designed to route water away from unstabilized areas. Velocity dissipation devices will be installed where applicable to prevent erosion from high-velocity stormwater flow. Perimeter sediment control measures should be installed for stockpiles and downstream drainage ways.

Unless otherwise indicated, all vegetative and structural erosion and sediment control practices should be installed to the Standard Practice. The contractor is responsible for the installation of any additional erosion and sediment control measures necessary to minimize erosion and sedimentation as determined by the Engineer or Primary Contact. At a minimum, additional erosion and sediment control devices should be maintained where land disturbances occur within the required 50-ft natural buffer from any receiving surface waters. Proposed sediment loads should not exceed the undisturbed natural buffer sediment load. In Minnesota, a 100-ft buffer zone is required for projects adjacent to special water or impaired waters.

1. **Stabilization Practices**
   Areas that will not be paved or covered with non-erosive material should be stabilized using procedures in substantial conformance with the MPCA Stormwater Best Management Practices Manual. This SESC Plan includes site-specific soil erosion and sediment control measures. Additional erosion controls should be implemented as necessary, as determined by the Engineer or Primary Contact.

   The following temporary and permanent stabilization practices, at a minimum, are proposed:

   - Temporary seeding
   - Permanent seeding
   - Erosion Control Blanket
   - Mulch
   - Straw Blanket

   A record of the dates when major grading activities occur, when construction activities cease on a portion of the site and when stabilization measures are initiated should be included in the SWPPP.

   Except as provided in paragraphs (a), (b), and (c) below, stabilization measures shall be initiated immediately on portions of the site where construction activities have temporarily or permanently ceased.

(a) Where the initiation of stabilization measures after construction activity temporarily or permanently ceased is precluded by snow cover, stabilization measures shall be initiated as soon as practicable.

(b) Where construction activity will resume on a portion of the site within 14 days from when activities ceased (e.g., the total time period that construction activity is temporarily ceased is less than 14 days), stabilization measures do not have to be initiated on that portion of the site after construction activity temporarily ceased.

(c) For site discharging to special or impaired waters, where construction activity will resume on a portion of the site within 7 days from when activities ceased (e.g., the total time period that construction activity is temporarily ceased is less than 7 days), stabilization measures do not have to be initiated on that portion of the site after construction activity temporarily ceased.

2. Structural Practices

Provided below is a description of structural practices that should be implemented, to the degree attainable to divert flows from exposed soils, store flows or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Structural practices should be placed on upland soils to the degree attainable. The installation of the following devices may be subject to Section 404 of the Clean Water Act:

- Rock construction entrance
- Silt fences
- Fiber blankets
- Inlet protection devices
- Concrete washout area

Note: Silt fence or fabric placed under the grate is NOT an approved form of inlet protection.

If temporary sediment basins are to be used, their outlet structures must be designed to withdraw water from the water's surface, unless infeasible due to frozen conditions. Sediment basins will be sited outside of any natural buffers located on the site. All natural buffers are to be preserved from surface waters and sediment controls during construction. At a minimum, sediment basins should be sized to handle the volume generated by the 2-year, 24-hour storm or 3,6000 CF per acre of drainage area.

2.3 Storm Water Management

1. **Stormwater Practices**
   Provided below is a description of measures that will be installed during the construction process to control the pollutants in storm water discharges that will occur after the construction operations have been completed. The installation of these devices may be subject to Section 404 of the Clean Water Act:

   - Pretreatment Structure
   - Underground Detention System
   - Stormwater Filtration Vault

   Velocity dissipation devices, such as rip-rap aprons at flared end sections or level spreaders, shall be placed at discharge locations and along the length of any outfall channel as necessary to provide a non-erosive velocity flow from the structure to a watercourse so that the natural, physical and biological characteristics and functions are maintained and protected (e.g., maintenance of hydrologic conditions, such as the hydro period and hydrodynamics present prior to the initiation of construction activities).

2.4 Non-Storm Water Discharges

The following non-stormwater discharges are prohibited from combining with stormwater discharges and must be disposed of properly:

- Backwash water from filters (unless returned to the beginning of the treatment process)
- Runoff from washing trucks and other construction vehicles when soaps, detergents or solvents are used
- Concrete washout wastewater
- Runoff from stucco, paint, form release oils, curing componds and other construction material
- Runoff from fuels, oils, and other pollutants used in vehicle and equipment operation and maintenance
- Other hazardous substances or wastes

Except for flows from fire fighting activities, possible sources of non-storm water that may be combined with storm water discharges associated with the proposed activity, are described below:

- Water used to wash vehicles where detergents and other solvents are not used
- Fire hydrant flushings
- Landscape irrigations
- Water used to control dust

- Pavement wash waters where spills or leaks of toxic or hazardous materials have not occurred (unless spilled materials have been removed) and where detergents are not used
- Uncontaminated potable water
- Uncontaminated and non-turbid ground water or spring water
- Foundation or footing drains where flows are not contaminated with process materials such as solvents.
- Exterior building washdown provided detergents and other solvents are not used and external surfaces do not contain hazardous substances (e.g. paint or caulk containing PCBs)
- Uncontaminated air conditioning or compressor condensate
- Uncontaminated dewatering activities, may still require pretreatment

Any allowed sources of non-stormwater discharges should be called out on the SWPPP site plan. Pollution prevention measures should be implemented for non-storm water components of the discharge.

SECTION 3: OTHER CONTROLS

This section of the SWPPP addresses the various controls that should be implemented for each of the major construction activities. For each measure identified in the SWPPP, the contractor(s) or subcontractor(s) that will implement the measure should be identified.

3.1 Waste Management

Solid waste materials including trash, construction debris, excess construction materials, machinery, tools and other items will be collected and disposed of off site by the contractor. The contractor is responsible to acquire the permit required for such disposal. Burning on site will not be permitted. No solid materials, including building materials, shall be discharged to Waters of the State, except as authorized by State approval. All waste materials should be collected and stored in approved, covered receptacles. No wastes should be placed in any location other than in the approved containers appropriate for the materials being discarded. There should be no liquid wastes deposited into dumpsters or other containers which may leak. Receptacles with deficiencies should be replaced as soon as possible, and the appropriate clean-up procedure should take place, if necessary. Construction waste material is not to be buried on site. Waste disposal should comply with all Local, State, and Federal regulations.

On-site hazardous material storage should be minimized and stored in labeled, separate receptacles from non-hazardous waste. All hazardous waste should be disposed of in the manner specified by Local or State regulation or by the manufacturer.

3.2 Concrete Waste Management

Concrete waste or washout should not be allowed in the street or allowed to reach a storm water drainage system or watercourse. When practicable, a sign should be posted at each location to identify the washout. To the extent practicable, concrete washout areas should be located a reasonable distance from a storm water drainage inlet or watercourse, and should be located at least 10 feet behind the curb, if the washout area is adjacent to a paved road. A stabilized entrance that meets local standards should be installed at each washout area.

The containment facilities should be of sufficient volume to completely contain all liquid and concrete waste materials including enough capacity for anticipated levels of rainwater. The dried concrete waste material should be picked up and disposed of properly when 75% capacity is reached. Hardened concrete can be properly recycled and used again on site (as approved by the Engineer) or hauled off site to an appropriate landfill.

3.3 Concrete Cutting

Concrete waste management should be implemented to contain and dispose of saw-cutting slurries. Concrete cutting should not take place during or immediately after a rainfall event. Waste generated from concrete cutting should be cleaned-up and disposed into the concrete washout facility as described above.

3.4 Vehicle Storage and Maintenance

When not in use, construction vehicles should be stored in a designated area(s) outside of the regulatory floodplain, away from any natural or created watercourse, pond, drainage-way or storm drain. Controls should be installed to minimize the potential of runoff from the storage area(s) from reaching storm drains or water courses. Vehicle maintenance (including both routine maintenance as well as on-site repairs) should be made within a designated area(s) to prevent the migration of mechanical fluids (oil, antifreeze, etc.) into watercourses, wetlands or storm drains. Drip pans or absorbent pads should be used for all vehicle and equipment maintenance activities that involve grease, oil, solvents, or other vehicle fluids. Construction vehicles should be inspected frequently to identify any leaks; leaks should be repaired immediately or the vehicle should be removed from the site. Dispose of all used oil, antifreeze, solvents and other vehicle-related chemicals in accordance with United States Environmental Protection Agency (USEPA), Minnesota regulations and per Material Safety Data Sheet (MSDS) and/or manufacturer instructions. Contractors should immediately report spills to the Primary Contact.

3.5 Material Storage and Good Housekeeping

Materials and/or contaminants should be stored in a manner that minimizes the potential to discharge into storm drains or watercourses. An on-site area should be designated for material delivery and storage. All materials kept on site should be stored in their original containers with legible labels, and if possible, under a roof or other enclosure. Labels should be replaced if damaged or difficult to read. Bermed-off storage areas are an acceptable control measure to prevent contamination of storm water. MSDS should be available for referencing clean-up procedures. Any release of chemicals/contaminants should be immediately cleaned up and disposed of properly. Contractors should immediately report all spills to the Primary Contact, who should notify the appropriate agencies, if needed.

In order to prevent chemical run-off, materials such as pesticides, herbicides, insecticides, fertilizers, treatment chemicals and landscape materials should be covered or otherwise protected from the environment. When practical, all chemical storage should be placed under some form of shelter.

To reduce the risks associated with hazardous materials on site, hazardous products should be kept in original containers unless they are not re-sealable. The original labels and MSDS should be retained on site at all times. Hazardous materials and all other material on site should be stored in accordance with manufacturer or MSDS specifications. When disposing of hazardous materials, follow manufacturer or Local and State recommended methods.

The following good housekeeping practices should be followed on site during the construction project:

- An effort should be made to store only enough product required to do the job.
- All materials stored on site should be stored in a neat, orderly manner in their appropriate containers and adequately protected from the environment.
- Products should be kept in their original containers with the original manufacturer's label.
- Substances should not be mixed with one another unless recommended by the manufacturer.
- Operations should be observed as necessary to ensure proper use and disposal of materials on site.
- Whenever possible, all of a product should be used up before disposing of the container.
- Manufacturer's recommendations for proper use and disposal should be followed.

3.6 Management of Portable Sanitary Stations

To the extent practicable, portable sanitary stations should be located in an area that does not drain to any protected natural areas, Waters of the State or storm water structures and should be anchored to the ground to prevent from tipping over. Portable sanitary stations located on impervious surfaces should be placed on top of a secondary containment device or be surrounded by a control device (e.g., gravel-bag berm). The contractor should not create or allow unsanitary conditions. Sanitary waste should be disposed of in accordance with applicable State and/or Local regulations.

3.7 Spill Prevention and Clean-Up Procedures

Manufacturer's recommended methods for spill clean-up should be available in the SWPPP, and site personnel should be made aware of the procedures and location of the information and clean-up supplies. Materials and equipment necessary for spill clean-up should be kept in the material storage area on site. Equipment and materials should include, but are not limited to, brooms, dust pans, mops, rags, gloves, goggles, kitty litter, sand, sawdust and plastic and/or metal trash containers specifically for this purpose. Discharges of a hazardous substances or oil caused by a spill (e.g., a spill of oil into a separate storm sewer or Waters of the State) are not authorized by the State

permit. If a spill occurs, notify the Primary Contact immediately. The construction site should have the capacity to control, contain and remove spills if they occur. Spills should be cleaned up immediately (after discovery) in accordance with MSDS and should not be buried on site or washed into storm sewer drainage inlets, drainage-ways or Waters of the State.

Spills in excess of Federal Reportable Quantities (as established under 40 CFR Parts 110, 117, or 302) should be reported to the National Response Center by calling (800) 424-8802. MSDS often include information on Federal Reportable Quantities for materials. Spills of toxic or hazardous materials should be reported to the appropriate State or Local government agency, as required. When cleaning up a spill, the area should be kept well ventilated, and appropriate personal protective equipment should be used to minimize injury from contact with a hazardous substance.

In addition to the good housekeeping and other management practices discussed in the previous sections of these Notes, the following minimum practices should be followed to reduce the risk of spills:

- On-site vehicles should be monitored for leaks and should receive regular preventative maintenance to reduce the chance of leakage.
- Petroleum products should be stored in tightly sealed and clearly labeled containers.
- Contractors should follow the manufacturer's recommendations for proper use, storage and disposal of materials. Excess materials should be disposed of according to the manufacturer's instructions or State and Local regulations, and should not be discharged to the storm sewer or waterbody.

3.8 Dewatering Operations

During dewatering and basin draining operations, only uncontaminated water should be allowed to discharge to protected natural areas, Waters of the State or to a storm sewer system (in accordance with Local permits). Any water found to contain oil or grease must be treated using an oil-water separator or other adequate filtration device. Inlet hoses should be placed in a stabilized sump pit or floated at the surface of the water in order to limit the amount of sediment intake. Filter media must be replaced when no longer functional. Pumping operations may be discharged to a stabilized area that consists of an energy dissipating device (e.g., stone), sediment filter bag, or both. Adequate erosion controls should be used during de-watering operations as necessary. Stabilized conveyance channels should be installed to direct water to the desired location as applicable. Additional control measures may be installed at the outlet area at the discretion of the Primary Contact or Engineer. Additional inspections are required for dewatering operations per Section 5 in this report.

3.9 Off-Site Vehicle Tracking

The site should have one or more stabilized construction entrances in conformance with the Plan details. Stabilized construction entrance(s) should be installed to help reduce vehicle tracking of sediments. Streets should be swept as needed to reduce excess sediment, dirt or stone tracked from the site. Maintenance may include top dressing the stabilized entrance with additional stone and removing top layers of stone and sediment, as needed. Vehicles hauling erodible material to and from the construction site should be covered with a tarp.

3.10 Dust Control

Dust control should be implemented on site as necessary. Repetitive treatment should be applied as needed to accomplish control when temporary dust control measures are used. A water truck should be present on site (or available) for sprinkling/irrigation to limit the amount of dust leaving the site. Watering should be applied daily (or more frequently) to be effective. Caution should be used not to overwater, as that may cause erosion.

If field observations indicate that additional protection from wind erosion (in addition to, or in place of watering) is necessary, alternative dust suppressant controls should be implemented at the discretion and approval of the Engineer and/or Primary Contact.

Street cleaning should also be used as necessary to control dust. Paved areas that have soil on them from the construction site should be cleaned as needed, utilizing a street sweeper or bucket-type end loader or scraper at the direction of the Engineer and/or Primary Contact.

SECTION 4: COMPLIANCE WITH REGULATIONS

The management practices, controls and other provisions contained in the SWPPP should be at least as protective as the requirements contained in the NPDES. Requirements specified in sediment and erosion control site plans or site permits or storm water management site plans or site permits approved by local officials that are applicable to protecting surface water resources are, upon submittal of a Notice of Intent (NOI), to be authorized to discharge under the NPDES permit, incorporated by reference and are enforceable under the NPDES permit even if they are not specifically included in a SWPPP required under the NPDES permit. This provision does not apply to provisions of master plans, comprehensive plans, non-enforceable guidelines or technical guidance documents that are not identified in a specific plan or permit that is issued for the construction site.

The soil erosion and sediment control measures for this site should meet the additional requirements of the following agencies:

- City of St. Paul
- Minnesota DNR
- MPCA

SECTION 5: INSPECTIONS AND MAINTENANCE

5.1 Inspections

1. **Inspection Personnel**

   Person(s) who will be responsible for conducting site inspections in compliance with the NPDES Permit:

   - Onsite superintendent Ryan Kelly, employed by Ryan Companies US, Inc.
   - If superintendent is not onsite, other qualified personnel shall inspect.

2. **Inspection Schedule and Procedures**

   After each inspection, a report should be prepared by the person who performed the inspection. The inspection report should be maintained on site as part of the SWPPP. The inspector will ensure that maintenance will be carried out within 24 hours of the inspection.

   During active construction, inspections should be conducted at least once every 7 calendar days and within 24 hours after a rainfall event greater than ½ inch, or equivalent snowfall. The amount of rainfall will be measured using a rain gauge installed onsite.

   For stabilized areas, inspections should be conducted at least twice during the first month of stabilization (no more than 14 calendar days apart) and then once per month after that.

   For stabilized, linear projects, inspections should be conducted at least twice during the first month of stabilization (no more than 14 calendar days apart) and then once more within 24 hours of a 0.25” rain event or snowmelt event that produces 3.25 inches or more of snowmelt.

   Each inspection should include the following components:

   A. Disturbed areas and areas used for the storage of materials that are exposed to precipitation should be inspected for evidence of, or the potential for, pollutants entering the drainage system. The erosion and sediment control measures identified in the SWPPP should be observed to ensure that they have been installed and are operating correctly. Where discharge points are accessible, they should be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to the receiving waters. The locations of every discharge point out of the site should be recorded, along with a description of the water’s visual quality and characteristics. Pictures should be taken of every discharge location to reinforce the written descriptions. Areas where vehicles enter or exit the site should be inspected for off-site sediment tracking. All pumping operations

and other potential non-stormwater discharge sources should also be inspected.

B. Based on the results of the inspection, locations of corrective actions, the description of potential pollutant sources identified and the pollution prevention measures described in the SWPPP should be revised, as appropriate, as soon as practicable after the inspection. The modifications, if any, shall provide for timely implementation of any changes to the SWPPP within 7 calendar days following the inspection.

C. A report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the SWPPP and actions taken in accordance with paragraph B above should be made and retained as part of the SWPPP for at least 3 years from the date that permit coverage expires or is terminated.

D. All reports of non-compliance shall be signed by a responsible authority as defined in NPDES Permit.

5.2 Maintenance of Controls

Maintenance of the controls incorporated into this project should be performed as needed to assure their continued effectiveness. This includes prompt and effective repair and/or replacement of deficient control measures. The following is a description of procedures that should be used to maintain, in good and effective operating condition, erosion and sediment control measures and other protective measures identified in the SESC Plan and Standard Specifications.

- Dust control: When temporary dust control measures are used, repetitive treatment should be applied as needed to accomplish control.

- Sediment filter bags: Sediment filter bags should be installed on pump outlet hoses that discharge off site or to sensitive on-site areas, and should be placed in an area that allows for the bag to be removed without producing a sediment discharge. The bags should be inspected frequently and repaired or replaced as needed.

- Silt fence: Silt fences should be inspected regularly for undercutting where the fence meets the ground, overtopping, and tears along the length of the fence. Deficiencies should be repaired immediately. Remove accumulated sediments from the fence base when the sediment reaches one-half the fence height. During final stabilization, properly dispose of any sediment that has accumulated on the silt fence. Alternative sediment control measures should be considered for areas where silt fence continually fails.

- Stabilized construction entrance: The stabilized construction entrances should be maintained to prevent tracking of sediment onto public streets. Maintenance includes top dressing with additional stone and removing top layers of stone and sediment. The sediment tracked onto the public right-of-way should be removed immediately.

- Sedimentation basin: The sedimentation basin is constructed before any site grading occurs. The sedimentation should be maintained by pumping stormwater when necessary and as described on the Grading and Erosion Control Plan.

SECTION 6: RECORDKEEPING AND TRAINING

6.1 Recordkeeping

The following is a list of records that should be kept at the project site available for inspectors to review:

- Dates of grading, construction activity and stabilization (which is covered in Section 7)
- The signed and certified NOI form or permit application form (Tab 2).
- A copy of the letter from the EPA/State notifying you of their receipt of your complete NOI/application (Tab 2).
- A copy of the construction general permit (Tab 3)
- Inspection reports (Tab 8).
- Records relating to endangered species and historic preservation (attach).

Check your permit for additional details.

6.2 Log of Changes to the SWPPP

An amendment log form is included within this SWPPP. Changes and updates to be logged include additions of new BMPs, replacement of failed BMPs, significant changes in the activities or their timing on the project, changes in personnel, changes in inspection and maintenance procedures, updates to site maps, etc.

6.3 Training

Instructions:

- Training your staff and subcontractors is an effective BMP. As with the other steps you take to prevent stormwater problems at your site, you should document the training that you conduct for your staff, for those with specific stormwater responsibilities (e.g. installing, inspecting, and maintaining BMPs), and for subcontractors.

Describe Training Conducted:

- Stormwater and BMP awareness training for staff and subcontractors:

  The Superintendent will conduct informal training for all staff, including subcontractors, on the site. The training will focus on avoiding damage to stormwater BMPs and preventing illicit discharges. Topics include Installing and Maintaining Erosion Control BMPs, Sediment Control BMPs, Non-Stormwater BMPs, Waste Management BMPs and Materials Storage BMPs specific to the construction site.

Individual(s) Responsible for Training:

- Superintendents are responsible for educating contractors and subcontractors of storm water and BMP requirements.
- Superintendents have received NPDES training.
- Superintendents must attend an Erosion and Sediment Control Training refresher course every three years.
- Any other personnel providing inspections shall be equally qualified.

SECTION 7: FINAL STABILIZATION

A site can be considered finally stabilized when all soil disturbing activities have been completed and a uniform perennial vegetative cover with a density of 70% of the vegetative expected final growth density for the unpaved areas and areas not covered by permanent structures has been established.

Within 30 days after a construction site has undergone final stabilization, temporary erosion control best management practices (BMP's) have been removed and all land disturbing construction activities that required coverage under this permit have ceased, the permittee shall submit a signed notice of termination to the Department.

The notice of termination shall be submitted on forms available from the Department. Data submitted in the notice of termination forms shall be used as a basis for terminating coverage under this permit.

Termination of coverage under this permit shall be effective upon the Department's written confirmation of permit termination to the permittee.

This filing terminates coverage under the General Permit and terminates the General Contractor's responsibility to implement the SWPPP.

FIGURE 1

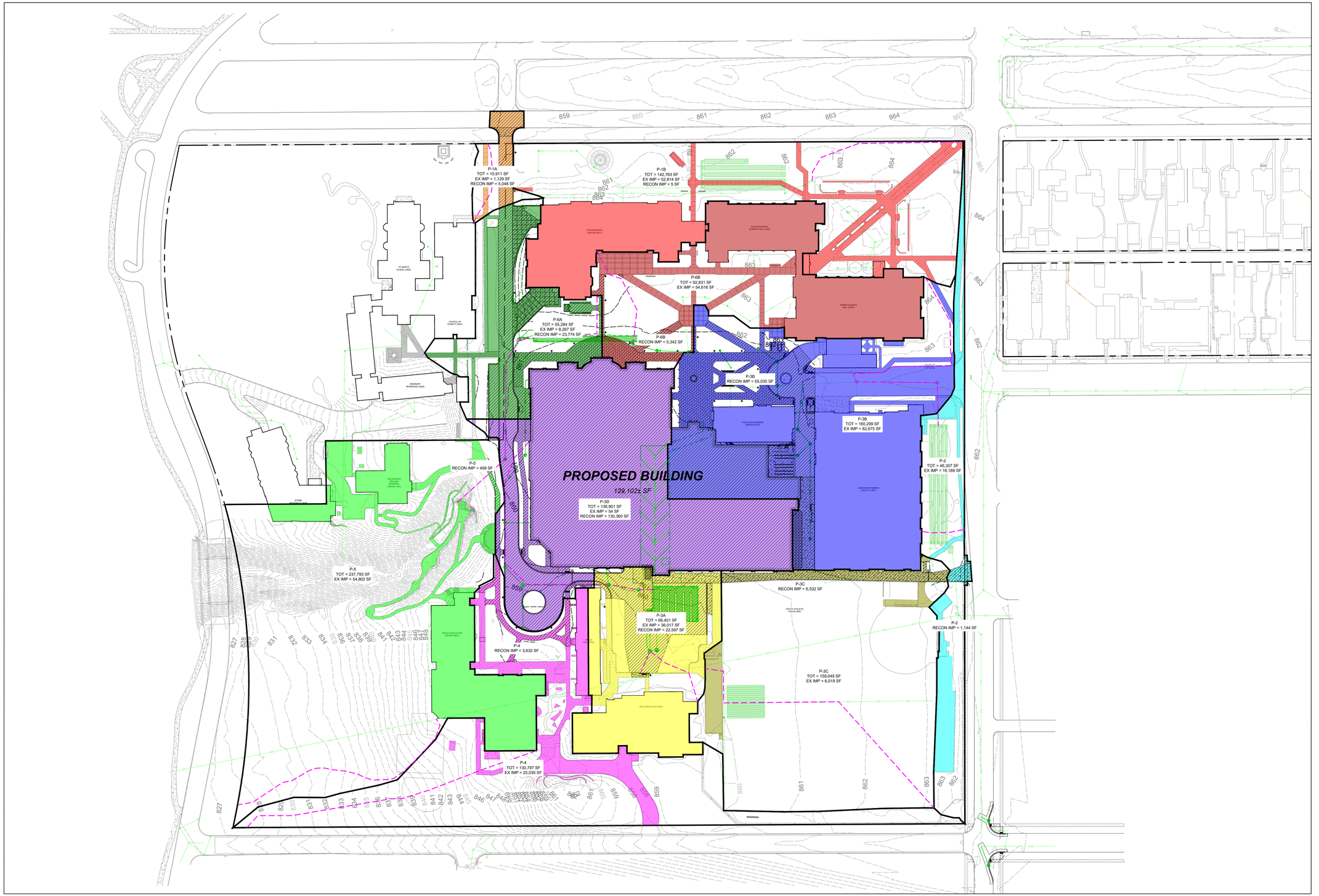
Device	Contech - StormFilter with PhosphoSorb	Contech - Filterra	Baysaver - BayFilter	Hydro International - Up-Flo	BioClean - Kraken	Bioclean - Modular Wetland
CRWD Volume Credit (%)	68	68	55	55	68	68
DP Removal	YES	YES	NO	NO	YES	YES

FIGURE 2

RYAN

UST Arena • Existing Conditions Drainage Plan • 01.19.2024

FIGURE 3



LEGEND:

IMPERVIOUS AREA

P-1A	NORTH OFFSITE (UNTREATED)
P-1B	NORTH OFFSITE (SCC SYSTEM)
P-2	EAST OFFSITE (UNTREATED)
P-3A	STORM TUNNEL (UNTREATED)
P-3B	STORM TUNNEL (APF SYSTEM)
P-3C	STORM TUNNEL (SAF SYSTEM)
P-3D	STORM TUNNEL (ARENA S SYSTEM)
P-4	SOUTH OFFSITE (UNTREATED)
P-5	WEST OFFSITE (UNTREATED)
P-6A	GROTTO (UNTREATED)
P-6B	GROTTO STORAGE (ARENA N SYSTEM)
	RECONSTRUCTED IMPERVIOUS
	TIME OF CONCENTRATION LINE

N

0 80 160

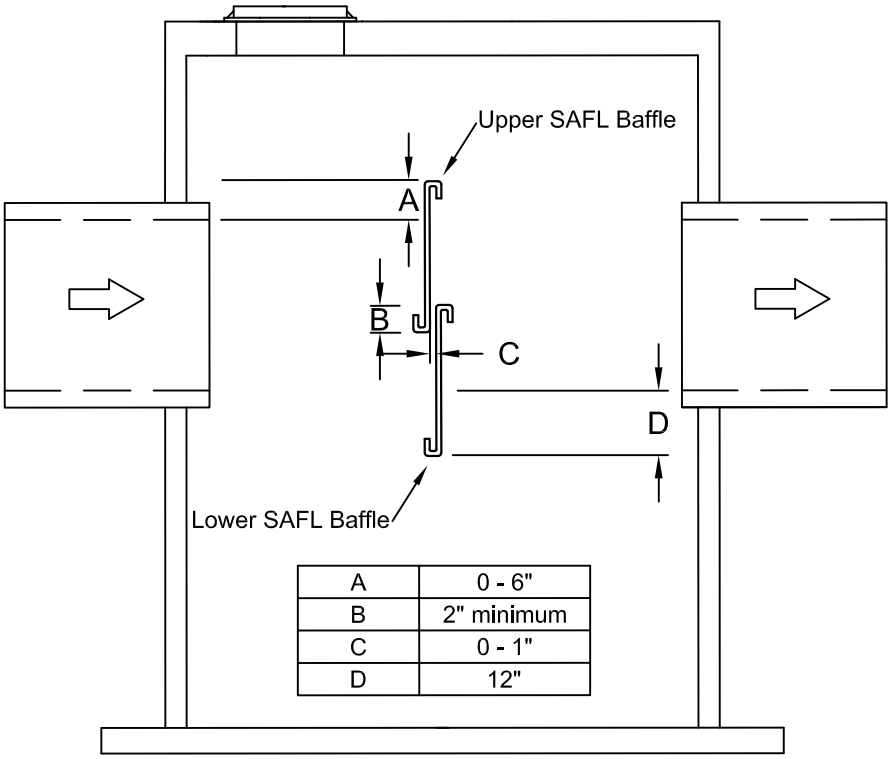
SCALE IN FEET

RYAN

UST Arena • Proposed Conditions Drainage Plan • 01.19.2024

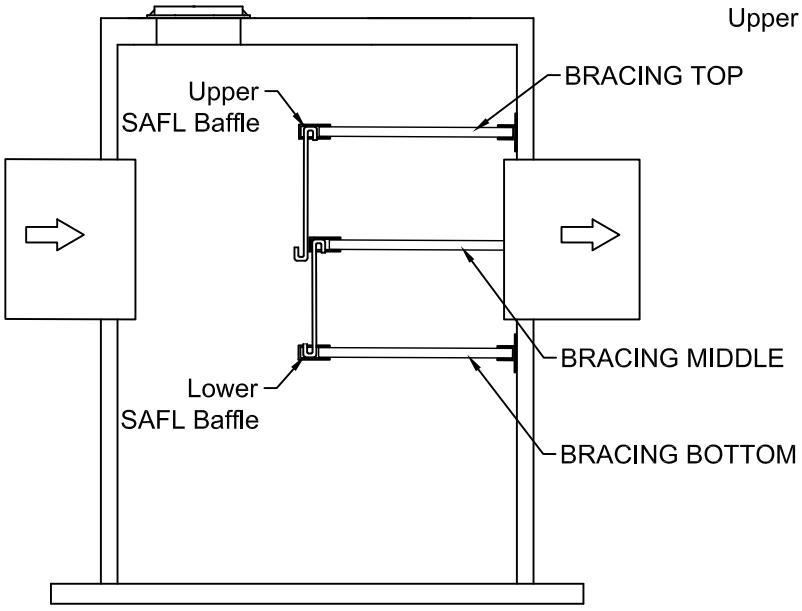
FIGURE 4

SAFL BAFFLE STACKING REQUIREMENTS

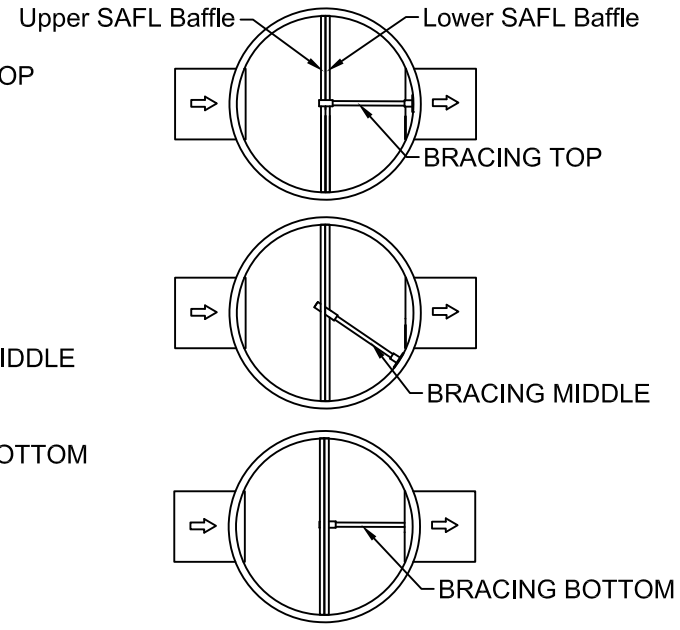


A	0 - 6"
B	2" minimum
C	0 - 1"
D	12"

Bracing for Stacked Baffles



SIDE VIEW



TOP VIEW

Also see: Bracing Guide & Sizing Guide

PATENT PROTECTED Patents: US #8663466B2 - US #8715507B2 - US #9506237B2 - CA #2742207

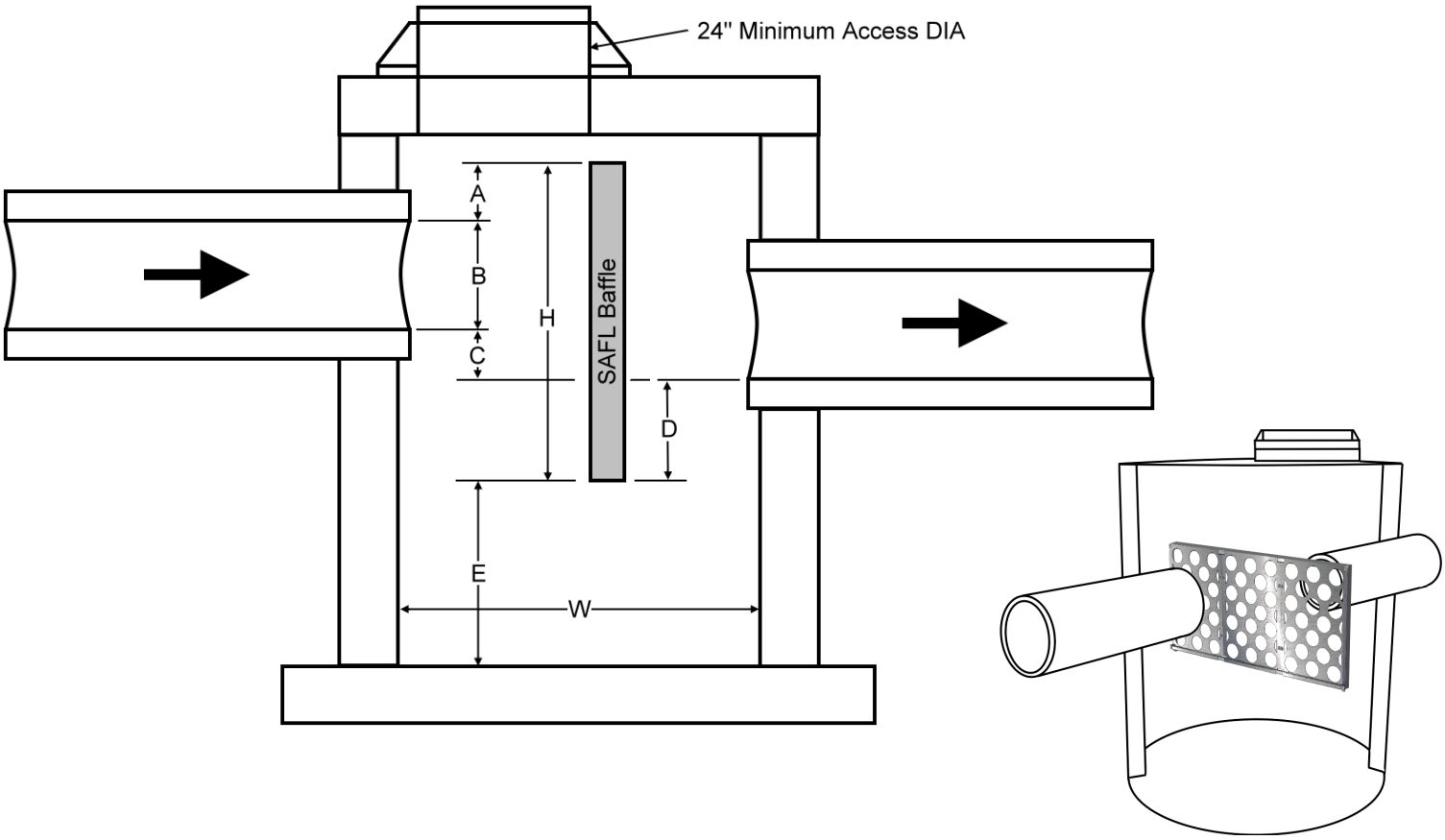
This generic detail does not encompass the sizing, fit, and applicability of the SAFL Baffle for this specific project. It is the ultimate responsibility of the design engineer to assure that the design is in compliance with all applicable laws and regulations. The SAFL Baffle is a patented technology of Upstream Technologies, Inc. Upstream Technologies does not approve plans, sizing, or system designs.

SAFL BAFFLE STACKING DETAIL

UPSTREAM TECHNOLOGIES INC.
5201 EAST RIVER ROAD, SUITE 303
FRIDLEY, MN 55421
651-237-5123

SAFL BAFFLE

SAFL BAFFLE SIZING REQUIREMENTS



A	0 to 6" 6" is ideal
B	Inlet pipe inside diameter
C	0 to 6" 0" is ideal
D	12"
E	36" Minimum. 48" or greater is ideal and results in less frequent sump cleanout
W	W = Sump diameter if round or width if rectangular
H	Baffle height = A + B + C + D
Purchase Baffle Size	W x H View the complete list of Available Baffle Sizes
	Also see: Bracing Guide & Stacking Guide
NOTE 1	If H is greater than 57" two SAFL Baffles may be stacked.
NOTE 2	75% of flow must be horizontal. No more than 25% falling from above
NOTE 3	This detail does not cover sizing the sump for sediment removal efficiency. Contact Upstream for sump sizing or use SHSAM Software
NOTE 4	For more information, see our Design Guide

PATENT PROTECTED Patents: US #8663466B2 - US #8715507B2 - US #9506237B2 - CA #2742207

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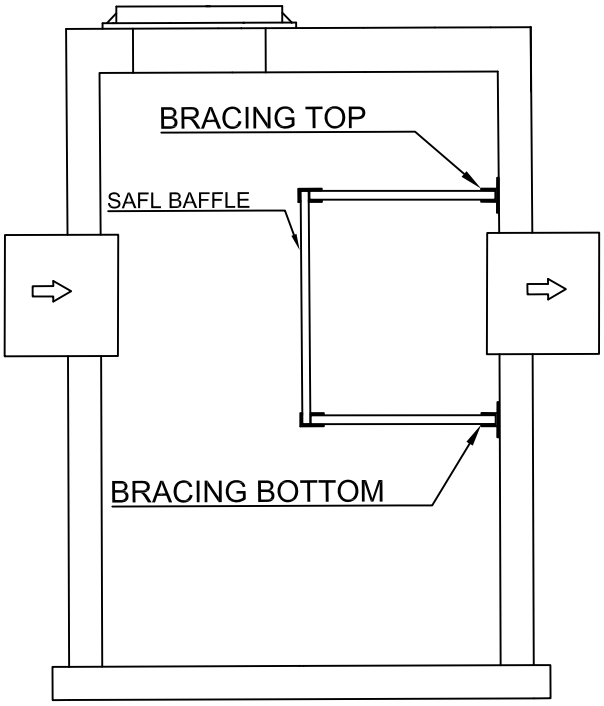
SAFL BAFFLE SIZING DETAIL

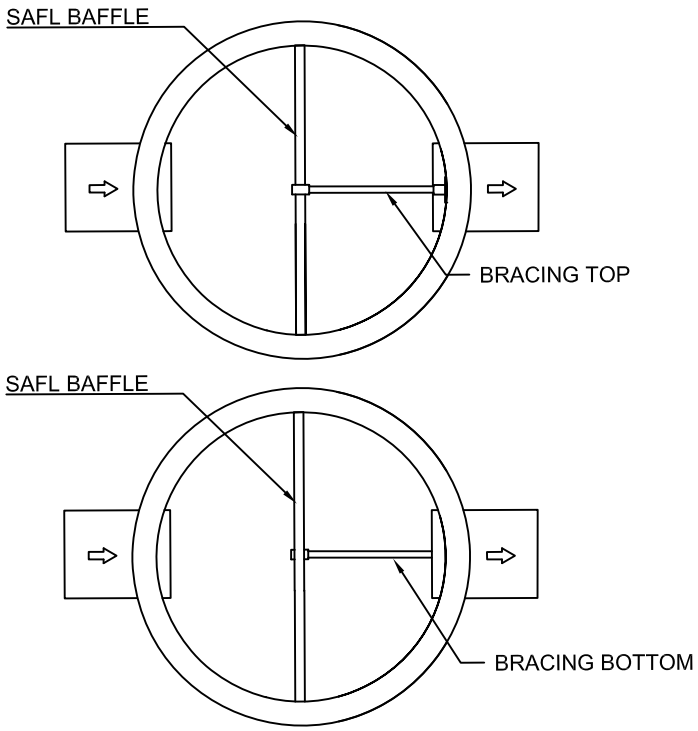
UPSTREAM TECHNOLOGIES INC.
5201 EAST RIVER ROAD, SUITE 303
FRIDLEY, MN 55421
651-237-5123

SAFL BAFFLE

SAFL BAFFLE BRACING REQUIREMENTS



SIDE VIEW



TOP VIEW

Guidance for Cross Bracing - SAFL Baffle

Pipe Inside Diameter (inches)	Bracing Needed Above This Flow (CFS)	Max Flow with 2 Braces (1 top, bottom)	Max Flow with 4 Braces (2 top, 2 bottom)
24	20	30	40
30	30	45	60
36	40	60	75
42	55	70	90
48	75	105	130
60	110	160	200

Note: Flows shown are maximum design flows with a slope of less than 3%. Contact Upstream Technologies if pipe slopes are 3% or greater.

Also see: Stacking Guide & Sizing Guide

PATENT PROTECTED Patents: US #8663466B2 - US #8715507B2 - US #9506237B2 - CA #2742207

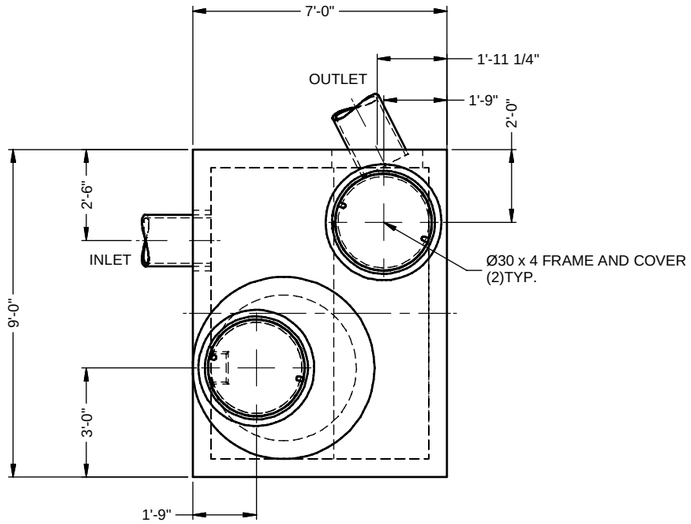
This generic detail does not encompass the sizing, fit, and applicability of the SAFL Baffle for this specific project. It is the ultimate responsibility of the design engineer to assure that the design is in compliance with all applicable laws and regulations. The SAFL Baffle is a patented technology of Upstream Technologies, Inc. Upstream Technologies does not approve plans, sizing, or system designs.

SAFL BAFFLE BRACING DETAIL

UPSTREAM TECHNOLOGIES INC.
5201 EAST RIVER ROAD, SUITE 303
FRIDLEY, MN 55421
651-237-5123

SAFL BAFFLE

FIGURE 5



PLAN VIEW ⚠2

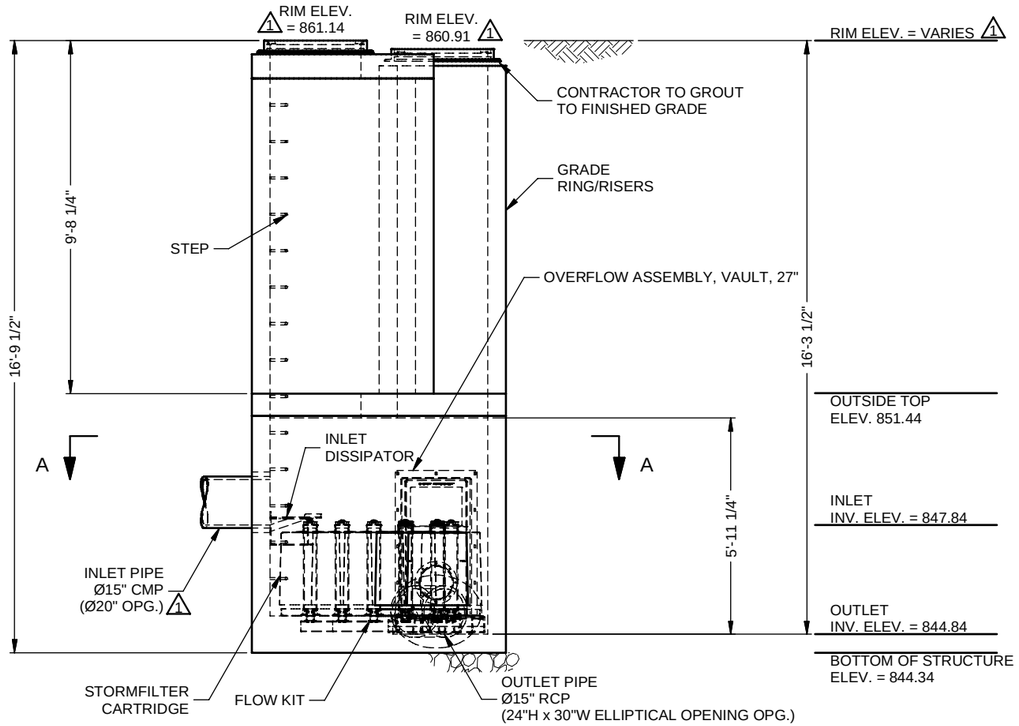
FLOW KIT NOT SHOWN

NOTES:

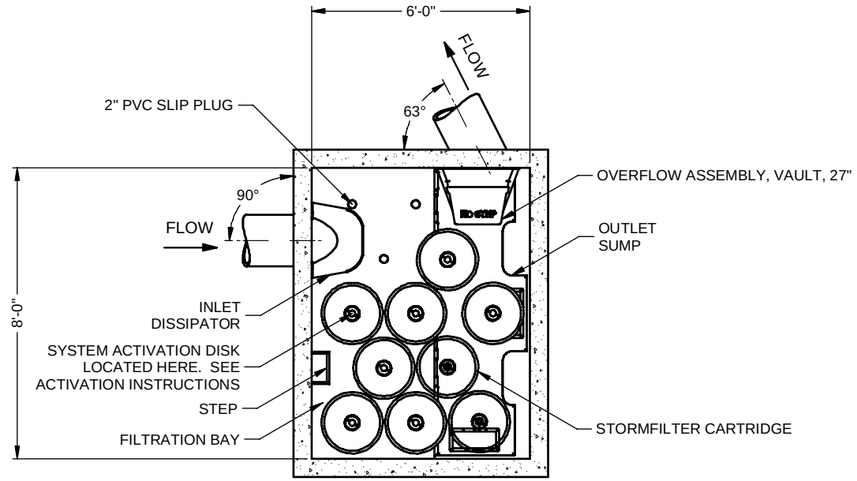
- NOTIFY CRWD (651-644-8888) AT LEAST 24 HOURS BEFORE THE CONSTRUCTION OF STORMWATER BMPS.

- INSTALLATION OF FILTRATION PRACTICES SHALL BE DONE DURING PERIODS OF DRY WEATHER AND COMPLETED BEFORE A RAINFALL EVENT. PLACEMENT OF ENGINEERED SOILS SHALL BE ON DRY NATIVE SOIL ONLY.

- DURING CONSTRUCTION, STORMWATER MUST BE ROUTED AROUND INFILTRATION/FILTRATION AREAS UNTIL ALL CONSTRUCTION ACTIVITY HAS CEASED, AND TRIBUTARY SURFACES ARE CLEANED OF SEDIMENT. IT IS REQUIRED THAT IMPERVIOUS AREA CONSTRUCTION IS COMPLETED, AND PERVIOUS AREAS ESTABLISHED WITH DENSE AND HEALTHY VEGETATION PRIOR TO INTRODUCTION OF STORMWATER INTO FILTRATION PRACTICES.



ELEVATION VIEW ⚠2



SECTION A-A ⚠2

MATERIAL LIST - PROVIDED BY CONTECH

	COUNT	DESCRIPTION	INSTALLED BY
	9	27", PHOSPHOSORB CARTRIDGE	CONTECH
	13	11.25 GPM, RESTRICTOR DISK (PINK POLY)	CONTECH
	4	2" PVC SLIP PLUG	CONTECH
	1	FLOW KIT 10A	CONTECH
	2	INLET DISSIPATOR ASSEMBLY, SHORT	CONTECH
	2	OVERFLOW ASSEMBLY, VAULT, 27"	CONTECH
	1	JOINT SEALANT	CONTRACTOR
	2 PLACES	GRADE RINGS/RISERS	CONTRACTOR
	2	30"Ø x 4" FRAME AND COVER, EJ #41600483	CONTRACTOR
⚠2	14	STEPS, P10CTS, BY LANE LADDER, OR EQUIV.	CONTECH

SITE DESIGN DATA

WATER QUALITY FLOW RATE	TBD
PEAK FLOW RATE	TBD
RETURN PERIOD OF PEAK FLOW	TBD
FILTER MEDIA TYPE	PHOSPHOSORB

PERFORMANCE SPECIFICATION

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 SHALL BE **1 GPM/SF (MAXIMUM)**. SPECIFIC FLOW RATE IS THE MEASURE OF THE FLOW (GPM) DIVIDED BY THE MEDIA SURFACE CONTACT AREA (SF). MEDIA VOLUMETRIC FLOW RATE SHALL BE **6 GPM/CF OF MEDIA (MAXIMUM)**.

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH REPRESENTATIVE. www.ContechES.com
3. STORMFILTER WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
⚠1 4. STRUCTURE SHALL MEET AASHTO HS-20, ASSUMING EARTH COVER OF 0' - 9.5', AND GROUNDWATER ELEVATION 10'-12' BELOW GRADE. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 LOAD RATING AND BE CAST WITH THE CONTECH LOGO.
5. STORMFILTER STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C-857 AND AASHTO LOAD FACTOR DESIGN METHOD.

INSTALLATION NOTES

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

STRUCTURE WEIGHT

APPROXIMATE HEAVIEST PICK = 23500 LBS
OF 2 PIECES
MAX FOOTPRINT = 9' x 7'

CONTECH
CONTRACT
DRAWING

WIES-MR
LAYOUT 6
CLASS 600

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NO.	DATE	REVISION DESCRIPTION	BY
2	12/18/23	UPDATED RISER LOCATIONS	TNT
1	12/01/23	UPDATED RIMS AND INLET PIPE MATERIAL	TNT

SF0608 - 771557-025
LEE & PENNY ANDERSON
MULTIPURPOSE ARENA
SAINT PAUL, MN
for SYSTEM: STORMFILTER
FILTRATION SYSTEM NORTH

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9100 Centre Pointe Drive, Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7846 FAX

The Stormwater Management Giant®
StormFilter®

THE PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,322,629; 5,624,576; 5,707,527; 5,893,617; 6,027,639; 6,406,644; RELATED FOREIGN PATENTS AND OTHER PATENTS PENDING.

DATE:	11/01/23
SCALE:	NONE
DESIGNED:	WPC
DRAWN:	TNT
CHECKED:	JRH
APPROVED:	WPC
PROJECT NUMBER:	771557
SHEET:	1 OF 1

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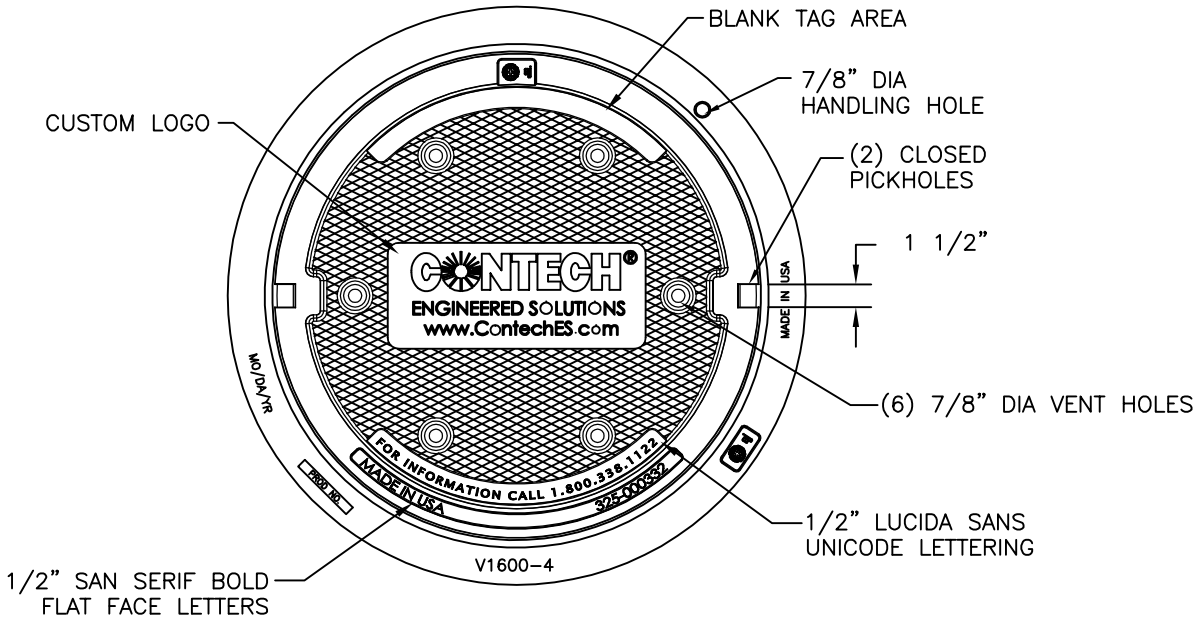
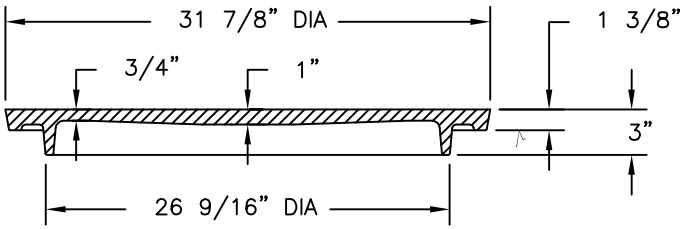
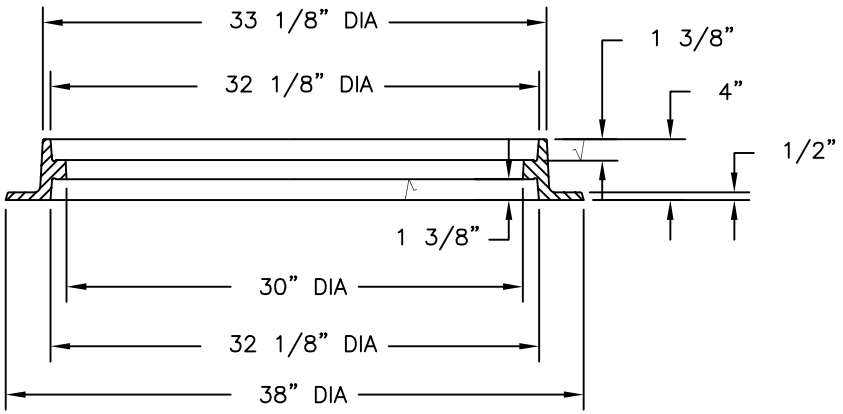
1810B4 V1600-4 Assembly





COVER SECTION



FRAME SECTION

Product Number

41600483

Design Features

-Materials
  Cover
    Gray Iron (CL35B)
  Frame
    Gray Iron (CL35B)

-Design Load
  Heavy Duty
-Open Area
  n/a
-Coating
  Undipped
-√ Designates Machined Surface

Certification

-
- ASTM A48
-
-Country of Origin: USA

Major Components

00180783
41600410

Drawing Revision

05/09/2007 Designer: SMH
6/26/2017 Revised By: DAE

Disclaimer

Weights (lbs./kg) dimensions (inches/mm) and drawings provided for your guidance. We reserve the right to modify specifications without prior notice.

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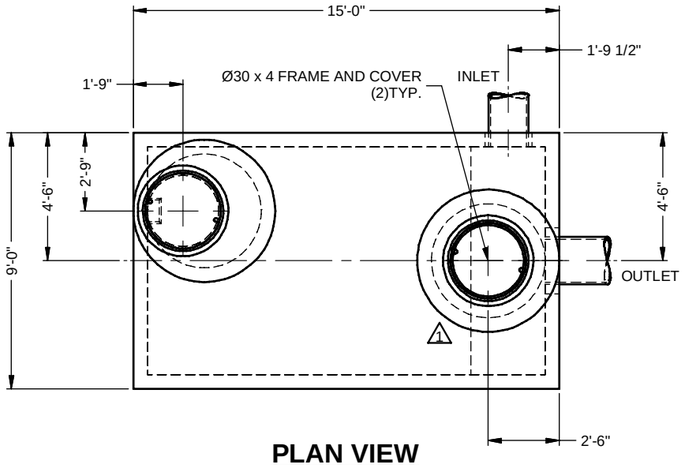
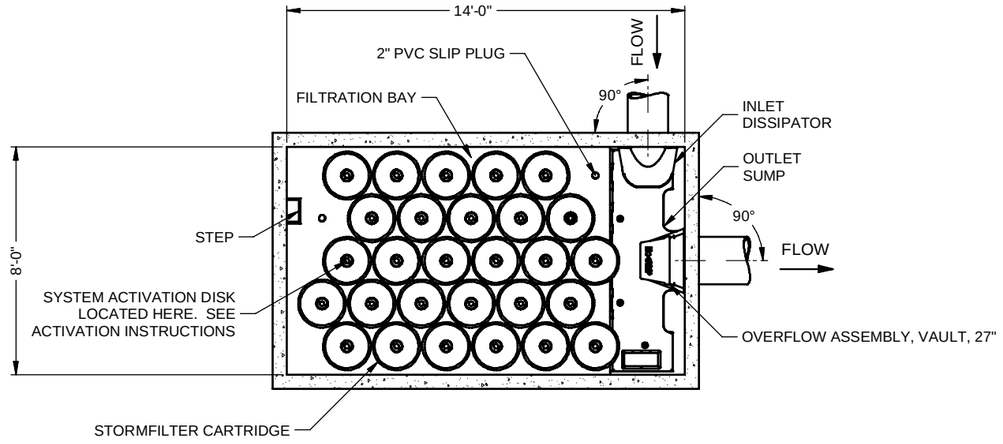
Contact

800 626 4653
ejco.com



PLAN VIEW

FLOW KIT NOT SHOWN



SECTION A-A

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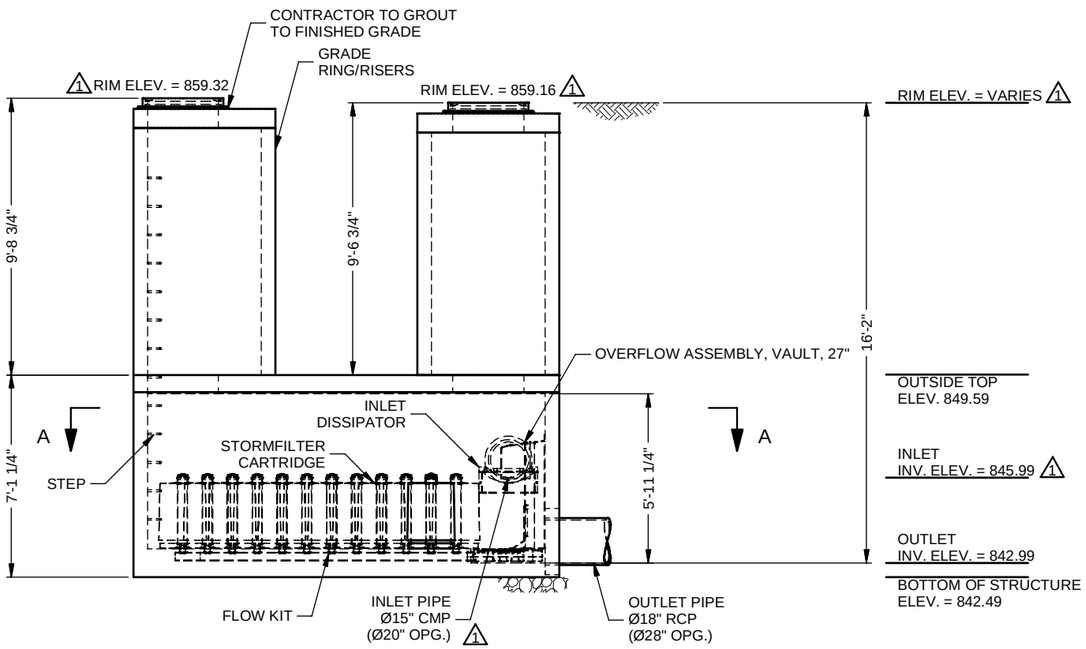

ELEVATION VIEW

MATERIAL LIST - PROVIDED BY CONTECH

COUNT	DESCRIPTION	INSTALLED BY
28	27", PHOSPHOSORB CARTRIDGE	CONTECH
36	11.25 GPM, RESTRICTOR DISK (PINK POLY)	CONTECH
8	2" PVC SLIP PLUG	CONTECH
1	FLOW KIT 18A	CONTECH
1	INLET DISSIPATOR ASSEMBLY, SHORT	CONTECH
1	OVERFLOW ASSEMBLY, VAULT, 27"	CONTECH
1	JOINT SEALANT	CONTRACTOR
2 PLACES	GRADE RINGS/RISERS	CONTRACTOR
2	30"Ø x 4" FRAME AND COVER, EJ #41600483	CONTRACTOR
		CONTRACTOR
13	STEPS, P10CTS, BY LANE LADDER, OR EQUIV.	CONTECH

SITE DESIGN DATA

WATER QUALITY FLOW RATE	TBD
PEAK FLOW RATE	TBD
RETURN PERIOD OF PEAK FLOW	TBD
FILTER MEDIA TYPE	PHOSPHOSORB

PERFORMANCE SPECIFICATION

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2. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH REPRESENTATIVE. www.ContechES.com
3. STORMFILTER WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. STRUCTURE SHALL MEET AASHTO HS-20, ASSUMING EARTH COVER OF 0' - 9.5', AND GROUNDWATER ELEVATION AT ~850.6. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 LOAD RATING AND BE CAST WITH THE CONTECH LOGO.
5. STORMFILTER STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C-857 AND AASHTO LOAD FACTOR DESIGN METHOD.

INSTALLATION NOTES

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

STRUCTURE WEIGHT

APPROXIMATE HEAVIEST PICK = 64000 LBS
OF 2 PIECES
MAX FOOTPRINT = 9' x 15'

CONTECH
CONTRACT
DRAWING

WIES-MR
LAYOUT 6
CLASS 600

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NO.	DATE	REVISION DESCRIPTION	BY
1	11/27/23	UPDATED PER EOR MARKUPS	TNT

SF0814 - 771557-015
LEE & PENNY ANDERSON
MULTIPURPOSE ARENA
SAINT PAUL, MN
for SYSTEM: STORMFILTER
FILTRATION SYSTEM SOUTH

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9100 Centre Pointe Drive, Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7846 FAX

The Stormwater Management StormFilter®

THE PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,322,629; 5,624,576; 5,707,527; 5,893,617; 6,027,639; 6,649,048; RELATED FOREIGN PATENTS AND OTHER PATENTS PENDING.

DATE:	11/01/23
SCALE:	NONE
DESIGNED:	WPC
DRAWN:	TNT
CHECKED:	JRH
APPROVED:	WPC
PROJECT NUMBER:	771557
SHEET:	1 OF 1

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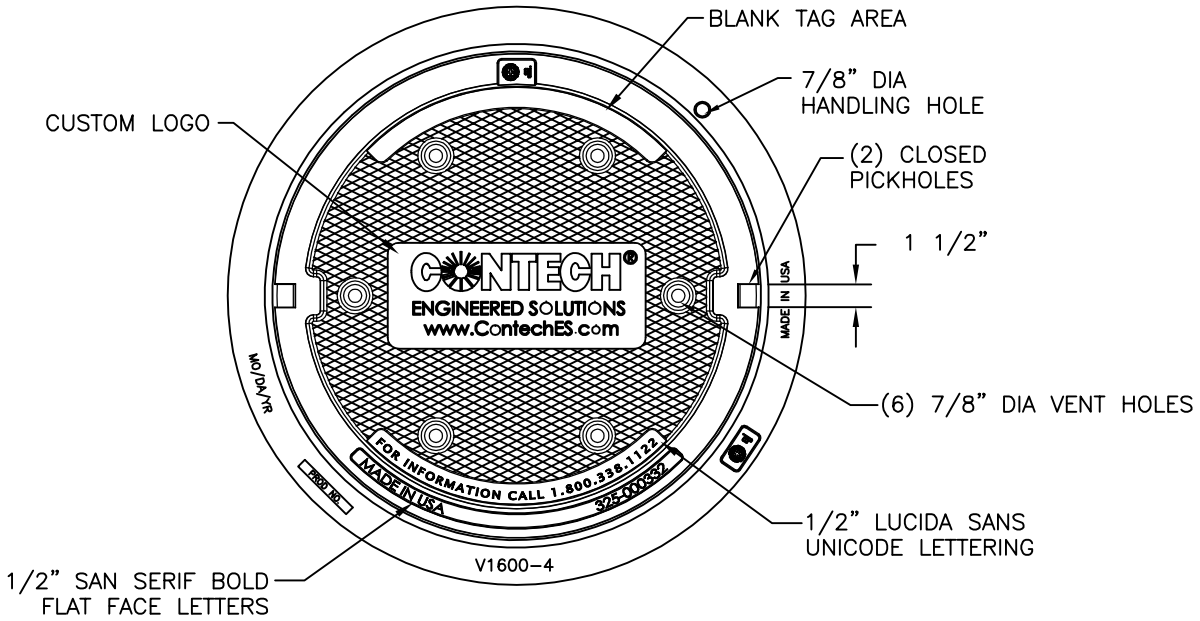
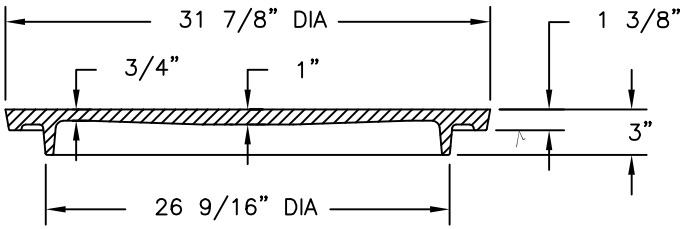
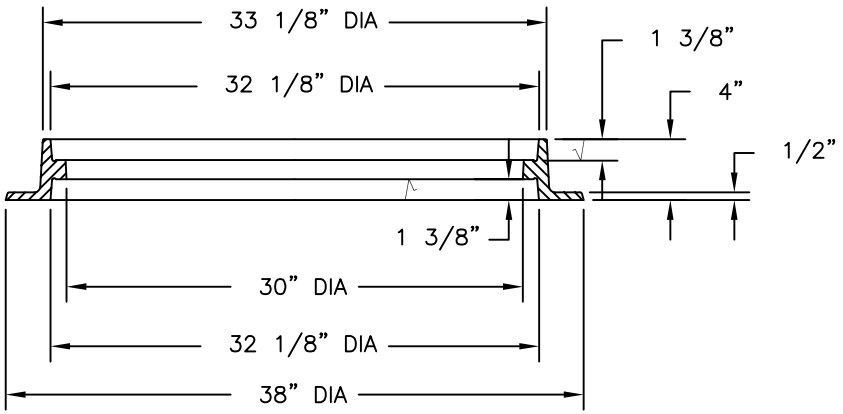
1810B4 V1600-4 Assembly





COVER SECTION



FRAME SECTION

Product Number

41600483

Design Features

-Materials
  Cover
    Gray Iron (CL35B)
  Frame
    Gray Iron (CL35B)

-Design Load
  Heavy Duty
-Open Area
  n/a
-Coating
  Undipped
-√ Designates Machined Surface

Certification

-
- ASTM A48
-
-Country of Origin: USA

Major Components

00180783
41600410

Drawing Revision

05/09/2007 Designer: SMH
6/26/2017 Revised By: DAE

Disclaimer

Weights (lbs./kg) dimensions (inches/mm) and drawings provided for your guidance. We reserve the right to modify specifications without prior notice.

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Contact

800 626 4653
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FIGURE 6

NORTH ARROW PROVIDED FOR
REFERENCE ONLY.
REFER TO ENGINEERED SITE PLANS FOR
EXACT LOCATION AND ORIENTATION

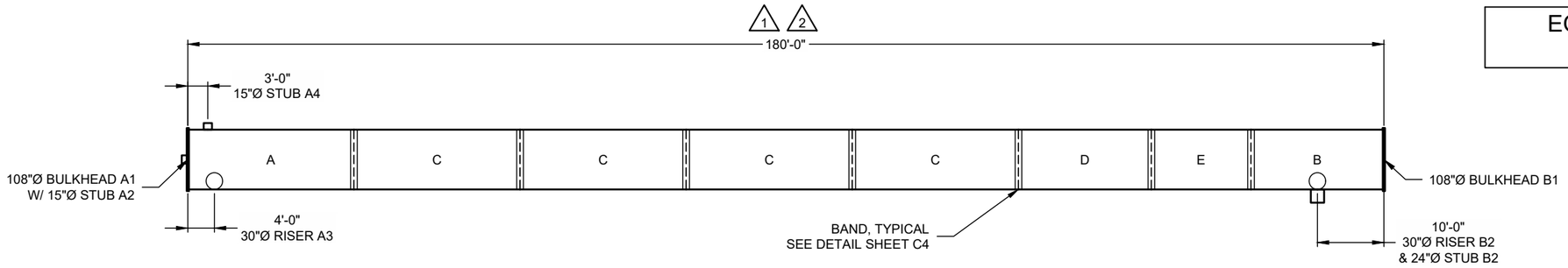
△2 **STUB INFORMATION**

PIECE	STUB INVERT	SYSTEM INVERT
15"Ø STUB A2	851.87	847.87
15"Ø STUB A4	847.87	847.87
24"Ø STUB B2	847.87	847.87

△2 **RISER INFORMATION**

PIECE	RIM ELEV.	SYSTEM INVERT
30"Ø RISER A3	860.28	847.87
30"Ø RISER B2	861.19	847.87

EOR TO CONFIRM ELEVATIONS



THE UNDERSIGNED HEREBY APPROVES THE ATTACHED (6) PAGES INCLUDING THE FOLLOWING:

- **PIPE STORAGE = 11,451 CF**
- **MAINLINE PIPE GAGE = 12**
- **WALL TYPE = SOLID**
- **DIAMETER = 108"** △2
- **FINISH = ALT2**
- **CORRUGATION = 5x1**

CUSTOMER _____ DATE _____

ASSEMBLY
SCALE: 1" = 20'
LOADING: H20
PIPE INV. = VARIES'±

NOTES

- ALL RISER AND STUB DIMENSIONS ARE TO CENTERLINE.
- ALL ELEVATIONS, DIMENSIONS, AND LOCATIONS OF RISERS AND INLETS, SHALL BE VERIFIED BY THE ENGINEER OF RECORD (EOR) PRIOR TO RELEASING FOR FABRICATION.
- ALL FITTINGS AND REINFORCEMENT COMPLY WITH ASTM A998.
- ALL RISERS AND STUBS ARE 2⅔" x ½" CORRUGATION AND 16 GAGE UNLESS OTHERWISE NOTED.
- RISERS TO BE FIELD TRIMMED TO GRADE AS REQUIRED, BY CONTRACTOR.
- QUANTITY OF PIPE SHOWN DOES NOT PROVIDE EXTRA PIPE FOR CONNECTING THE SYSTEM TO EXISTING PIPE OR DRAINAGE STRUCTURES. OUR SYSTEM AS DETAILED PROVIDES NOMINAL INLET AND/OR OUTLET PIPE STUB FOR CONNECTION TO EXISTING DRAINAGE FACILITIES. IF ADDITIONAL PIPE IS NEEDED IT IS THE RESPONSIBILITY OF THE CONTRACTOR.
- ALL ACCESS CASTINGS ARE THE RESPONSIBILITY OF THE CONTRACTOR AND ARE NOT SUPPLIED BY CONTECH.

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1	10/27/23	PER EOR MARKUPS	WPC

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800-338-1122 513-645-7000 513-645-7993 FAX

CONTECH CMP DETENTION SYSTEMS
CONTECH **CONTRACT** DRAWING

108"Ø UNDERGROUND DETENTION SYSTEM - 771557-020
PROJECT NAME
PROJECT LOCATION
SITE DESIGNATION: 84" CMP DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
771557	020	10/11/2023
DESIGNED: WPC	DRAWN: WPC	
CHECKED: BAK	APPROVED: WPC	
SHEET NO.: C1	OF 6	

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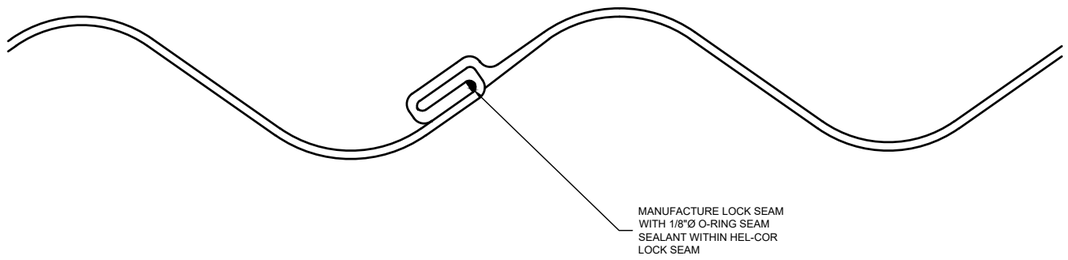
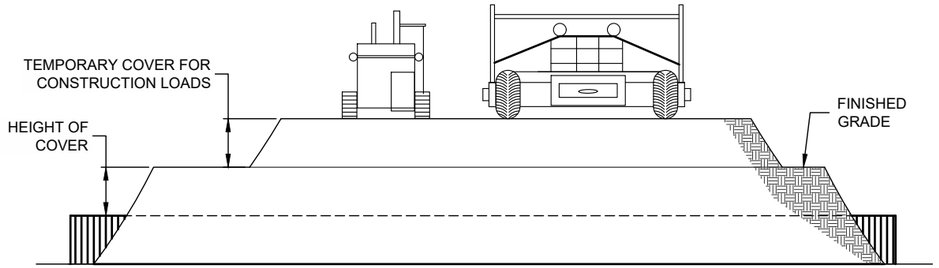


LOCK SEAM DETAIL
NOT TO SCALE



CONSTRUCTION LOADS

FOR TEMPORARY CONSTRUCTION VEHICLE LOADS, AN EXTRA AMOUNT OF COMPACTED COVER MAY BE REQUIRED OVER THE TOP OF THE PIPE. THE HEIGHT-OF-COVER SHALL MEET THE MINIMUM REQUIREMENTS SHOWN IN THE TABLE BELOW. THE USE OF HEAVY CONSTRUCTION EQUIPMENT NECESSITATES GREATER PROTECTION FOR THE PIPE THAN FINISHED GRADE COVER MINIMUMS FOR NORMAL HIGHWAY TRAFFIC.

PIPE SPAN, INCHES	AXLE LOADS (kips)			
	18-50	50-75	75-110	110-150
	MINIMUM COVER (FT)			
12-42	2.0	2.5	3.0	3.0
48-72	3.0	3.0	3.5	4.0
78-120	3.0	3.5	4.0	4.0
126-144	3.5	4.0	4.5	4.5

*MINIMUM COVER MAY VARY, DEPENDING ON LOCAL CONDITIONS. THE CONTRACTOR MUST PROVIDE THE ADDITIONAL COVER REQUIRED TO AVOID DAMAGE TO THE PIPE. MINIMUM COVER IS MEASURED FROM THE TOP OF THE PIPE TO THE TOP OF THE MAINTAINED CONSTRUCTION ROADWAY SURFACE.

CONSTRUCTION LOADING DIAGRAM
NOT TO SCALE

SPECIFICATION FOR CORRUGATED STEEL PIPE-ALUMINIZED TYPE 2 STEEL

SCOPE

THIS SPECIFICATION COVERS THE MANUFACTURE AND INSTALLATION OF THE CORRUGATED STEEL PIPE (CSP) DETAILED IN THE PROJECT PLANS.

MATERIAL

THE ALUMINIZED TYPE 2 STEEL COILS SHALL CONFORM TO THE APPLICABLE REQUIREMENTS OF AASHTO M274 OR ASTM A929.

PIPE

THE CSP SHALL BE MANUFACTURED IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF AASHTO M36 OR ASTM A760. THE PIPE SIZES, GAGES AND CORRUGATIONS SHALL BE AS SHOWN ON THE PROJECT PLANS.

ALL FABRICATION OF THE PRODUCT SHALL OCCUR WITHIN THE UNITED STATES.

HANDLING AND ASSEMBLY

SHALL BE IN ACCORDANCE WITH RECOMMENDATIONS OF THE NATIONAL CORRUGATED STEEL PIPE ASSOCIATION (NCSPA)

INSTALLATION

SHALL BE IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, SECTION 26, DIVISION II OR ASTM A798 AND IN CONFORMANCE WITH THE PROJECT PLANS AND SPECIFICATIONS. IF THERE ARE ANY INCONSISTENCIES OR CONFLICTS THE CONTRACTOR SHOULD DISCUSS AND RESOLVE WITH THE SITE ENGINEER.

IT IS ALWAYS THE RESPONSIBILITY OF THE CONTRACTOR TO FOLLOW OSHA GUIDELINES FOR SAFE PRACTICES.

ANTI-FLOTATION PROVISIONS DUE TO HIGH GROUNDWATER OR OTHER FLOTATION CONCERNS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.

MATERIAL SPECIFICATION
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CONTECH CMP DETENTION SYSTEMS
CONTECH CONTRACT DRAWING

108"Ø UNDERGROUND DETENTION SYSTEM - 771557-020
PROJECT NAME
PROJECT LOCATION
SITE DESIGNATION: 84" CMP DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
771557	020	10/11/2023
DESIGNED: WPC	DRAWN: WPC	
CHECKED: BAK	APPROVED: WPC	
SHEET NO.: C2 OF 6		

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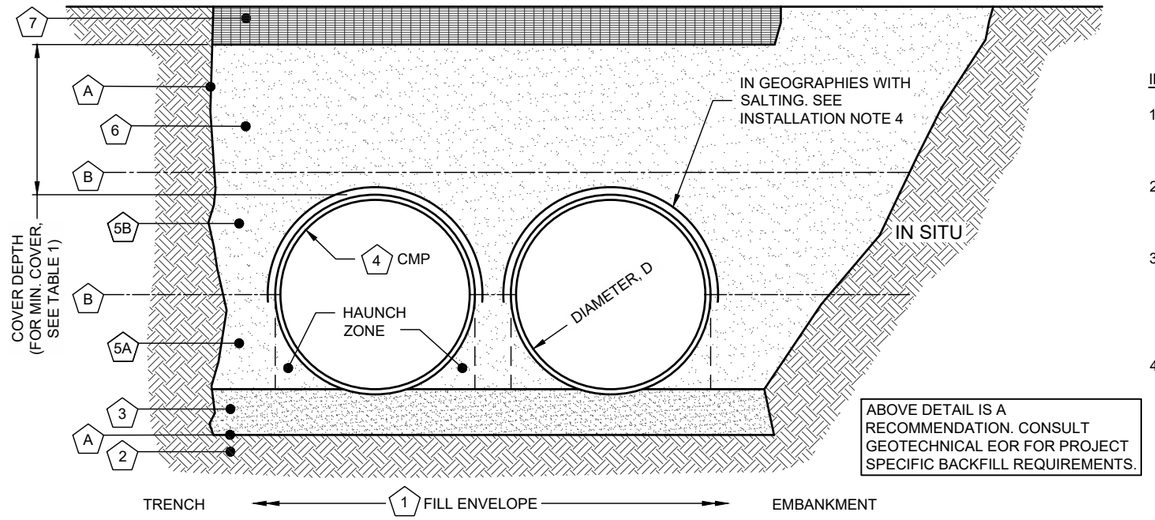
TABLE 1:

DIAMETER, D	MIN. COVER	CORR. PROFILE
6"-10"	12"	1 1/2" x 1/4"
12"-48"	12"	2 2/3" x 1/2"
>48"-96"	12"	3" x 1", 5" x 1"
>96"	D/8	3" x 1", 5" x 1"

- STRUCTURAL BACKFILL MUST EXTEND TO LIMITS OF THE TABLE
- TOTAL HEIGHT OF COMPACTED COVER FOR CONVENTIONAL HIGHWAY LOADS IS MEASURED FROM TOP OF PIPE TO BOTTOM OF FLEXIBLE PAVEMENT OR TOP OF RIGID PAVEMENT
- ULTRAFLO ALSO AVAILABLE FOR SIZES 18" - 120" WITH 3/4"x 3/4"x 7 1/2" CORRUGATION



MINIMUM WIDTH DEPENDS ON SITE CONDITIONS AND ENGINEERING JUDGEMENT

INSTALLATION NOTES

1. WHEN PLACING THE FIRST LIFTS OF BACKFILL IT IS IMPORTANT TO MAKE SURE THAT THE BACKFILL IS PROPERLY COMPACTED UNDER AND AROUND THE PIPE HAUNCHES.
2. OTHER ALTERNATE BACKFILL MATERIAL MAY BE ALLOWED DEPENDING ON SITE SPECIFIC CONDITIONS, AS APPROVED BY SITE ENGINEER.
3. BACKFILL USING CONTROLLED LOW-STRENGTH MATERIAL (CLSM, "FLASH FILL" OR "FLOWABLE FILL") MAY BE USED WHEN THE SPACING BETWEEN THE PIPES WILL NOT ALLOW FOR PLACEMENT AND ADEQUATE COMPACTION OF THE BACKFILL. CONTACT CONTECH FOR FURTHER EVALUATION.
4. IF SALTING AGENTS FOR SNOW AND ICE REMOVAL ARE USED ON OR NEAR THE PROJECT, A GEOMEMBRANE BARRIER IS RECOMMENDED OVER THE UPPER HALF OF THE PIPE. THE GEOMEMBRANE LINER IS INTENDED TO HELP PROTECT THE SYSTEM FROM THE POTENTIAL ADVERSE EFFECTS THAT MAY RESULT FROM A CHANGE IN THE SURROUNDING ENVIRONMENT OVER A PERIOD OF TIME. PLEASE REFER TO THE CORRUGATED METAL PIPE DETENTION DESIGN GUIDE FOR ADDITIONAL INFORMATION.

TABLE 2:

CMP DETENTION AND CMP DRAINAGE STANDARD BACKFILL SPECIFICATIONS

	MATERIAL LOCATION	MATERIAL SPECIFICATION	DESCRIPTION	
1	FILL ENVELOPE WIDTH	PER ENGINEER OF RECORD	MINIMUM TRENCH WIDTH MUST ALLOW ROOM FOR PROPER COMPACTION OF HAUNCH MATERIALS UNDER THE PIPE. THE SUGGESTED MINIMUM TRENCH WIDTH, OR EOR RECOMMENDATION: PIPE ≤ 12": D + 16" PIPE > 12": 1.5D + 12"	MINIMUM EMBANKMENT WIDTH (IN FEET) FOR INITIAL FILL ENVELOPE: PIPE < 24": 3.0D PIPE 24" - 144": D + 4'0" PIPE > 144": D + 10'0"
2	FOUNDATION	**AASHTO 26.5.2** OR PER ENGINEER OF RECORD	PRIOR TO PLACING THE BEDDING, THE FOUNDATION MUST BE CONSTRUCTED TO A UNIFORM AND STABLE GRADE. IN THE EVENT THAT UNSUITABLE FOUNDATION MATERIALS ARE ENCOUNTERED DURING EXCAVATION, THEY SHALL BE REMOVED AND FOUNDATION BROUGHT BACK TO GRADE WITH A FILL MATERIAL APPROVED BY THE ENGINEER OF RECORD.	
3	BEDDING	**AASHTO M 43: 3, 357, 4, 467, 5, 56, 57** (APPROVED REGIONAL EQUIVALENTS INCLUDE CA-7)	ENGINEER OF RECORD TO DETERMINE IF BEDDING IS REQUIRED. PIPE MAY BE PLACED ON THE TRENCH BOTTOM OF A RELATIVELY LOOSE, NATIVE SUITABLE WELL GRADED GRANULAR MATERIAL THAT IS ROUGHLY SHAPED TO FIT THE BOTTOM OF THE PIPE, 2" MIN DEPTH. THE BEDDING MATERIAL MAY BE SUITABLE FOUNDATION SOILS CONFORMING TO AASHTO SOIL CLASSIFICATIONS A1, A2, OR A3 WITH MAXIMUM PARTICLE SIZE OF 3" PER AASHTO 26.3.8.1	
4	CORRUGATED METAL PIPE			
5A	CRITICAL BACKFILL	**AASHTO M 145: A-1, A-2, A-3** *	HAUNCH ZONE MATERIAL SHALL BE HAND SHOVELED OR SHOVEL SLICED INTO PLACE TO ALLOW FOR PROPER COMPACTION WITHOUT SOFT SPOTS. BACKFILL SHALL BE PLACED IN 8" +/- LOOSE LIFTS AND COMPACTED TO 90% STANDARD PROCTOR PER AASHTO T 99. BACKFILL SHALL BE PLACED SUCH THAT THERE IS NO MORE THAN A THREE LIFT (24") DIFFERENTIAL BETWEEN ANY OF THE PIPES AT ANY TIME DURING THE BACKFILL PROCESS. THE BACKFILL SHOULD BE ADVANCED ALONG THE LENGTH OF THE SYSTEM TO AVOID DIFFERENTIAL LOADING. WELL GRADED GRANULAR MATERIAL WHICH MAY CONTAIN SMALL AMOUNTS OF SILT OR CLAY AND MAXIMUM PARTICLE SIZE OF 3" (PER AASHTO 26.3.8.1 AND 12.4-1.3).	
5B	BACKFILL	**AASHTO M 145: A-1, A-2, A-3**		
6	COVER MATERIAL	UP TO MIN. COVER - SEE 5A AND 5B ABOVE ABOVE MIN. COVER - PER ENGINEER OF RECORD	COVER MATERIAL MAY INCLUDE NON-BITUMINOUS, GRANULAR ROAD BASE MATERIAL WITHIN MIN COVER LIMITS	
7	RIGID OR FLEXIBLE PAVEMENT (IF APPLICABLE)	PER ENGINEER OF RECORD	FLEXIBLE PAVEMENT SHOULD NOT BE COUNTED AS PART OF THE FILL HEIGHT OVER THE CMP. FINAL BACKFILL MATERIAL SELECTION AND COMPACTION REQUIREMENTS SHALL FOLLOW THE PROJECT PLANS AND SPECIFICATIONS PER THE ENGINEER OF RECORD.	
A	OPTIONAL SIDE GEOTEXTILE	NONE	GEOTEXTILE LAYER IS RECOMMENDED ON SIDES OF EXCAVATION TO PREVENT SOIL MIGRATION.	
B	OPTIONAL GEOTEXTILE BETWEEN LAYERS	NONE	IF SOIL TYPES DIFFER AT ANY POINT ABOVE PIPE INVERT, A GEOTEXTILE LAYER IS RECOMMENDED TO BE PLACED BETWEEN THE LAYERS TO PREVENT SOIL MIGRATION.	

NOTES:
- FOR MULTIPLE BARREL INSTALLATIONS, THE RECOMMENDED STANDARD SPACING BETWEEN PARALLEL PIPE RUNS SHALL BE THE PIPE DIAMETER /2 BUT NO LESS THAN 12" FOR DIAMETERS <72". FOR 72" AND LARGER DIAMETERS, THE MINIMUM SPACING IS 36". CONTACT YOUR CONTECH REPRESENTATIVE FOR NONSTANDARD SPACING.

* APPROVED REGIONAL EQUIVALENTS FOR SECTION 5A INCLUDE CA-7, MIDOT 2G, 34G, OR 21AA STONE OR GRAVEL; #8; #57; MIDOT 6A, 2G, 3G, 34G.

MANUFACTURER RECOMMENDED BACKFILL

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CONTECH CMP DETENTION SYSTEMS
CONTECH CONTRACT DRAWING

108"Ø UNDERGROUND DETENTION SYSTEM - 771557-020
PROJECT NAME
PROJECT LOCATION
SITE DESIGNATION: 84" CMP DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
771557	020	10/11/2023
DESIGNED: WPC	DRAWN: WPC	
CHECKED: BAK	APPROVED: WPC	
SHEET NO.: C3 OF 6		

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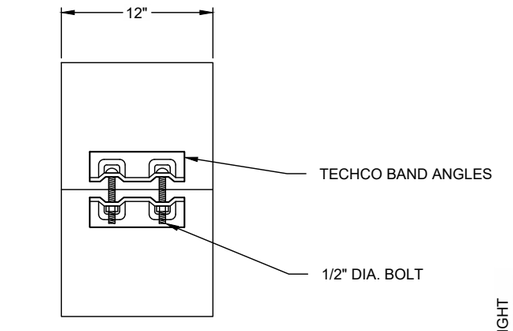
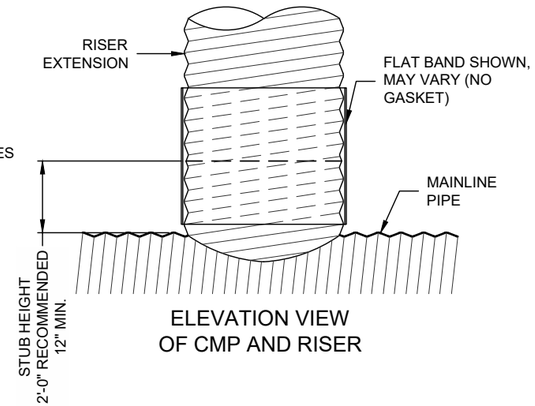


CONNECTION DETAIL
7 1/2" TECHCO SHOWN - MAY VARY



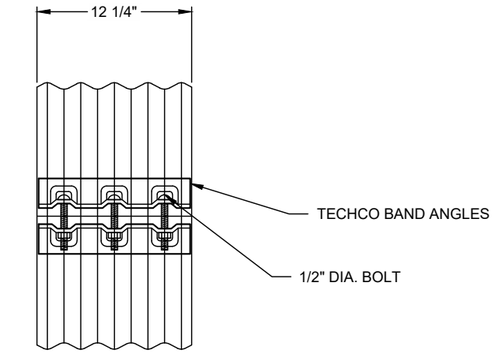
ELEVATION VIEW
OF CMP AND RISER

PLAIN END CMP RISER PIPE

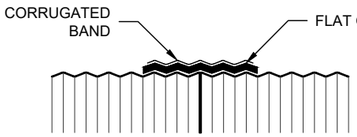
GENERAL NOTES:

1. **DELIVERED BAND STYLE AND FASTENER TYPE MAY VARY BY FABRICATION PLANT.**
2. JOINT IS TO BE ASSEMBLED PER AASHTO BRIDGE CONSTRUCTION SPECIFICATION SEC 26.4.2.4.
3. BAND MATERIAL AND GAGE TO BE SAME AS RISER MATERIAL.
4. IF RISER HAS A HEIGHT OF COVER OF 10' OR MORE, USE A SLIP JOINT.
5. BANDS ARE NORMALLY FURNISHED AS FOLLOWS:
   - 12" THRU 48" 1-PIECE
   - 54" 2-PIECES
6. ALL RISER JOINT COMPONENTS WILL BE FIELD ASSEMBLED.
7. MANHOLE RISERS IN APPLICATIONS WHERE TRAFFIC LOADS ARE IMPOSED REQUIRE SPECIAL DESIGN CONSIDERATIONS.
8. DIMENSIONS SUBJECT TO MANUFACTURING TOLERANCES.

12" RISER BAND DETAIL
NOT TO SCALE



CONNECTION DETAIL
12" TECHCO



FLAT GASKET

2 2/3"x1/2" RIVETED PIPE

GENERAL NOTES:

1. JOINT IS TO BE ASSEMBLED PER AASHTO BRIDGE CONSTRUCTION SPECIFICATION SEC 26.4.2.4.
2. BAND MATERIALS AND/OR COATING CAN VARY BY LOCATION. CONTACT YOUR CONTECH REPRESENTATIVE FOR AVAILABILITY.
3. BANDS ARE SHAPED TO MATCH THE PIPE-ARCH WHEN APPLICABLE.
4. BANDS ARE NORMALLY FURNISHED AS FOLLOWS:
   - 12" THRU 48" 1-PIECE
   - 54" THRU 96" 2-PIECES
   - 102" THRU 144" 3-PIECES
5. BAND FASTENERS ARE ATTACHED WITH SPOT WELDS, RIVETS OR HAND WELDS.
6. ALL CMP IS REROLLED TO HAVE ANNULAR END CORRUGATIONS OF 2 2/3"x1/2"
7. DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES.
8. ORDER SHALL DESIGNATE GASKET OPTION, IF REQUIRED (SEE DETAILS ABOVE).

5-C BAND DETAIL
NOT TO SCALE

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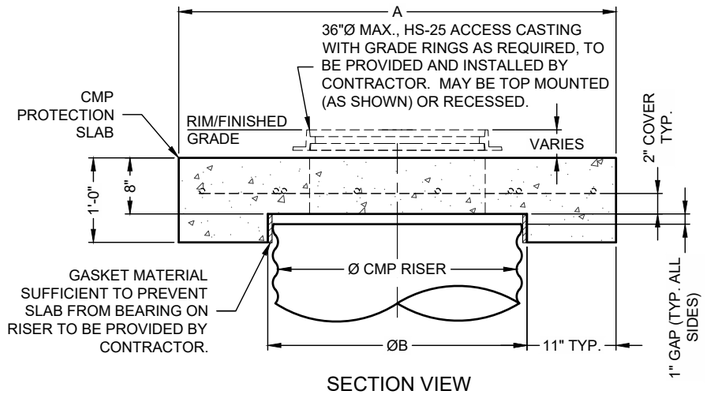
CONTECH CMP DETENTION SYSTEMS
CONTECH CONTRACT DRAWING

108"Ø UNDERGROUND DETENTION SYSTEM - 771557-020
PROJECT NAME
PROJECT LOCATION
SITE DESIGNATION: 84" CMP DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
771557	020	10/11/2023
DESIGNED: WPC	DRAWN: WPC	
CHECKED: BAK	APPROVED: WPC	
SHEET NO.: C4 OF 6		

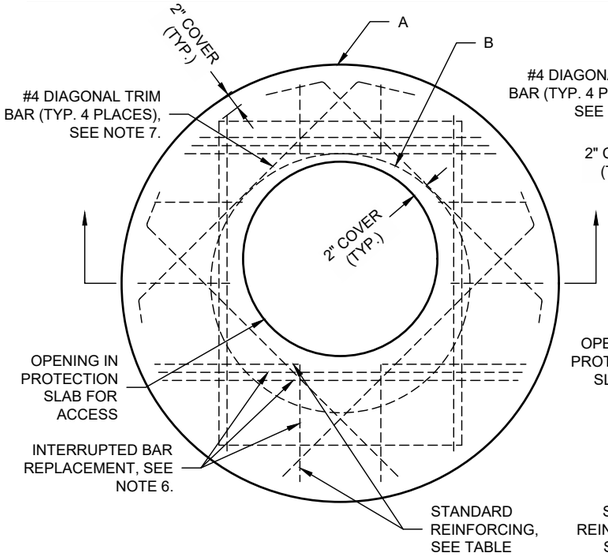


SECTION VIEW

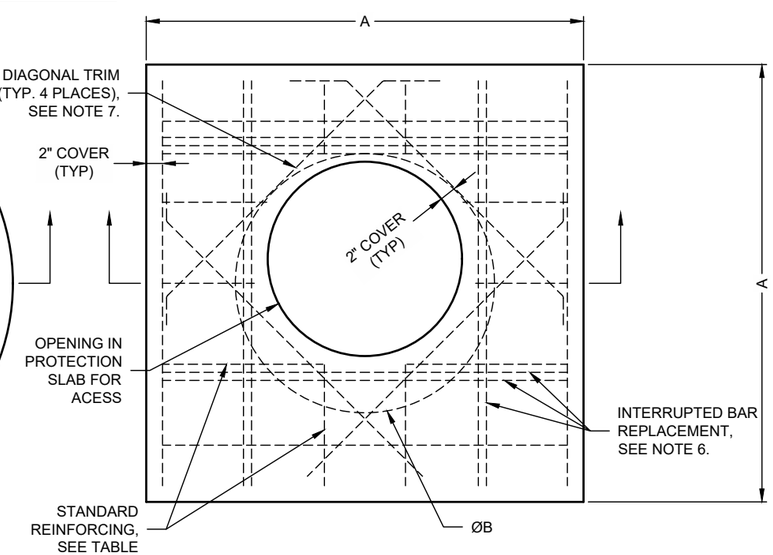
REINFORCING TABLE				
Ø CMP RISER	A	B Ø	REINFORCING	**BEARING PRESSURE (PSF)
24"	4'Ø 4'x4'	26"	#5 @ 10" OCEW #5 @ 10" OCEW	2,540 1,900
30"	4'-6"Ø 4'-6" x 4'-6"	32"	#5 @ 10" OCEW #5 @ 9" OCEW	2,260 1,670
36"	5'Ø 5' x 5'	38"	#5 @ 9" OCEW #5 @ 8" OCEW	2,060 1,500
42"	5'-6"Ø 5'-6" x 5'-6"	44"	#5 @ 8" OCEW #5 @ 8" OCEW	1,490 1,370
48"	6'Ø 6' x 6'	50"	#5 @ 7" OCEW #5 @ 7" OCEW	1,210 1,270

** ASSUMED SOIL BEARING CAPACITY

ACCESS CASTING NOT SUPPLIED BY CONTECH



ROUND OPTION PLAN VIEW



SQUARE OPTION PLAN VIEW

NOTES:

1. DESIGN IN ACCORDANCE WITH AASHTO, 17th EDITION AND ACI 350.
2. DESIGN LOAD HS25.
3. EARTH COVER = 1' MAX.
4. CONCRETE STRENGTH = 4,000 psi
5. REINFORCING STEEL = ASTM A615, GRADE 60.
6. PROVIDE ADDITIONAL REINFORCING AROUND OPENINGS EQUAL TO THE BARS INTERRUPTED, HALF EACH SIDE. ADDITIONAL BARS TO BE IN THE SAME PLANE.
7. TRIM OPENING WITH DIAGONAL #4 BARS, EXTEND BARS A MINIMUM OF 12" BEYOND OPENING, BEND BARS AS REQUIRED TO MAINTAIN BAR COVER.
8. PROTECTION SLAB AND ALL MATERIALS TO BE PROVIDED AND INSTALLED BY CONTRACTOR.
9. DETAIL DESIGN BY DELTA ENGINEERS, ARCHITECTS AND LAND SURVEYORS, ENDWELL, NY.

MANHOLE CAP DETAIL

NOT TO SCALE

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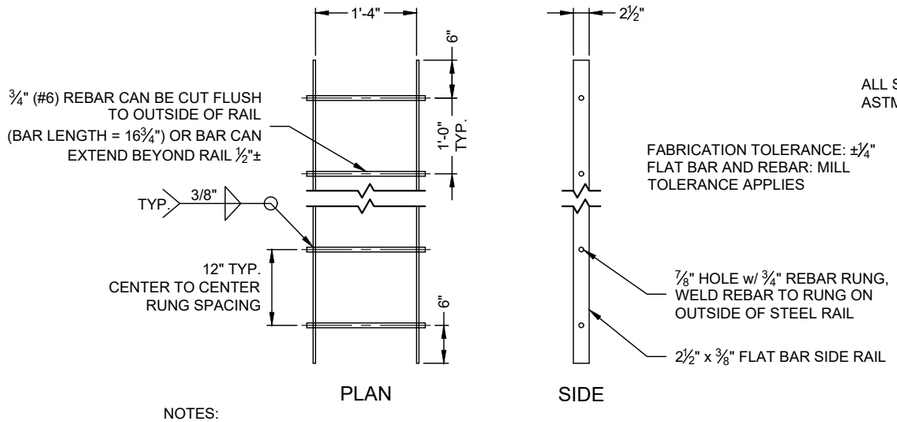
CONTECH CMP DETENTION SYSTEMS

CONTECH **CONTRACT** DRAWING

108"Ø UNDERGROUND DETENTION SYSTEM - 771557-020
PROJECT NAME
PROJECT LOCATION
SITE DESIGNATION: 84" CMP DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
771557	020	10/11/2023
DESIGNED: WPC		DRAWN: WPC
CHECKED: BAK		APPROVED: WPC
SHEET NO.: C5	OF 6	



PLAN SIDE

ALL STEEL PER ASTM A36

FABRICATION TOLERANCE: ±¼" FLAT BAR AND REBAR: MILL TOLERANCE APPLIES

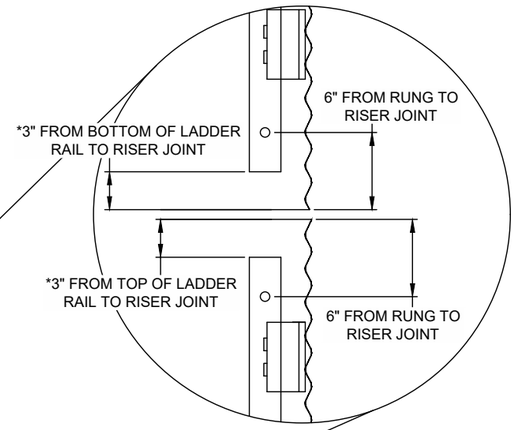
NOTES:
1. LADDERS CAN BE MADE IN 20'-0" STANDARD LENGTHS AND CUT TO FIT
2. ALL MATERIAL TO MEET ASTM A36
3. LADDER TO BE HOT DIPPED GALVANIZED PER ASTM A-123 AFTER FABRICATION IS COMPLETE

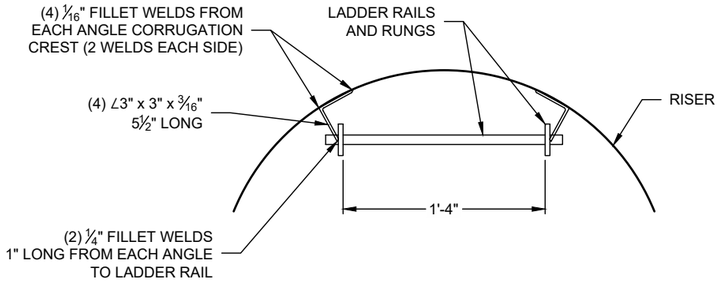
STANDARD LADDER DETAIL

NOT TO SCALE

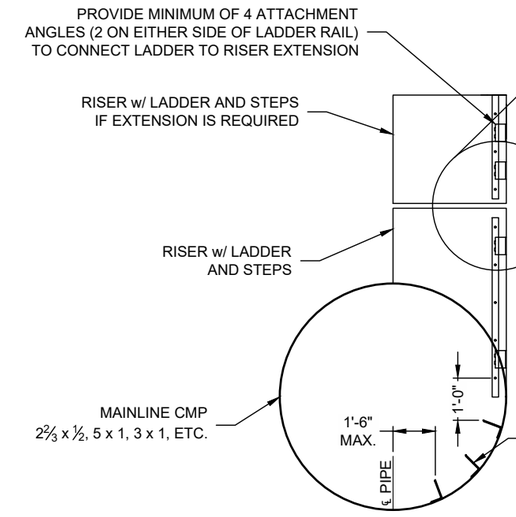
PART NO. HALAGVL16

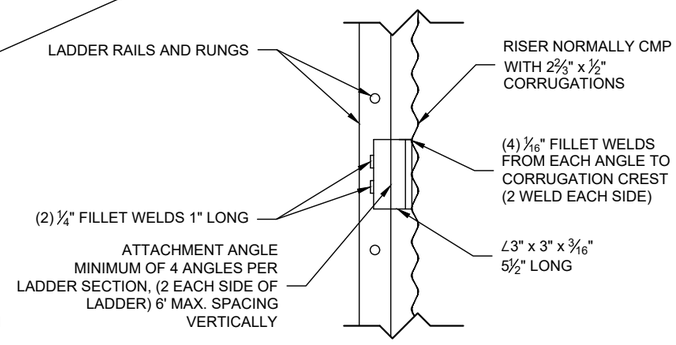
*NOTE: WHEN RISER EXTENSIONS ARE USED, THE PLANT SHOULD CUT 3" FROM THE SIDE RAILS AS SHOWN



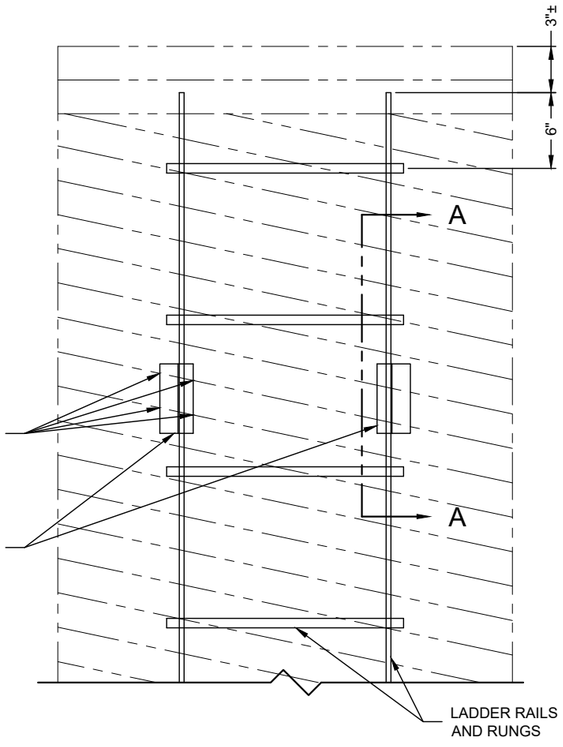


PLAN





SECTION A-A



ELEVATION

NOTE:
THIS DRAWING IS INTENDED TO APPLY TO LADDERS INSTALLED IN RISERS HAVING A DIAMETER OF 30" OR LARGER. DUE TO SPACE CONSTRAINTS AND LIMITED ACCESSIBILITY, THE PRACTICALITY AND SUITABILITY OF UTILIZING RISERS SMALLER THAN 30" DIAMETER AND/OR INCORPORATING LADDERS IN THESE SMALLER DIAMETER RISERS SHOULD BE ADDRESSED BY THE OWNER AND PROJECT ENGINEER

RISER LADDER DETAIL

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CONTECH CMP DETENTION SYSTEMS
CONTECH CONTRACT DRAWING

108"Ø UNDERGROUND DETENTION SYSTEM - 771557-020
PROJECT NAME
PROJECT LOCATION
SITE DESIGNATION: 84" CMP DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
771557	020	10/11/2023
DESIGNED: WPC	DRAWN: WPC	
CHECKED: BAK	APPROVED: WPC	
SHEET NO.: C6	OF 6	

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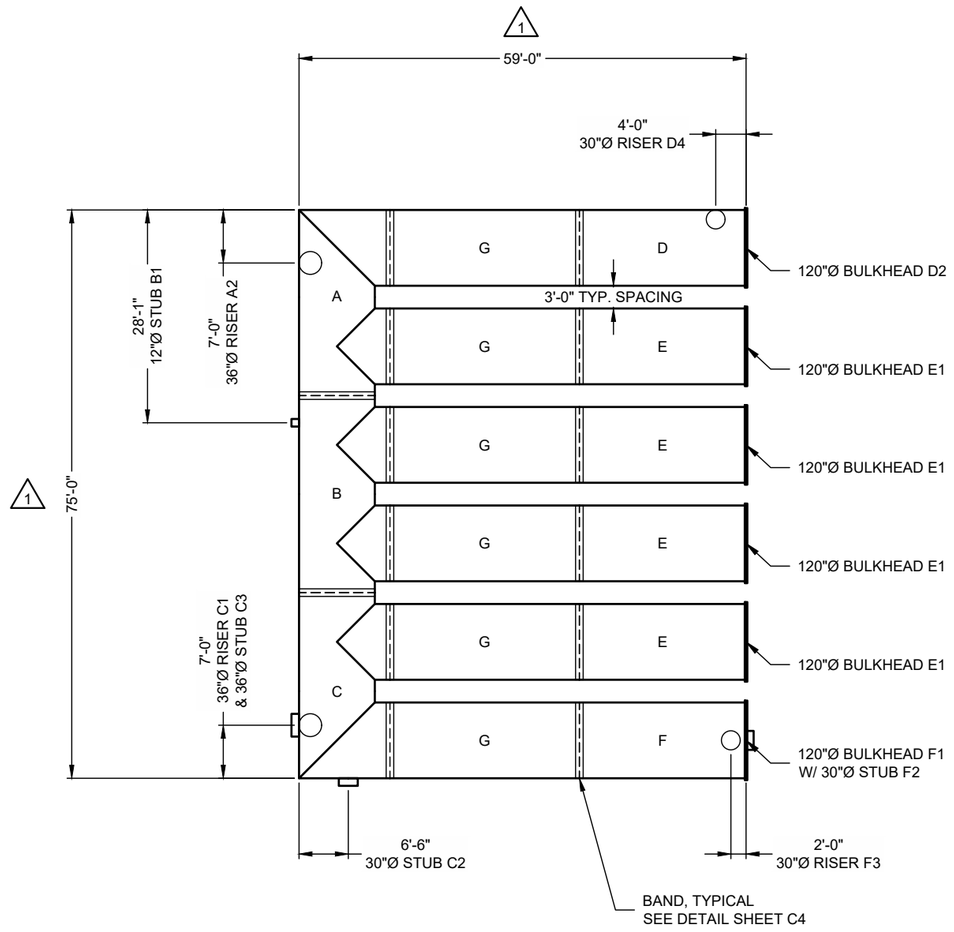
NORTH ARROW PROVIDED FOR
REFERENCE ONLY.
REFER TO ENGINEERED SITE PLANS FOR
EXACT LOCATION AND ORIENTATION



ASSEMBLY

SCALE: 1" = 20'
LOADING: H20
PIPE INV. = 846.00'±

1

STUB INFORMATION		
PIECE	STUB INVERT	SYSTEM INVERT
12"Ø STUB B1	857.79	846.00
30"Ø STUB C2	853.00	846.00
36"Ø STUB C3	846.00	846.00
30"Ø STUB F2	846.00	846.00

1

RISER INFORMATION		
PIECE	RIM ELEV.	SYSTEM INVERT
36"Ø RISER A2	860.59	846.00
36"Ø RISER C1	861.03	846.00
30"Ø RISER D4	859.73	846.00
30"Ø RISER F3	859.16	846.00

THE UNDERSIGNED HEREBY APPROVES THE ATTACHED (6) PAGES INCLUDING THE FOLLOWING:

- **PIPE STORAGE = 28,982 CF**
- **MAINLINE PIPE GAGE = 10**
- **WALL TYPE = SOLID**
- **DIAMETER = 120"**
- **FINISH = ALT2**
- **CORRUGATION = 5x1**

CUSTOMER _____ DATE _____

NOTES

- ALL RISER AND STUB DIMENSIONS ARE TO CENTERLINE.
- ALL ELEVATIONS, DIMENSIONS, AND LOCATIONS OF RISERS AND INLETS, SHALL BE VERIFIED BY THE ENGINEER OF RECORD (EOR) PRIOR TO RELEASING FOR FABRICATION.
- ALL FITTINGS AND REINFORCEMENT COMPLY WITH ASTM A998.
- ALL RISERS AND STUBS ARE 2⅔" x ½" CORRUGATION AND 16 GAGE UNLESS OTHERWISE NOTED.
- RISERS TO BE FIELD TRIMMED TO GRADE AS REQUIRED, BY CONTRACTOR.
- QUANTITY OF PIPE SHOWN DOES NOT PROVIDE EXTRA PIPE FOR CONNECTING THE SYSTEM TO EXISTING PIPE OR DRAINAGE STRUCTURES. OUR SYSTEM AS DETAILED PROVIDES NOMINAL INLET AND/OR OUTLET PIPE STUB FOR CONNECTION TO EXISTING DRAINAGE FACILITIES. IF ADDITIONAL PIPE IS NEEDED IT IS THE RESPONSIBILITY OF THE CONTRACTOR.
- ALL ACCESS CASTINGS ARE THE RESPONSIBILITY OF THE CONTRACTOR AND ARE NOT SUPPLIED BY CONTECH.

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CONTECH CMP DETENTION SYSTEMS
CONTECH CONTRACT DRAWING

120"Ø UNDERGROUND DETENTION SYSTEM - 771557-010
LEE & PENNY ANDERSON MULTIPURPOSE ARENA
SAINT PAUL, MN
SITE DESIGNATION: 120" CMP DETENTION

PROJECT No.:	SEQ. No.:	DATE:
771557	010	10/11/2023
DESIGNED: WPC	DRAWN: WPC	
CHECKED: BAK	APPROVED: WPC	
SHEET NO.: C1 OF 6		

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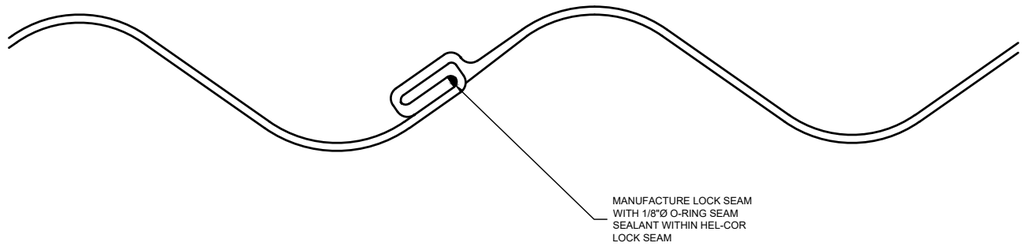
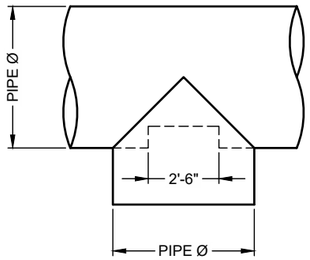
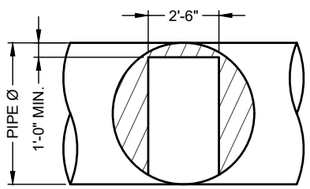


LOCK SEAM DETAIL
NOT TO SCALE



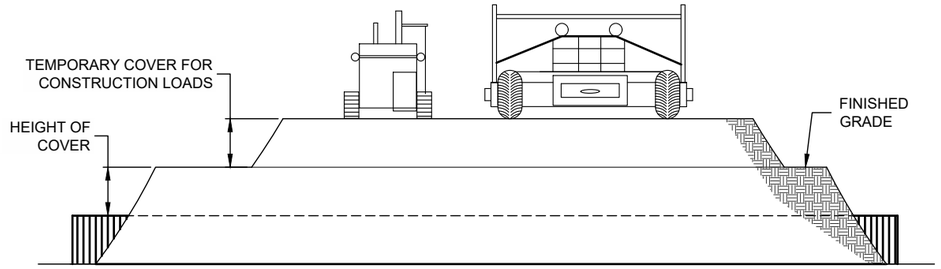
PLAN



FRONT

48"Ø to 90"Ø FITTING REINFORCEMENT
MAY BE REQUIRED BASED ON HEIGHT OF
COVER AND LIVE LOAD CONDITION

TYPICAL MANWAY DETAIL
NOT TO SCALE



CONSTRUCTION LOADS

FOR TEMPORARY CONSTRUCTION VEHICLE LOADS, AN EXTRA AMOUNT OF COMPACTED COVER MAY BE REQUIRED OVER THE TOP OF THE PIPE. THE HEIGHT-OF-COVER SHALL MEET THE MINIMUM REQUIREMENTS SHOWN IN THE TABLE BELOW. THE USE OF HEAVY CONSTRUCTION EQUIPMENT NECESSITATES GREATER PROTECTION FOR THE PIPE THAN FINISHED GRADE COVER MINIMUMS FOR NORMAL HIGHWAY TRAFFIC.

PIPE SPAN, INCHES	AXLE LOADS (kips)			
	18-50	50-75	75-110	110-150
	MINIMUM COVER (FT)			
12-42	2.0	2.5	3.0	3.0
48-72	3.0	3.0	3.5	4.0
78-120	3.0	3.5	4.0	4.0
126-144	3.5	4.0	4.5	4.5

*MINIMUM COVER MAY VARY, DEPENDING ON LOCAL CONDITIONS. THE CONTRACTOR MUST PROVIDE THE ADDITIONAL COVER REQUIRED TO AVOID DAMAGE TO THE PIPE. MINIMUM COVER IS MEASURED FROM THE TOP OF THE PIPE TO THE TOP OF THE MAINTAINED CONSTRUCTION ROADWAY SURFACE.

CONSTRUCTION LOADING DIAGRAM
NOT TO SCALE

SPECIFICATION FOR CORRUGATED STEEL PIPE-ALUMINIZED TYPE 2 STEEL

SCOPE

THIS SPECIFICATION COVERS THE MANUFACTURE AND INSTALLATION OF THE CORRUGATED STEEL PIPE (CSP) DETAILED IN THE PROJECT PLANS.

MATERIAL

THE ALUMINIZED TYPE 2 STEEL COILS SHALL CONFORM TO THE APPLICABLE REQUIREMENTS OF AASHTO M274 OR ASTM A929.

PIPE

THE CSP SHALL BE MANUFACTURED IN ACCORDANCE WITH THE APPLICABLE REQUIREMENTS OF AASHTO M36 OR ASTM A760. THE PIPE SIZES, GAGES AND CORRUGATIONS SHALL BE AS SHOWN ON THE PROJECT PLANS.

ALL FABRICATION OF THE PRODUCT SHALL OCCUR WITHIN THE UNITED STATES.

HANDLING AND ASSEMBLY

SHALL BE IN ACCORDANCE WITH RECOMMENDATIONS OF THE NATIONAL CORRUGATED STEEL PIPE ASSOCIATION (NCSPA)

INSTALLATION

SHALL BE IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, SECTION 26, DIVISION II OR ASTM A798 AND IN CONFORMANCE WITH THE PROJECT PLANS AND SPECIFICATIONS. IF THERE ARE ANY INCONSISTENCIES OR CONFLICTS THE CONTRACTOR SHOULD DISCUSS AND RESOLVE WITH THE SITE ENGINEER.

IT IS ALWAYS THE RESPONSIBILITY OF THE CONTRACTOR TO FOLLOW OSHA GUIDELINES FOR SAFE PRACTICES.

ANTI-FLOTATION PROVISIONS DUE TO HIGH GROUNDWATER OR OTHER FLOTATION CONCERNS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.

MATERIAL SPECIFICATION
NOT TO SCALE

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CONTECH CMP DETENTION SYSTEMS
CONTECH CONTRACT DRAWING

120"Ø UNDERGROUND DETENTION SYSTEM - 771557-010
LEE & PENNY ANDERSON MULTIPURPOSE ARENA
SAINT PAUL, MN
SITE DESIGNATION: 120" CMP DETENTION

PROJECT No.:	SEQ. No.:	DATE:
771557	010	10/11/2023
DESIGNED: WPC	DRAWN: WPC	
CHECKED: BAK	APPROVED: WPC	
SHEET NO.: C2	OF 6	

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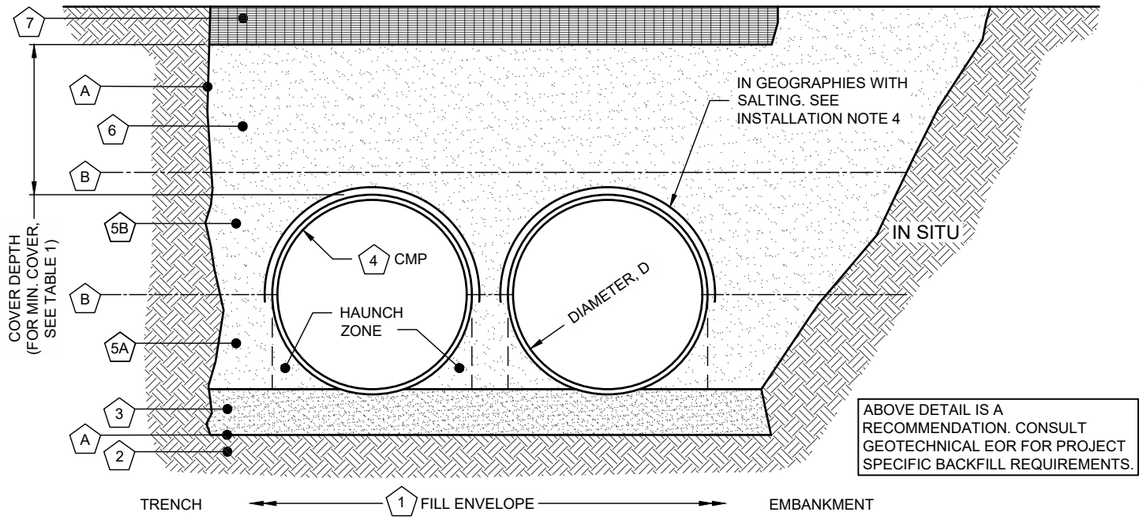
TABLE 1:

DIAMETER, D	MIN. COVER	CORR. PROFILE
6"-10"	12"	1 1/2" x 1/4"
12"-48"	12"	2 2/3" x 1/2"
>48"-96"	12"	3" x 1", 5" x 1"
>96"	D/8	3" x 1", 5" x 1"

- STRUCTURAL BACKFILL MUST EXTEND TO LIMITS OF THE TABLE
- TOTAL HEIGHT OF COMPACTED COVER FOR CONVENTIONAL HIGHWAY LOADS IS MEASURED FROM TOP OF PIPE TO BOTTOM OF FLEXIBLE PAVEMENT OR TOP OF RIGID PAVEMENT
- ULTRAFLO ALSO AVAILABLE FOR SIZES 18" - 120" WITH 3/4"x 3/4"x 7 1/2" CORRUGATION



MINIMUM WIDTH DEPENDS ON SITE CONDITIONS AND ENGINEERING JUDGEMENT

INSTALLATION NOTES

1. WHEN PLACING THE FIRST LIFTS OF BACKFILL IT IS IMPORTANT TO MAKE SURE THAT THE BACKFILL IS PROPERLY COMPACTED UNDER AND AROUND THE PIPE HAUNCHES.
2. OTHER ALTERNATE BACKFILL MATERIAL MAY BE ALLOWED DEPENDING ON SITE SPECIFIC CONDITIONS, AS APPROVED BY SITE ENGINEER.
3. BACKFILL USING CONTROLLED LOW-STRENGTH MATERIAL (CLSM, "FLASH FILL" OR "FLOWABLE FILL") MAY BE USED WHEN THE SPACING BETWEEN THE PIPES WILL NOT ALLOW FOR PLACEMENT AND ADEQUATE COMPACTION OF THE BACKFILL. CONTACT CONTECH FOR FURTHER EVALUATION.
4. IF SALTING AGENTS FOR SNOW AND ICE REMOVAL ARE USED ON OR NEAR THE PROJECT, A GEOMEMBRANE BARRIER IS RECOMMENDED OVER THE UPPER HALF OF THE PIPE. THE GEOMEMBRANE LINER IS INTENDED TO HELP PROTECT THE SYSTEM FROM THE POTENTIAL ADVERSE EFFECTS THAT MAY RESULT FROM A CHANGE IN THE SURROUNDING ENVIRONMENT OVER A PERIOD OF TIME. PLEASE REFER TO THE CORRUGATED METAL PIPE DETENTION DESIGN GUIDE FOR ADDITIONAL INFORMATION.

TABLE 2:

CMP DETENTION AND CMP DRAINAGE STANDARD BACKFILL SPECIFICATIONS

	MATERIAL LOCATION	MATERIAL SPECIFICATION	DESCRIPTION	
1	FILL ENVELOPE WIDTH	PER ENGINEER OF RECORD	MINIMUM TRENCH WIDTH MUST ALLOW ROOM FOR PROPER COMPACTION OF HAUNCH MATERIALS UNDER THE PIPE. THE SUGGESTED MINIMUM TRENCH WIDTH, OR EOR RECOMMENDATION: PIPE ≤ 12": D + 16" PIPE > 12": 1.5D + 12"	MINIMUM EMBANKMENT WIDTH (IN FEET) FOR INITIAL FILL ENVELOPE: PIPE < 24": 3.0D PIPE 24" - 144": D + 4'0" PIPE > 144": D + 10'0"
2	FOUNDATION	**AASHTO 26.5.2** OR PER ENGINEER OF RECORD	PRIOR TO PLACING THE BEDDING, THE FOUNDATION MUST BE CONSTRUCTED TO A UNIFORM AND STABLE GRADE. IN THE EVENT THAT UNSUITABLE FOUNDATION MATERIALS ARE ENCOUNTERED DURING EXCAVATION, THEY SHALL BE REMOVED AND FOUNDATION BROUGHT BACK TO GRADE WITH A FILL MATERIAL APPROVED BY THE ENGINEER OF RECORD.	
3	BEDDING	**AASHTO M 43: 3, 357, 4, 467, 5, 56, 57** (APPROVED REGIONAL EQUIVALENTS INCLUDE CA-7)	ENGINEER OF RECORD TO DETERMINE IF BEDDING IS REQUIRED. PIPE MAY BE PLACED ON THE TRENCH BOTTOM OF A RELATIVELY LOOSE, NATIVE SUITABLE WELL GRADED GRANULAR MATERIAL THAT IS ROUGHLY SHAPED TO FIT THE BOTTOM OF THE PIPE, 2" MIN DEPTH. THE BEDDING MATERIAL MAY BE SUITABLE FOUNDATION SOILS CONFORMING TO AASHTO SOIL CLASSIFICATIONS A1, A2, OR A3 WITH MAXIMUM PARTICLE SIZE OF 3" PER AASHTO 26.3.8.1	
4	CORRUGATED METAL PIPE			
5A	CRITICAL BACKFILL	**AASHTO M 145: A-1, A-2, A-3** *	HAUNCH ZONE MATERIAL SHALL BE HAND SHOVELED OR SHOVEL SLICED INTO PLACE TO ALLOW FOR PROPER COMPACTION WITHOUT SOFT SPOTS. BACKFILL SHALL BE PLACED IN 8" +/- LOOSE LIFTS AND COMPACTED TO 90% STANDARD PROCTOR PER AASHTO T 99. BACKFILL SHALL BE PLACED SUCH THAT THERE IS NO MORE THAN A THREE LIFT (24") DIFFERENTIAL BETWEEN ANY OF THE PIPES AT ANY TIME DURING THE BACKFILL PROCESS. THE BACKFILL SHOULD BE ADVANCED ALONG THE LENGTH OF THE SYSTEM TO AVOID DIFFERENTIAL LOADING. WELL GRADED GRANULAR MATERIAL WHICH MAY CONTAIN SMALL AMOUNTS OF SILT OR CLAY AND MAXIMUM PARTICLE SIZE OF 3" (PER AASHTO 26.3.8.1 AND 12.4-1.3).	
5B	BACKFILL	**AASHTO M 145: A-1, A-2, A-3**		
6	COVER MATERIAL	UP TO MIN. COVER - SEE 5A AND 5B ABOVE ABOVE MIN. COVER - PER ENGINEER OF RECORD	COVER MATERIAL MAY INCLUDE NON-BITUMINOUS, GRANULAR ROAD BASE MATERIAL WITHIN MIN COVER LIMITS	
7	RIGID OR FLEXIBLE PAVEMENT (IF APPLICABLE)	PER ENGINEER OF RECORD	FLEXIBLE PAVEMENT SHOULD NOT BE COUNTED AS PART OF THE FILL HEIGHT OVER THE CMP. FINAL BACKFILL MATERIAL SELECTION AND COMPACTION REQUIREMENTS SHALL FOLLOW THE PROJECT PLANS AND SPECIFICATIONS PER THE ENGINEER OF RECORD.	
A	OPTIONAL SIDE GEOTEXTILE	NONE	GEOTEXTILE LAYER IS RECOMMENDED ON SIDES OF EXCAVATION TO PREVENT SOIL MIGRATION.	
B	OPTIONAL GEOTEXTILE BETWEEN LAYERS	NONE	IF SOIL TYPES DIFFER AT ANY POINT ABOVE PIPE INVERT, A GEOTEXTILE LAYER IS RECOMMENDED TO BE PLACED BETWEEN THE LAYERS TO PREVENT SOIL MIGRATION.	

NOTES:
- FOR MULTIPLE BARREL INSTALLATIONS, THE RECOMMENDED STANDARD SPACING BETWEEN PARALLEL PIPE RUNS SHALL BE THE PIPE DIAMETER /2 BUT NO LESS THAN 12" FOR DIAMETERS <72". FOR 72" AND LARGER DIAMETERS, THE MINIMUM SPACING IS 36". CONTACT YOUR CONTECH REPRESENTATIVE FOR NONSTANDARD SPACING.

* APPROVED REGIONAL EQUIVALENTS FOR SECTION 5A INCLUDE CA-7, MIDOT 2G, 34G, OR 21AA STONE OR GRAVEL; #8; #57; MIDOT 6A, 2G, 3G, 34G.

MANUFACTURER RECOMMENDED BACKFILL

NOT TO SCALE

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CONTECH CMP DETENTION SYSTEMS
CONTECH **CONTRACT** DRAWING

120"Ø UNDERGROUND DETENTION SYSTEM - 771557-010
LEE & PENNY ANDERSON MULTIPURPOSE ARENA
SAINT PAUL, MN
SITE DESIGNATION: 120" CMP DETENTION

PROJECT No.:	SEQ. No.:	DATE:
771557	010	10/11/2023
DESIGNED: WPC	DRAWN: WPC	
CHECKED: BAK	APPROVED: WPC	
SHEET NO.: C3	OF 6	

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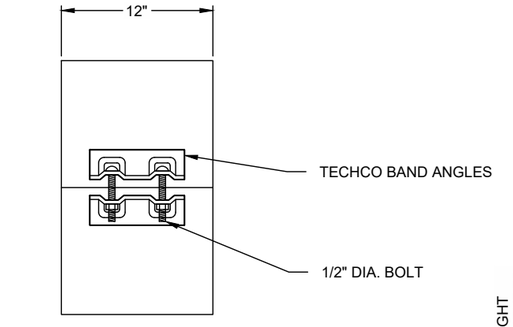
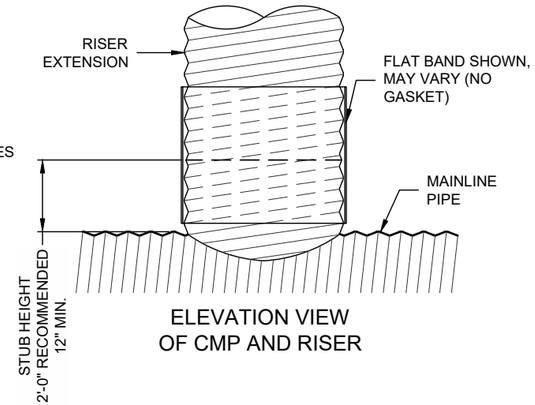


CONNECTION DETAIL
7 1/2" TECHCO SHOWN - MAY VARY



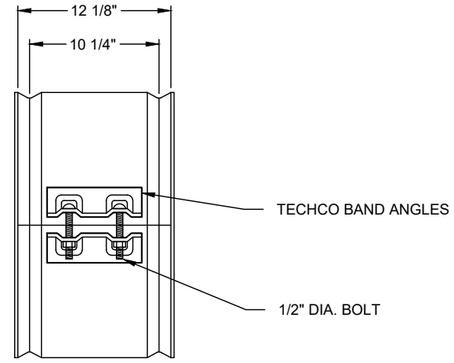
ELEVATION VIEW
OF CMP AND RISER

PLAIN END CMP RISER PIPE

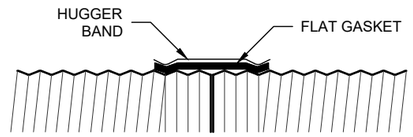
GENERAL NOTES:

1. **DELIVERED BAND STYLE AND FASTENER TYPE MAY VARY BY FABRICATION PLANT.**
2. JOINT IS TO BE ASSEMBLED PER AASHTO BRIDGE CONSTRUCTION SPECIFICATION SEC 26.4.2.4.
3. BAND MATERIAL AND GAGE TO BE SAME AS RISER MATERIAL.
4. IF RISER HAS A HEIGHT OF COVER OF 10' OR MORE, USE A SLIP JOINT.
5. BANDS ARE NORMALLY FURNISHED AS FOLLOWS:
   - 12" THRU 48" 1-PIECE
   - 54" 2-PIECES
6. ALL RISER JOINT COMPONENTS WILL BE FIELD ASSEMBLED.
7. MANHOLE RISERS IN APPLICATIONS WHERE TRAFFIC LOADS ARE IMPOSED REQUIRE SPECIAL DESIGN CONSIDERATIONS.
8. DIMENSIONS SUBJECT TO MANUFACTURING TOLERANCES.

12" RISER BAND DETAIL
NOT TO SCALE



CONNECTION DETAIL
7 1/2" TECHCO



FLAT GASKET

2 2/3"x1/2" RE-ROLLED END HEL-COR PIPE

GENERAL NOTES:

1. JOINT IS TO BE ASSEMBLED PER AASHTO BRIDGE CONSTRUCTION SPECIFICATION SEC 26.4.2.4.
2. BAND MATERIALS AND/OR COATING CAN VARY BY LOCATION. CONTACT YOUR CONTECH REPRESENTATIVE FOR AVAILABILITY.
3. BANDS ARE SHAPED TO MATCH THE PIPE-ARCH WHEN APPLICABLE.
4. BANDS ARE NORMALLY FURNISHED AS FOLLOWS:
   - 12" THRU 48" 1-PIECE
   - 54" THRU 96" 2-PIECES
   - 102" THRU 144" 3-PIECES
5. BAND FASTENERS ARE ATTACHED WITH SPOT WELDS, RIVETS OR HAND WELDS.
6. ALL CMP IS REROLLED TO HAVE ANNULAR END CORRUGATIONS OF 2 2/3"x1/2"
7. DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES.
8. ORDER SHALL DESIGNATE GASKET OPTION, IF REQUIRED (SEE DETAILS ABOVE).

H-12 HUGGER BAND DETAIL
NOT TO SCALE

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CONTECH CMP DETENTION SYSTEMS
CONTECH CONTRACT DRAWING

120"Ø UNDERGROUND DETENTION SYSTEM - 771557-010
LEE & PENNY ANDERSON MULTIPURPOSE ARENA
SAINT PAUL, MN
SITE DESIGNATION: 120" CMP DETENTION

PROJECT No.:	SEQ. No.:	DATE:
771557	010	10/11/2023
DESIGNED: WPC	DRAWN: WPC	
CHECKED: BAK	APPROVED: WPC	
SHEET NO.: C4 OF 6		

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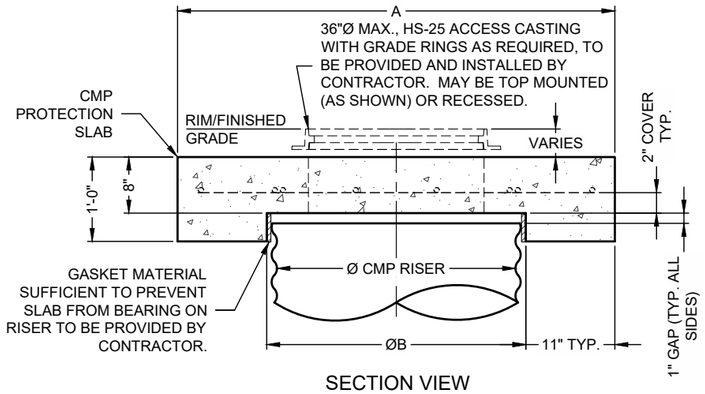
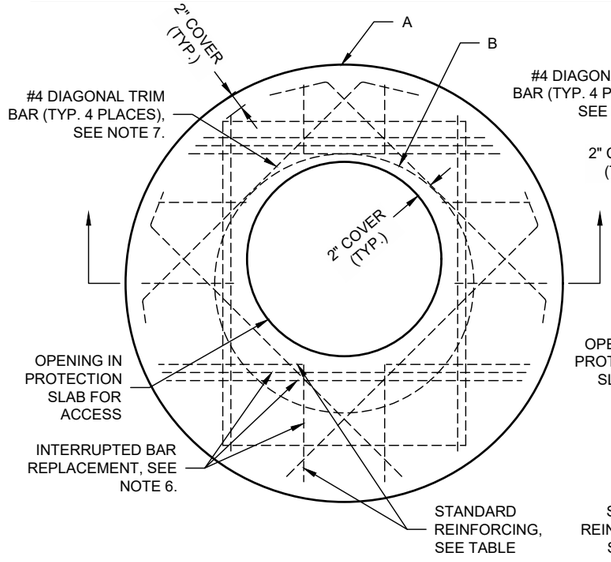


SECTION VIEW

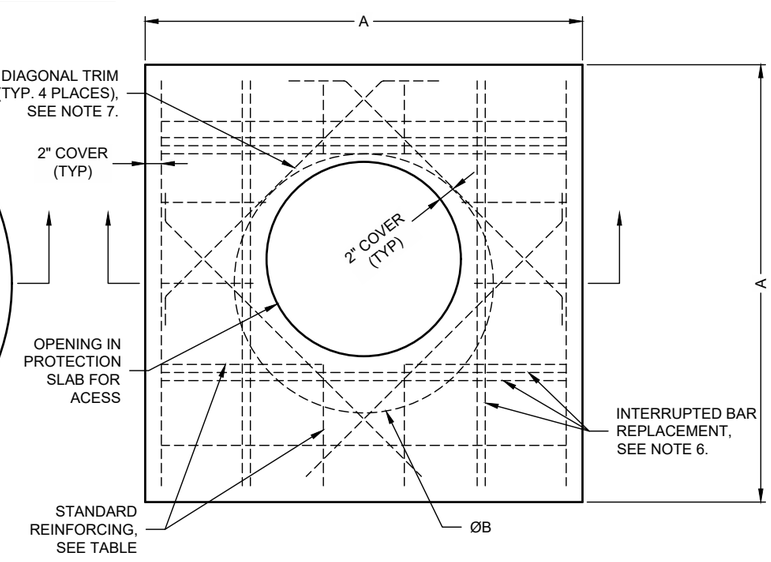
REINFORCING TABLE				
Ø CMP RISER	A	B Ø	REINFORCING	**BEARING PRESSURE (PSF)
24"	4'Ø 4'x4'	26"	#5 @ 10" OCEW #5 @ 10" OCEW	2,540 1,900
30"	4'-6"Ø 4'-6" x 4'-6"	32"	#5 @ 10" OCEW #5 @ 9" OCEW	2,260 1,670
36"	5'Ø 5' x 5'	38"	#5 @ 9" OCEW #5 @ 8" OCEW	2,060 1,500
42"	5'-6"Ø 5'-6" x 5'-6"	44"	#5 @ 8" OCEW #5 @ 8" OCEW	1,490 1,370
48"	6'Ø 6' x 6'	50"	#5 @ 7" OCEW #5 @ 7" OCEW	1,210 1,270

** ASSUMED SOIL BEARING CAPACITY

ACCESS CASTING NOT SUPPLIED BY CONTECH



ROUND OPTION PLAN VIEW



SQUARE OPTION PLAN VIEW

NOTES:

1. DESIGN IN ACCORDANCE WITH AASHTO, 17th EDITION AND ACI 350.
2. DESIGN LOAD HS25.
3. EARTH COVER = 1' MAX.
4. CONCRETE STRENGTH = 4,000 psi
5. REINFORCING STEEL = ASTM A615, GRADE 60.
6. PROVIDE ADDITIONAL REINFORCING AROUND OPENINGS EQUAL TO THE BARS INTERRUPTED, HALF EACH SIDE. ADDITIONAL BARS TO BE IN THE SAME PLANE.
7. TRIM OPENING WITH DIAGONAL #4 BARS, EXTEND BARS A MINIMUM OF 12" BEYOND OPENING, BEND BARS AS REQUIRED TO MAINTAIN BAR COVER.
8. PROTECTION SLAB AND ALL MATERIALS TO BE PROVIDED AND INSTALLED BY CONTRACTOR.
9. DETAIL DESIGN BY DELTA ENGINEERS, ARCHITECTS AND LAND SURVEYORS, ENDWELL, NY.

MANHOLE CAP DETAIL

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SAINT PAUL, MN
SITE DESIGNATION: 120" CMP DETENTION

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CHECKED: BAK	APPROVED: WPC	
SHEET NO.: C5	OF 6	

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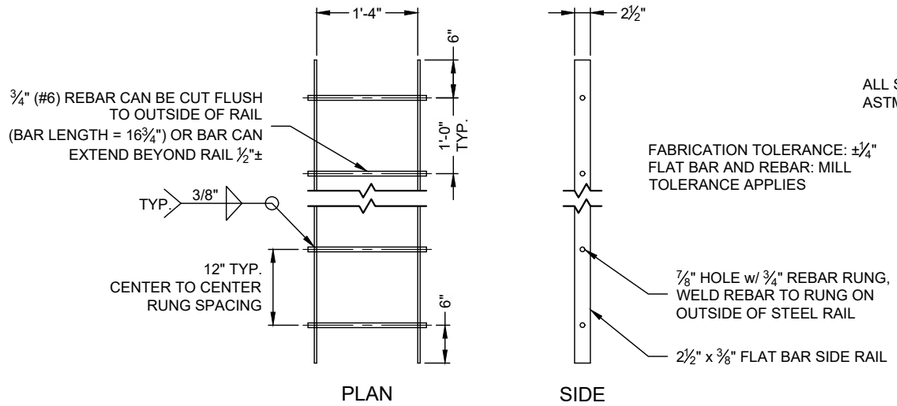


ALL STEEL PER ASTM A36

FABRICATION TOLERANCE: ±¼" FLAT BAR AND REBAR: MILL TOLERANCE APPLIES

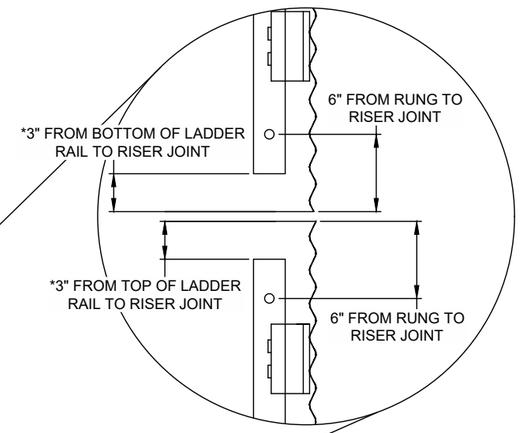
NOTES:
1. LADDERS CAN BE MADE IN 20'-0" STANDARD LENGTHS AND CUT TO FIT
2. ALL MATERIAL TO MEET ASTM A36
3. LADDER TO BE HOT DIPPED GALVANIZED PER ASTM A-123 AFTER FABRICATION IS COMPLETE

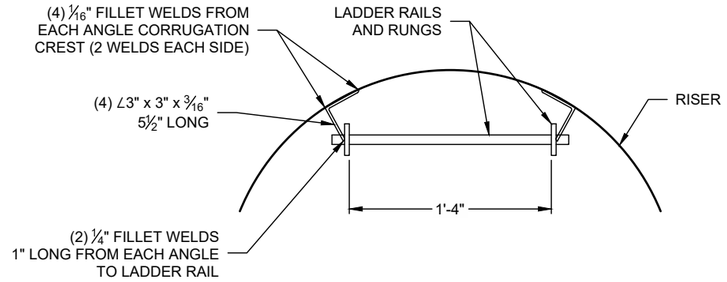
STANDARD LADDER DETAIL

NOT TO SCALE

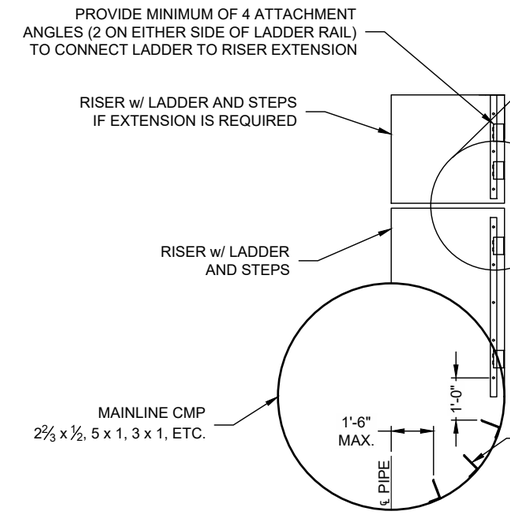
PART NO. HALAGVL16

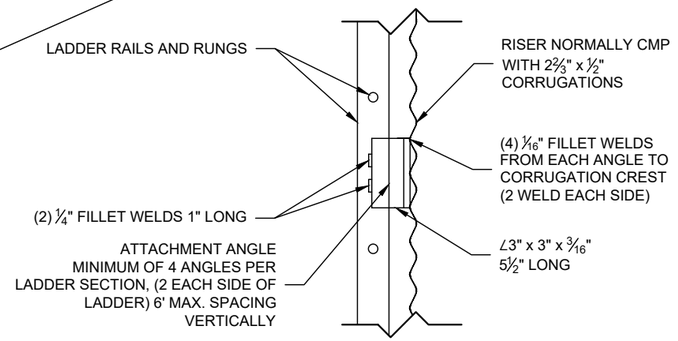
*NOTE: WHEN RISER EXTENSIONS ARE USED, THE PLANT SHOULD CUT 3" FROM THE SIDE RAILS AS SHOWN



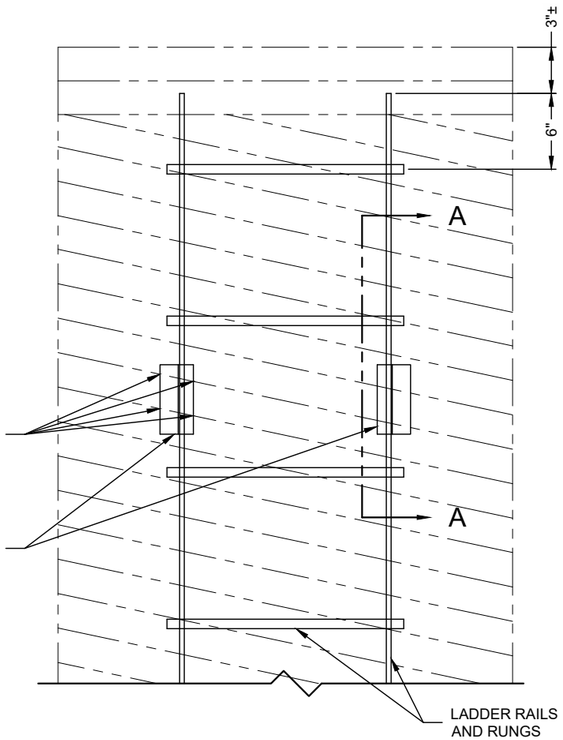


PLAN





SECTION A-A



ELEVATION

NOTE:
THIS DRAWING IS INTENDED TO APPLY TO LADDERS INSTALLED IN RISERS HAVING A DIAMETER OF 30" OR LARGER. DUE TO SPACE CONSTRAINTS AND LIMITED ACCESSIBILITY, THE PRACTICALITY AND SUITABILITY OF UTILIZING RISERS SMALLER THAN 30" DIAMETER AND/OR INCORPORATING LADDERS IN THESE SMALLER DIAMETER RISERS SHOULD BE ADDRESSED BY THE OWNER AND PROJECT ENGINEER

RISER LADDER DETAIL

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120"Ø UNDERGROUND DETENTION SYSTEM - 771557-010
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SITE DESIGNATION: 120" CMP DETENTION

PROJECT No.:	SEQ. No.:	DATE:
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FIGURE 7

SCHOENECKER CENTER (SCC)

O'SHAUGHNESSY SCIENCE HALL (OSS)
TOTAL AC = 0.40
IMP AC = 0.40

ST MARYS CHAPEL (SMC)

SCHOOL OF DIVINITY (SOD)

SEMINARY RESIDENCE (SEM)

OWENS SCIENCE HALL (OWS)
TOTAL AC = 0.56
IMP AC = 0.56

FACILITIES & DESIGN CENTER (FDC)
TOTAL AC = 0.19
IMP AC = 0.19

ANDERSON PARKING FACILITY (APF)

ARCHBISHOP IRELAND MEMORIAL LIBRARY (IRL)

BYRNE RESIDENCE (BYR)

BRADY EDUCATION CENTER (BEC)

GRACE HALL (GRA)
TOTAL AC = 0.18
IMP AC = 0.18

BINZ REFECTORY (BIN)

SOUTH ATHLETIC FIELDS (SAF)

PROPOSED BUILDING
28,417± SF

TOTAL AC = 0.52
IMP AC = 0.38

TOTAL AC = 0.17
IMP AC = 0.06

TOTAL AC = 0.14
IMP AC = 0.05

TOTAL AC = 0.08
IMP AC = 0.01

TOTAL AC = 0.20
IMP AC = 0.05

TOTAL AC = 0.05
IMP AC = 0.02

TOTAL AC = 0.40
IMP AC = 0.15

TOTAL AC = 0.34
IMP AC = 0.12

TOTAL AC = 0.14
IMP AC = 0.08

TOTAL AC = 0.14
IMP AC = 0.08

TOTAL AC = 0.09
IMP AC = 0.02

TOTAL AC = 0.41
IMP AC = 0.25

TOTAL AC = 0.17
IMP AC = 0.14

TOTAL AC = 0.16
IMP AC = 0.12

TOTAL AC = 0.23
IMP AC = 0.15

TOTAL AC = 0.09
IMP AC = 0.08

TOTAL AC = 0.48
IMP AC = 0.48

TOTAL AC = 0.45
IMP AC = 0.45

TOTAL AC = 0.04
IMP AC = 0.04

TOTAL AC = 0.51
IMP AC = 0.51

TOTAL AC = 0.09
IMP AC = 0.09

TOTAL AC = 0.13
IMP AC = 0.10

TOTAL AC = 0.12
IMP AC = 0.08

TOTAL AC = 0.45
IMP AC = 0.45

TOTAL AC = 0.46
IMP AC = 0.46

TOTAL AC = 0.60
IMP AC = 0.60

TOTAL AC = 0.10
IMP AC = 0.10

TOTAL AC = 0.10
IMP AC = 0.07

TOTAL AC = 0.11
IMP AC = 0.06

TOTAL AC = 0.41
IMP AC = 0.31

TOTAL AC = 0.64
IMP AC = 0.54

TOTAL AC = 0.37
IMP AC = 0.25

TOTAL AC = 0.27
IMP AC = 0.09

N

0 50 100
SCALE IN FEET

RYAN

UST Arena • Proposed Drainage Areas for Storm Sewer Sizing • 09.11.2023

Stormwater Management Plan Summary

For Linear Projects

Project Name: Lee & Penny Anderson Multipurpose Arena

Site Address/PID: 2260 Summit Ave, St. Paul, MN 55105

Site Size (acres): 27.45 AC

Disturbed area (sf): 323,470 SF

If ≥ 1 acre was a SWPPP submitted? ☑ Yes ☐ No ☐ N/A

Existing Impervious (sf): 216,000 SF

Proposed Impervious (sf): 258,850 SF

Fully Reconstructed Impervious (sf): 254000 SF

Rate Control Trigger: Land Disturbance ≥ 0.25 acres		
	Existing Peak Discharge Rate (cfs)	Proposed Peak Discharge Rate (cfs)
2-year	47.86	30.88
10-year	82.98	75.83
100-year	188.75	170.54

Note: If there are multiple discharge points, include a table of the peak rate comparison for all of them in the Stormwater Management Plan.

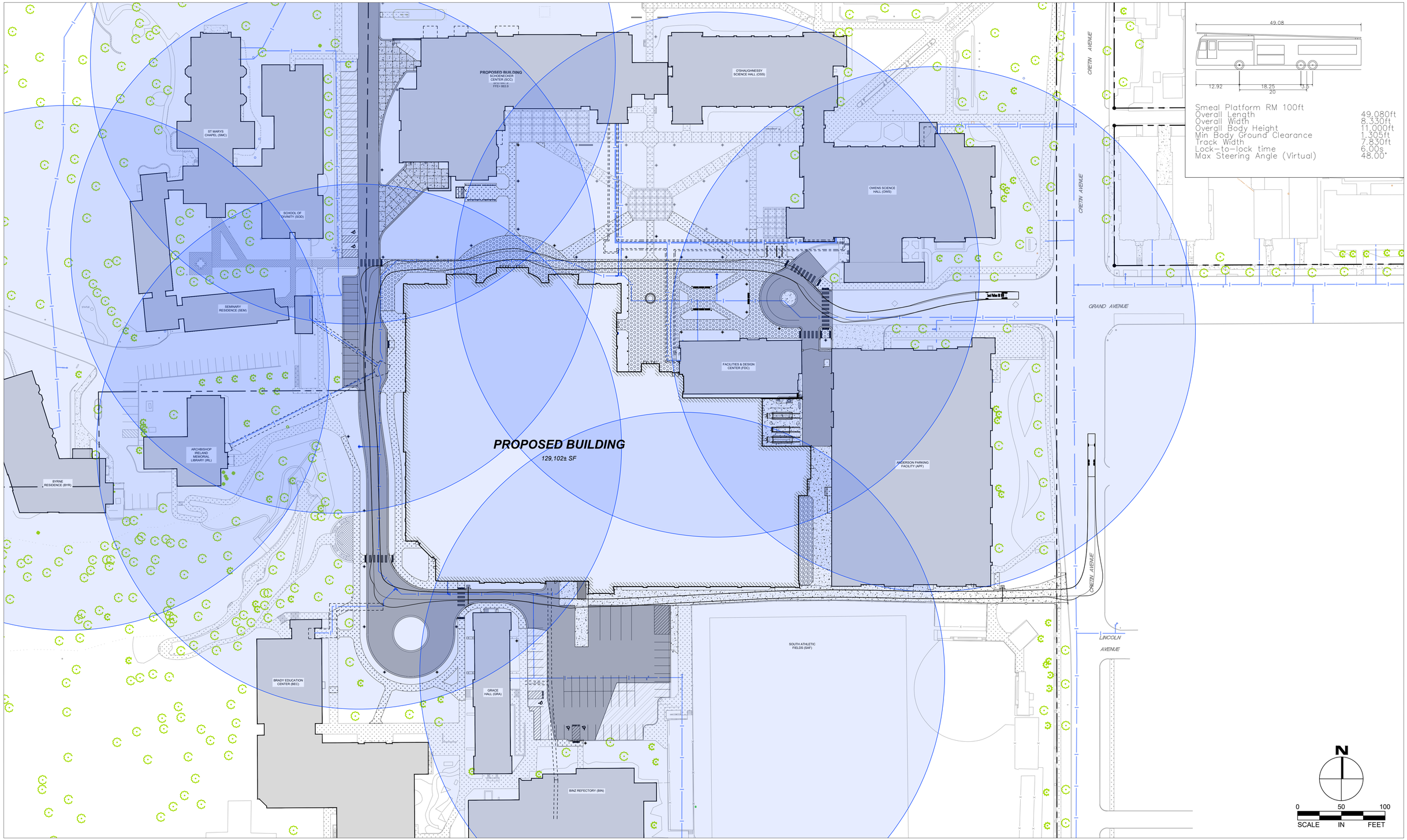
Water Quality Trigger: Construction Activity (Land Disturbance ≥ 1 acre)		
Water Quality Volume (WQV) Required (cf)		40,959 CF
Water Quality Volume Provided (cf)		
Unrestricted	As Infiltration	0 CF
Alt Seq 1	As Filtration (WQV_F = WQV * 1.82)	41,824 CF
	As Iron-Enhanced Sand Filtration (WQV_IESF = WQV * 1.25)	0 CF
Alt Seq 2	Off-site	0 CF
Alt Seq 3	Via Payment into Stormwater Impact Fund (CRWD and RWMWD only)	0 CF
Proposed TSS load reduction (ton/yr)		
% TSS reduction		97.6%
Proposed TP load reduction (lb/yr)		
% TP reduction		N/A

Note: **WQV (ft^3) = New and Fully Reconstructed Impervious (ft^2) x 1.1(in) x 1/12 (ft/in)**

Signature: _____ Date: 01/19/2024

Name: Jared Olson PE license number: 42340

Title: VP of Site Design Company: Ryan Companies US, Inc.



RYAN

UST Arena • Vehicle Tracking Exhibit - Fire Truck Movement • 01.19.2024

City of Saint Paul Transportation Demand Management Form

Project Address	2260 Summit Ave St. Paul, MN 55105
Project Name	University of St. Thomas - Lee & Penny Anderson Multipurpose Arena
Developer	University of St. Thomas
On-site Property Contact (Name, Email, Phone Number)	Jim Brummer, jim.brummer@stthomas.edu, 651-962-6595

For assistance with the TDM process, please contact Theresa Nelson with Move Minnesota at 651-789-1402 or at theresan@movemn.org.

Introduction

This form will guide you in determining your project's Travel Demand Management (TDM) Point Target. Once you establish your Point Target, you will select TDM Strategies with point values that meet or exceed that Point Target.

Determining whether a TDM Plan is required

A TDM Plan is required for developments that meet or surpass the following thresholds:

- 25 or more new dwelling units
- 20,000 square feet Gross Floor Area or more of new construction of non-residential uses

Order of Steps

If a TDM Plan is required for your project, follow these steps to identify what your required point target will be and what Travel Demand Management Strategies you will use to reach that target.

1. Identify the project type and proposed parking ratio(s).
2. Use the table to determine the project's location type.
3. Determine the TDMP land use category.
4. Use the location type and land use category to determine a parking ratio range.
5. Use the above information to determine the project's point target
6. Contact Move Minnesota to discuss the best TDM Strategies for this site and development.
7. Select appropriate TDM Strategies to reach your point target.

1. Project type and proposed parking ratio:

Enter the information that applies to your project type in the chart below. If your project includes both residential and commercial uses, fill in both sections. If the parking ratio for one use does not meet its corresponding threshold above, leave that section blank; parking for that part of your project will not need to be factored into this TDM Plan.

RESIDENTIAL	
Gross Floor Area (GFA)	
Residential Units	
Number of Parking Spaces	0
Proposed Parking Ratio *(spaces per dwelling unit)*	
COMMERCIAL, INDUSTRIAL, or INSTIUTIONAL	
Gross Floor Area Square Footage	248,255 SF GFA
Number of Parking Spaces	0
Proposed Parking Ratio *(spaces per square foot GFA)*	0 spaces per 248,255 SF GFA
Proposed Parking Ratio *(from above)*	0 spaces per 248,255 SF GFA

2. Location Type:

Development within a quarter mile of a high frequency transit line (i.e. Bus Rapid Transit, Streetcar, or Light Rail Transit) or in downtown will have a higher target point assigned than other areas. Find your zoning district here and your transit proximity here.

Place a check mark next to your project's location type.

☐	Transit Proximate (within a quarter mile of Bus Rapid Transit or Light Rail Transit)
☐	In B4 or B5 Zoning Districts (Downtown)
☑	All other locations

3. TDMP Land Use Category:
Land uses from the zoning code have been grouped into four categories that reflect the travel characteristics of its users. Consult the TDM Program Standards Guide for help determining your land use category.

Place a check mark next to the land use category/categories that describe(s) your project.

☐	**Home-End Uses** – Uses that predominantly generate trip-origin patterns of parking demand, such as housing.
☐	**Commute-End Uses** – Uses that predominantly generate daily-trip or long-term discretionary-trip patterns of parking demand, such as offices and schools.
☑	**Visit-End Uses** – Uses that predominantly generate short-term discretionary-trip forms of parking demand such as retail.
☐	**Other Uses** – Uses that typically generate moderate or minimal parking demand and/or are typically minimally responsive to TDM mitigation efforts.

4. Parking Ratio Range:
Your project's location type and TDMP land use category determine the parking ratio range for your project. Providing more or less parking than this range will impact your point target. In the TDM Program Standards Guide, the top end of the ratio range is called the "Excess Parking Ratio", and the bottom end is called the "Reduced Parking Ratio".

Reduced Parking Ratios:

Land Use Category	B4 and B5 Districts	Transit-Proximate Locations	All Other Areas
Home-End Uses	1 space per 2 Dwelling Units (DU)	1 space per DU	1.5 spaces per DU
Commute-End Uses	1 space per 1,000 SF GFA	1 space per 500 SF GFA	1 space per 250 SF GFA
Visit-End Uses	1 space per 1,000 SF GFA	1 space per 500 SF GFA	1 space per
Other Uses	N/A		

Excess Parking Ratios:

Land Use Category	B4 and B5 Districts	Transit-Proximate Locations	All Other Areas
Home-End Uses	1.25 spaces per DU	1.5 spaces per DU	2 spaces per DU
Commute-End Uses	1 space per 500 SF GFA	1 space per 330 SF GFA	1 space per 250 SF GFA
Visit-End Uses	1 space per 500 SF GFA	1 space per 330 SF GFA	1 space per 250 SF GFA
Other Uses	N/A		

Required Parking Ratio	1 space per 250 SF GFA

5. Point Target:

After your parking ratio range is determined, find and check your point target in the table below.

Land Use Category	Proposed parking amount	Point Targets		
		All Other Areas	Transit-Proximate Locations	B4 and B5 Districts Downtown
Home-End, Commute-End, and Visit-End Uses	Parking provided within the parking ratio range	☐ 6 points	☐ 8 points	☐ 10 points
	Parking provided below the parking ratio range	☑ 4 points, minus 1 point for each 20% that parking is provided below the parking ratio range - for a minimum possible target of 0.	☐ 6 points, minus 1 point for each 20% that parking is provided below the parking ratio range - for a minimum possible target of 1 point.	☐ 8 points, minus 1 point for each 20% that parking is provided below the parking ratio range - for a minimum possible target of 3 points.
	Parking provided above the parking ratio range	☐ 7 points, plus 1 point for each 10% that parking is provided above the parking ratio range.	☐ 9 points, plus 1 point for each 10% that parking is provided above the parking ratio range.	☐ 11 points, plus 1 point for each 10% that parking is provided above the parking ratio range.
Other Uses	Any amount of parking spaces	☐ 0 points	☐ 2 points	☐ 4 points

Required Point Target	0 points

6. TDM Strategies:

Use the TDM Program Standards Guide to select the TDM Strategies you will implement to achieve your point target. At least one-third of a proposed development's TDM Plan points requirement must be met through physical measures. Section 63.211 requires parking to be unbundled from the cost of rent for any development or redevelopment of a structure with twenty-five (25) or more residential dwelling units. If your project meets this threshold list unbundling as a strategy, but no points can be allocated for this strategy if it's required. Affordable housing dwelling units, with financing that requires the cost for parking and housing be bundled together, are exempt from this requirement.

Fill in the table below with the TDM Strategies and their associated points. Include any other TDM Strategies you will implement above your required point total.

Category	Strategy	Points
Visit-End Uses	Physical-4: Bicycle Parking. Required bike spaces for the project are 50 spaces. 54 are proposed to be added exterior to the arena with 48 bike spaces within the APF Ramp directly adjacent. 102 bike parking	4
Visit-End Uses	Programs-2: Free or Subsidized Transit Passes. Full-time employees who do not purchase a parking permit are eligible for the Employee Metropass program which subsidizes 75% (thus resulting in 3 points) of the annual	3
Visit-End Uses		
Visit-End Uses		
Visit-End Uses		
Visit-End Uses		
Visit-End Uses		
Visit-End Uses		
	TOTAL	7

Overall Budget for TDM Strategies	**$**	0

Please provide the following information:

Date:	12/4/23
Signature:	

OWENS SCIENCE HALL (OWS)

FACILITIES & DESIGN CENTER (FDC)

ANDERSON PARKING FACILITY (APF)

CRETIN AVENUE

GRA

N

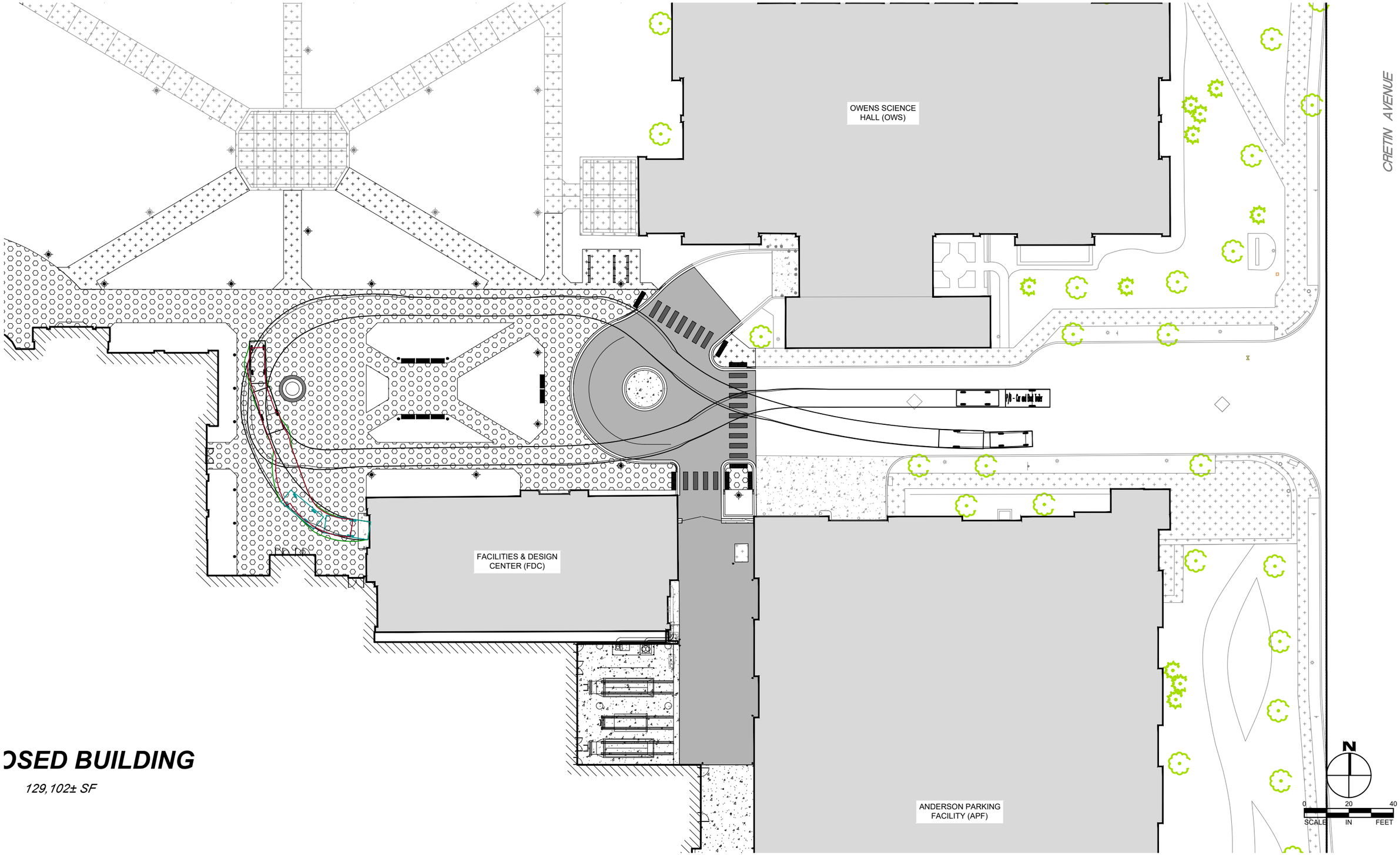
0 20 40

SCALE IN FEET

OSED BUILDING

129,102± SF

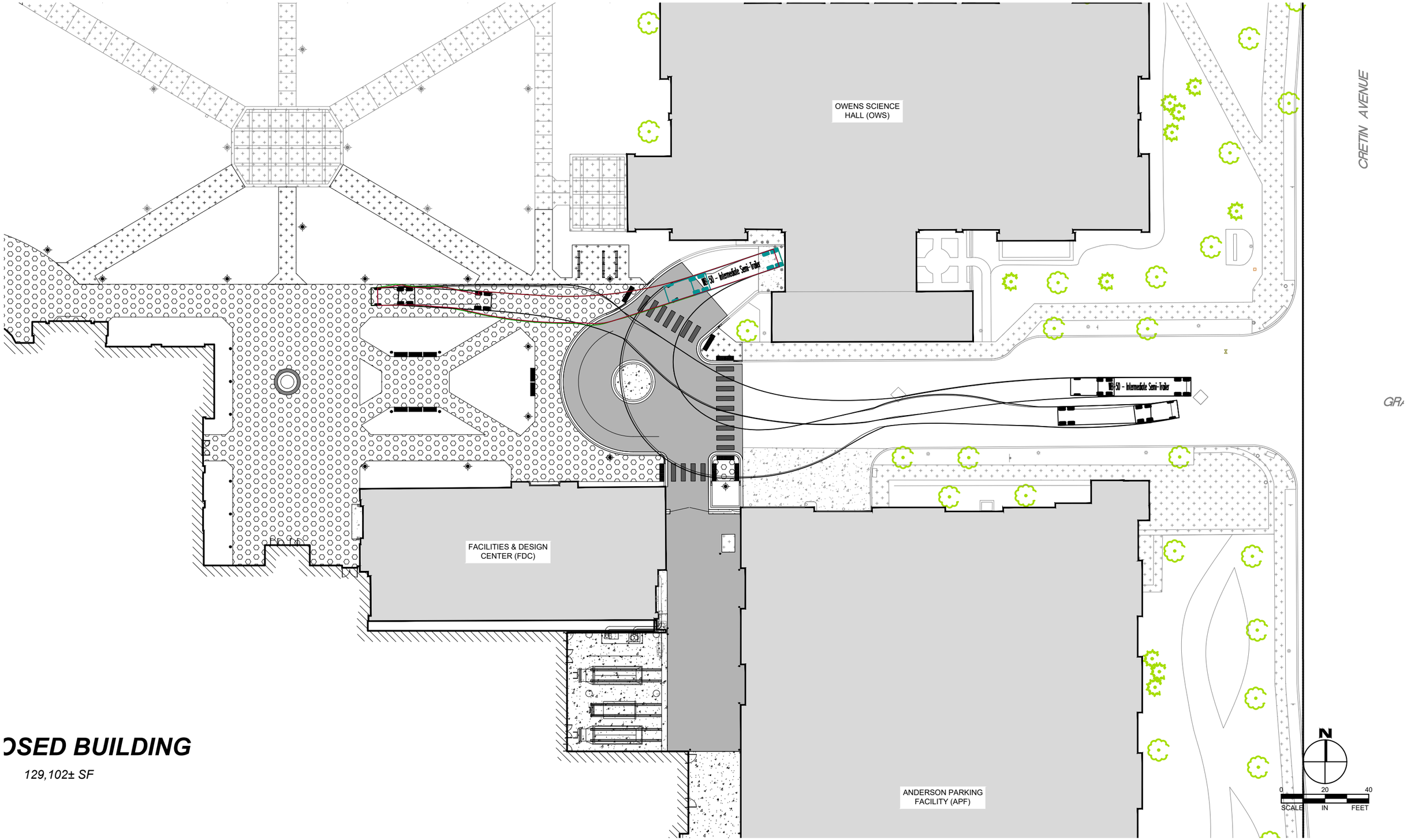
RYAN



OSED BUILDING

129,102± SF

RYAN



OSED BUILDING

129,102± SF

RYAN

OWENS SCIENCE HALL (OWS)

FACILITIES & DESIGN CENTER (FDC)

ANDERSON PARKING FACILITY (APF)

Waller's Recycling Truck

CRETIN AVENUE

GRA

N

0 20 40

SCALE IN FEET

OSED BUILDING

129,102± SF

RYAN

UST Multipurpose Arena • Vehicle Tracking Exhibit - Recycling Truck Movement • 01.19.2024

SUMMIT AVENUE

PROPOSED BUILDING
SCHOENECKER CENTER (SCC)
4F=Schoenecker
FFE= 863.9

O'SHAUGHNESSY SCIENCE HALL (OSS)

OWENS SCIENCE HALL (OWS)

ST MARYS CHAPEL (SMC)

SCHOOL OF DIVINITY (SOD)

SEMINARY RESIDENCE (SEM)

BYRNE RESIDENCE (BYR)

ARCHBISHOP IRELAND MEMORIAL LIBRARY (IRL)

BRADY EDUCATION CENTER (BEC)

GRACE HALL (GRA)

FACILITIES & DESIGN CENTER (FDC)

ANDERSON PARKING FACILITY (APF)

SOUTH ATHLETIC FIELDS (SAF)

PROPOSED BUILDING

129,102± SF

CRETIN AVENUE

ALLEY

CRETIN AVENUE

GRAND AVENUE

CRETIN AVENUE

LINCOLN AVENUE

N

0 50 100

SCALE IN FEET

RYAN

UST Arena • Vehicle Tracking Exhibit - Coach Bus Movement • 01.19.2024

SCHOOL OF
VINITY (SOD)

OWENS SCIENCE
HALL (OWS)

CRETIN AVENUE

GRAND AVENU

FACILITIES & DESIGN
CENTER (FDC)

PROPOSED BUILDING

129,102± SF

ANDERSON PARKING
FACILITY (APF)

SOUTH ATHLETIC
FIELDS (SAF)

CRETIN AVENUE

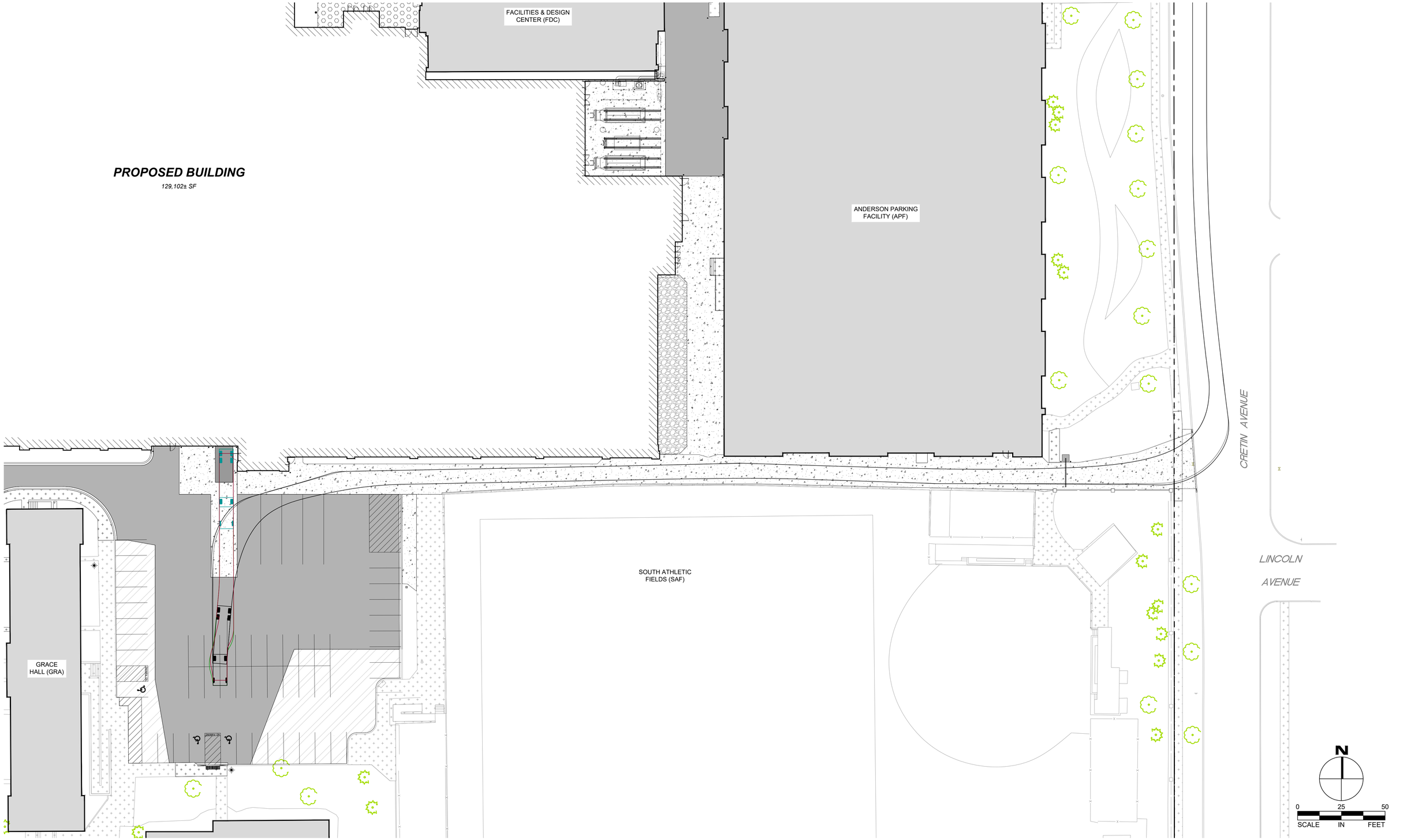
LINCOLN
AVENUE

N

0 30 60
SCALE IN FEET

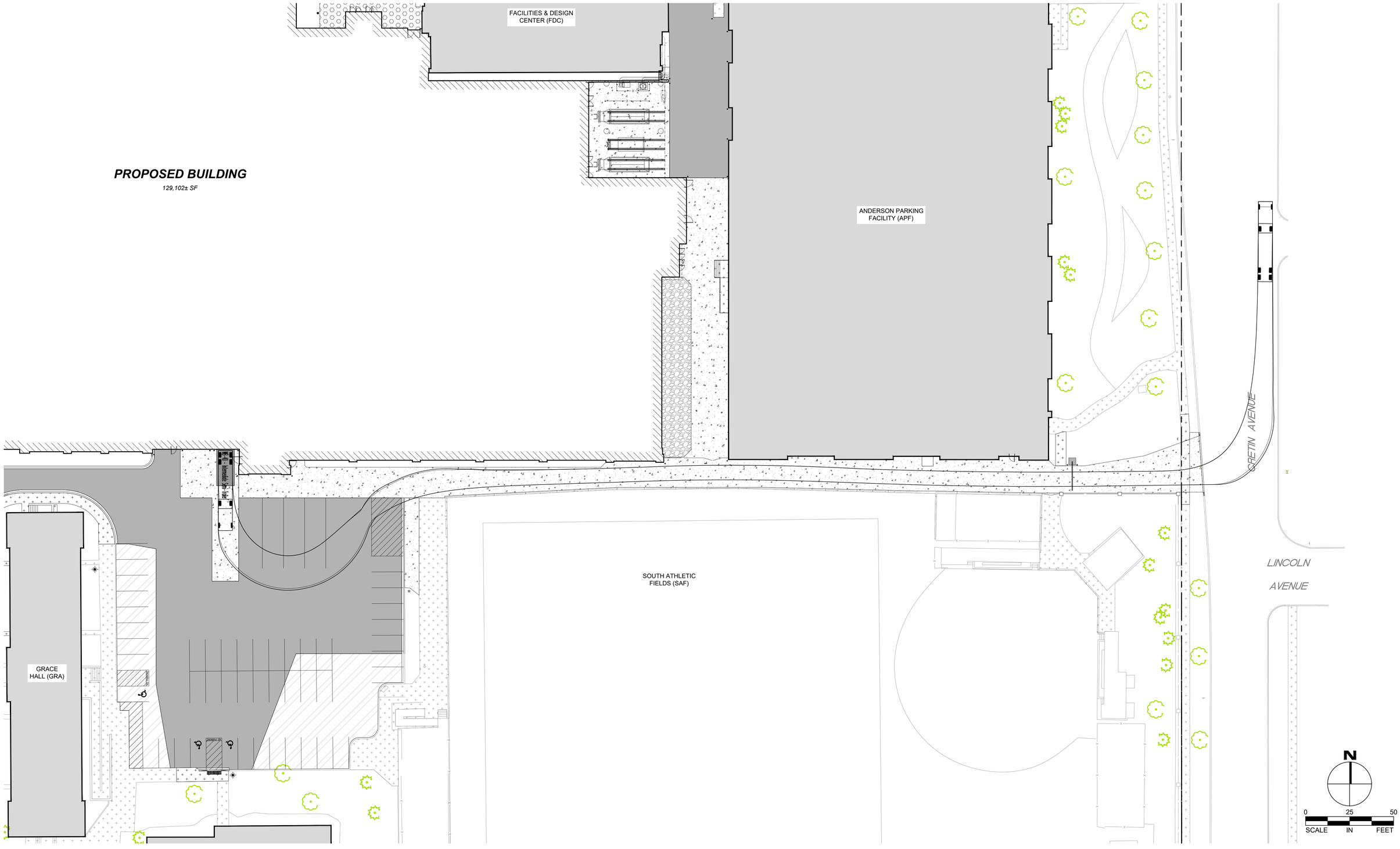
RYAN

UST Arena • Vehicle Tracking Exhibit - SCC WB-50 Movement • 01.19.2024



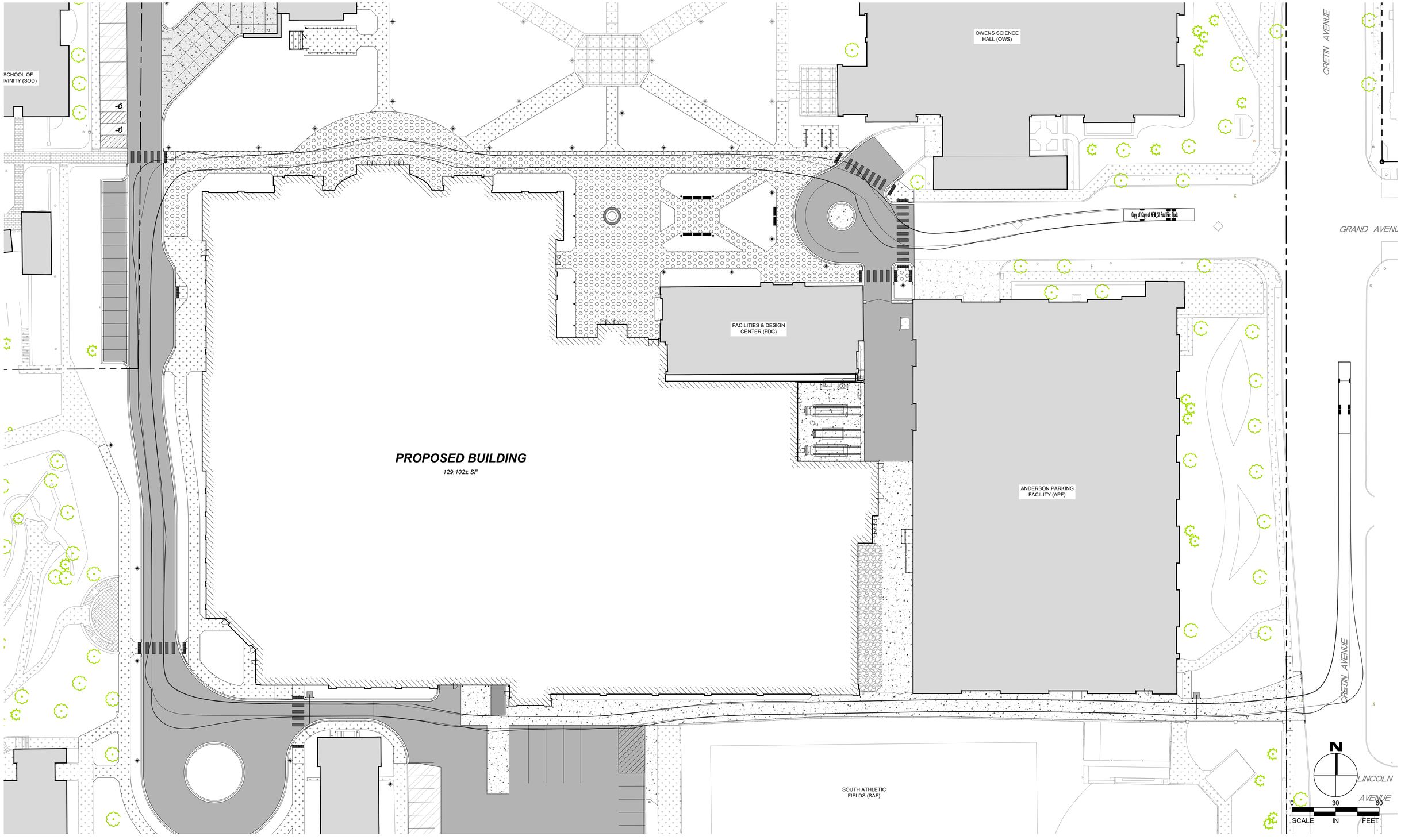
RYAN

UST Arena • Vehicle Tracking Exhibit - Cretin Access: WB-40 Movement • 01.19.2024



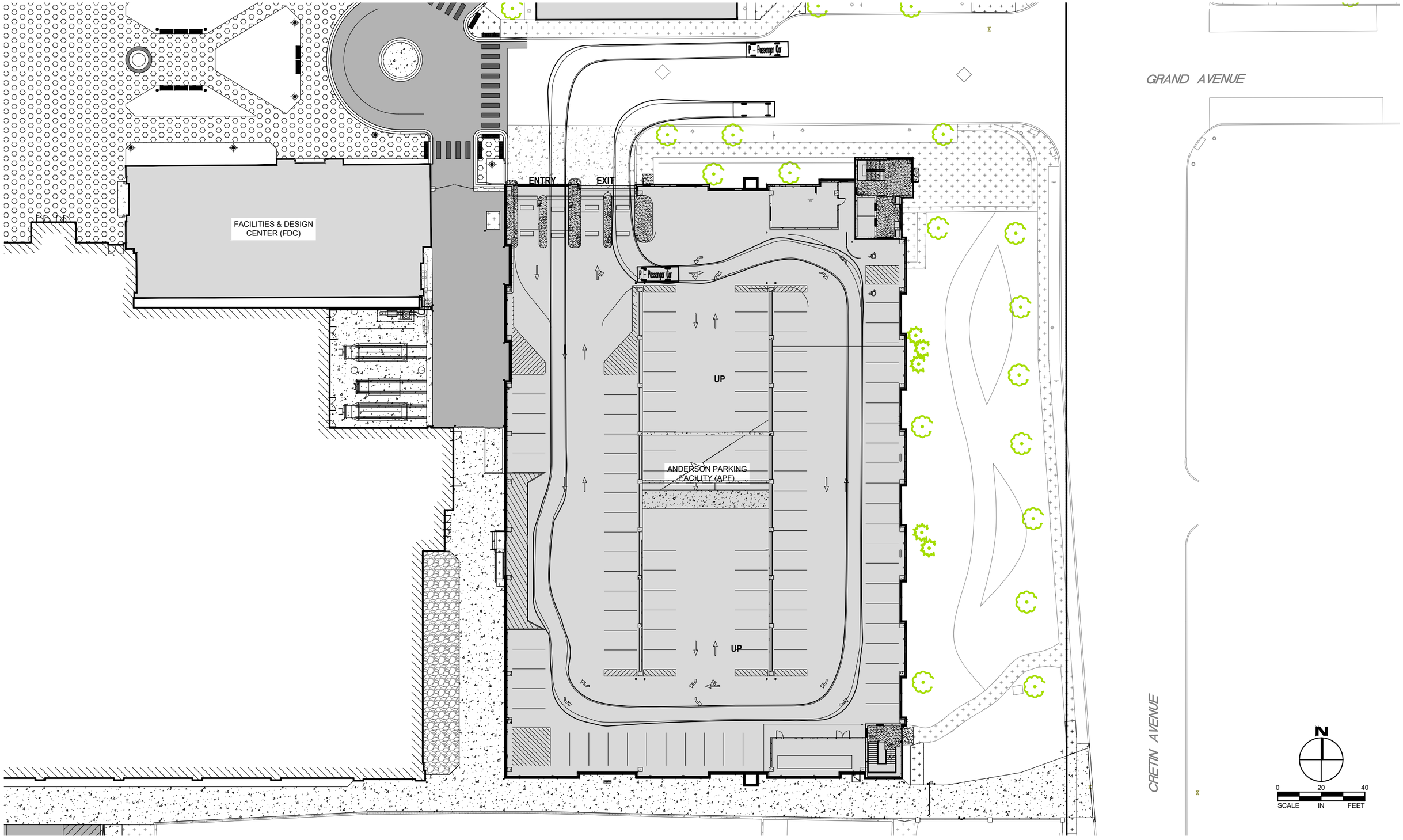
RYAN

UST Arena • Vehicle Tracking Exhibit - Cretin Access: WB-40 Movement • 01.19.2024



RYAN

UST Arena • Vehicle Tracking Exhibit - Fire Truck Movement • 01.19.2024



RYAN

UST Multipurpose Arena • Vehicle Tracking Exhibit - Passenger Car Movement - APF Drop Off • 03.25.2024

SCHOOL OF DIVINITY (SOD)

FACILITIES & DESIGN CENTER (FDC)

ANDERSON PARKING FACILITY (APF)

PROPOSED BUILDING

129,022± SF

BRADY EDUCATION CENTER (BEC)

GRACE HALL (GRA)

SOUTH ATHLETIC FIELDS (SAF)

CRETIN AVENUE

GRAN

N

0 30 60

SCALE IN FEET

RYAN

UST Arena • Vehicle Tracking Exhibit - Shuttles • 03.23.2024

SCHOOL OF DIVINITY (SOD)

FACILITIES & DESIGN CENTER (FDC)

ANDERSON PARKING FACILITY (APF)

PROPOSED BUILDING

129,022± SF

BRADY EDUCATION CENTER (BEC)

GRACE HALL (GRA)

SOUTH ATHLETIC FIELDS (SAF)

CRETIN AVENUE

GRAN

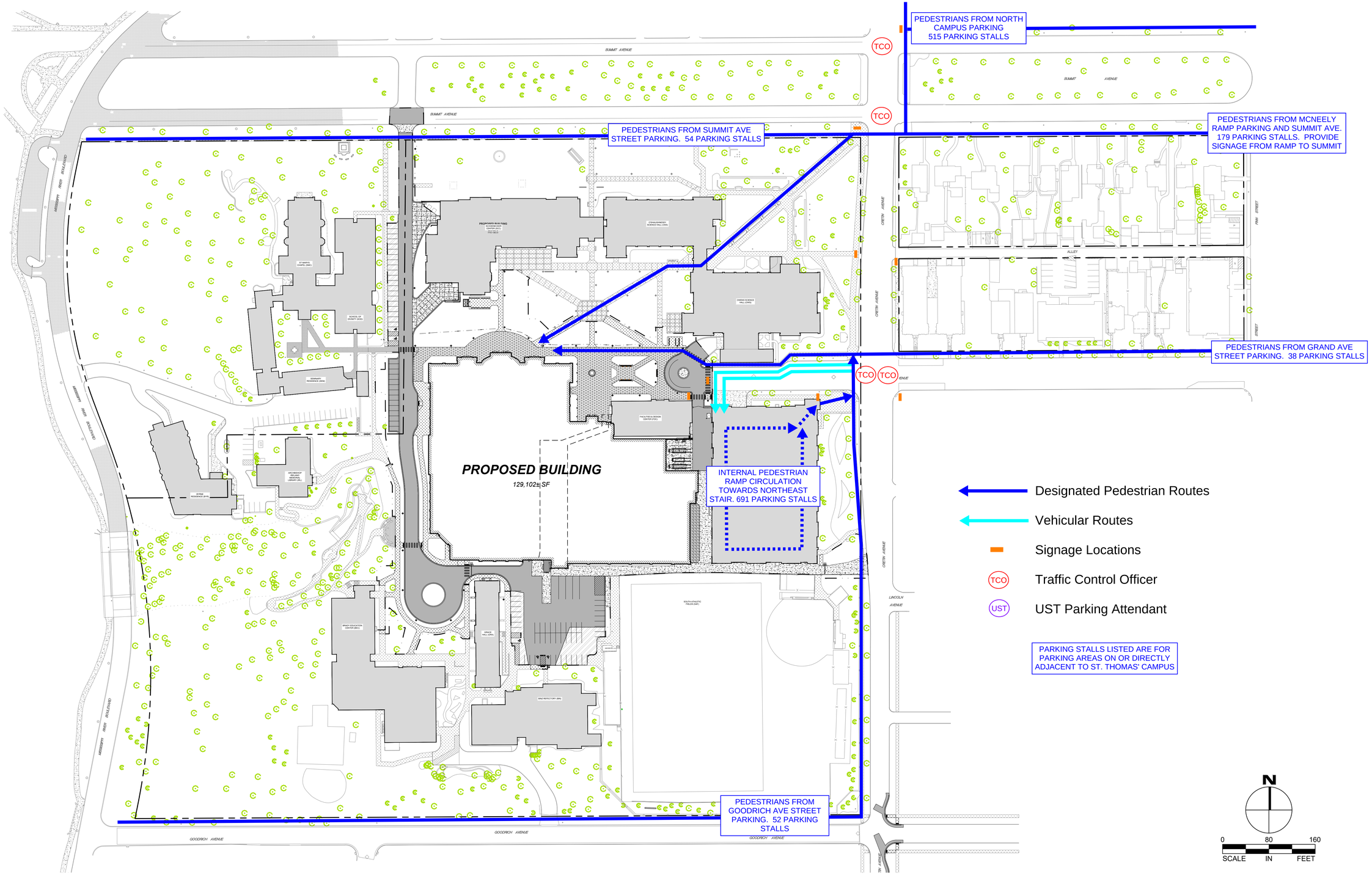
N

0 30 60

SCALE IN FEET

RYAN

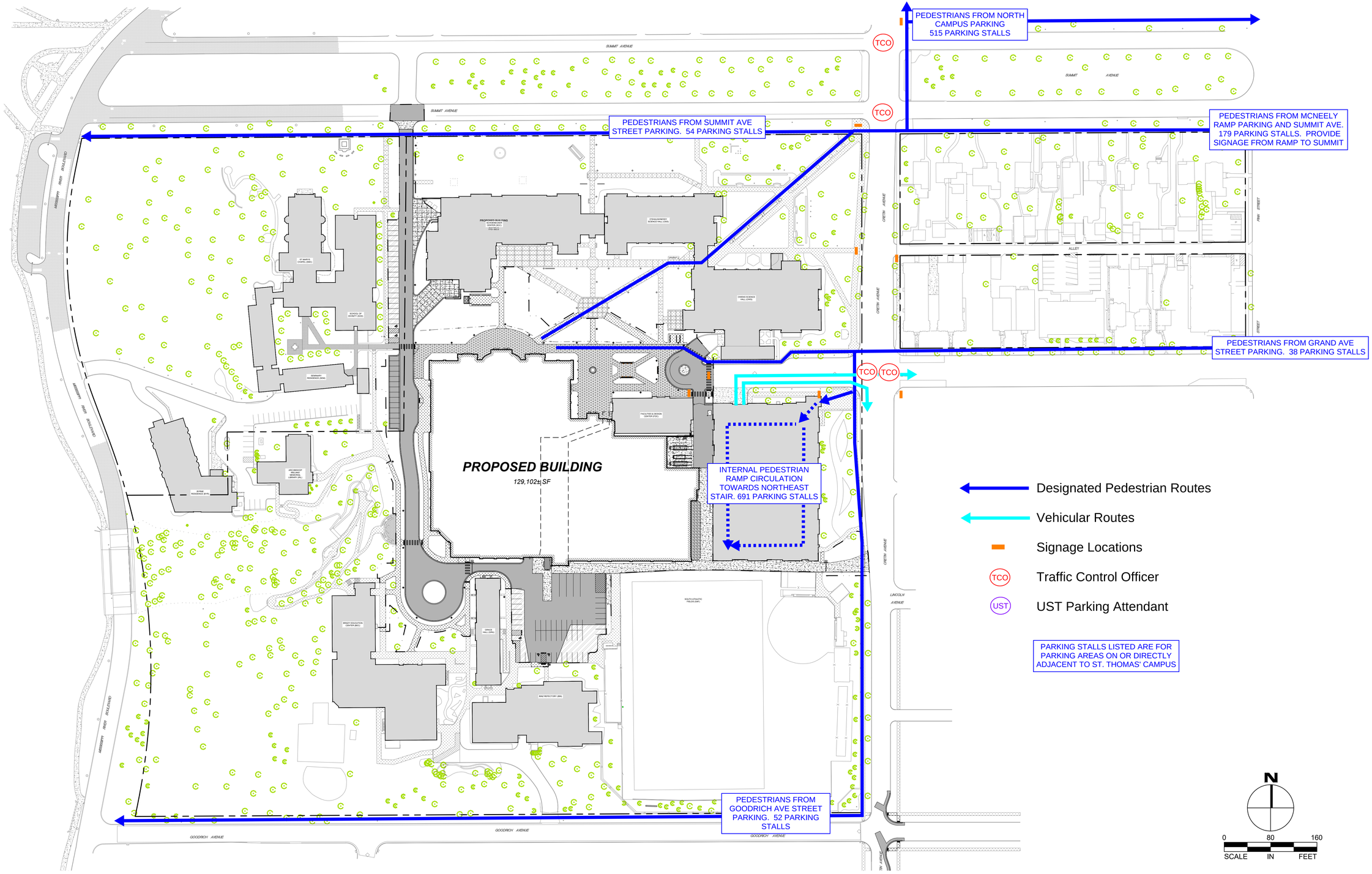
UST Arena • Vehicle Tracking Exhibit - Shuttles + Fire Truck • 03.23.2024



RYAN

Lee & Penny Anderson Multipurpose Arena • Scaled Site Plan • 01.19.2024

PRE-EVENT



RYAN

Lee & Penny Anderson Multipurpose Arena • Scaled Site Plan • 01.19.2024

POST-EVENT

DRAFT Memorandum

SRF No. 16489

To: Anthony Adams, PE, Civil Engineer
Ryan Companies

From: Brent Clark, PE, Project Manager – Traffic Studies
Collin Schroeder, PE, Traffic Operations and Modeling Lead

Date: January 23, 2024

Subject: *UST Multipurpose Arena EAW Transportation Analysis* – APF Access Addendum

Introduction

The *UST Multipurpose Arena EAW Transportation Analysis* was developed by SRF Consulting Group, Inc. (SRF) in June of 2023. Since completion of the EAW, pedestrian access assumptions to/from the Anderson Parking Facility (APF) have changed. Therefore, the objectives of this addendum are to evaluate the event operations expected with the current APF access assumptions and recommend mitigation improvements/strategies to address any issues, if necessary. The following information provides the assumptions, analysis, and recommendations offered for consideration.

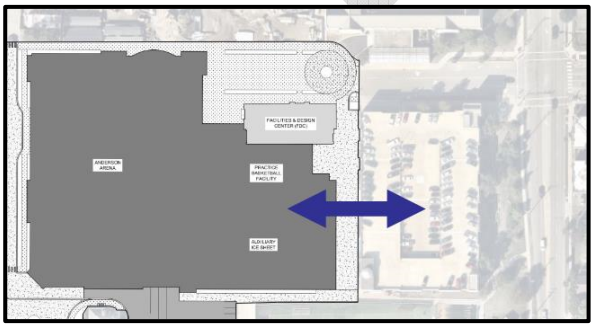
Assumption Modifications

The following assumptions have either been modified or additional information has been collected since completion of the EAW, that may impact the anticipated maximum capacity event operations.

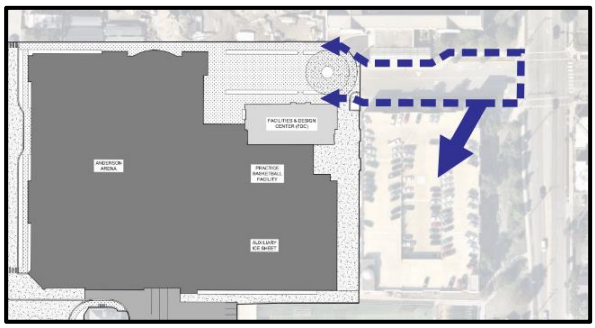
APF Pedestrian Access

As part of the EAW, the west side of the APF was expected to be modified to provide a pedestrian entrance/exit, thus providing a direct connection for APF users and the Arena. While an at-grade pedestrian access is still proposed on the west side of the APF (for access to the auxiliary ice rink only), a stairwell to provide pedestrian access from the other levels of the ramp is no longer proposed to be constructed at this time. Pedestrians are now proposed to route to/from the APF utilizing the northeast stair tower, thus crossing APF vehicular traffic either at the APF entrance or the Cretin Ave/Grand Ave intersection. Therefore, the main objective of this addendum is to evaluate the event operations expected with the current APF access and determine which crossing location is better from an operational and safety perspective.

Previous APF Access Assumptions



Current APF Crossing Options



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Off-Site Parking & Shuttle Service

While off-site parking and shuttle services were identified as a mitigation strategy within the EAW, they were not assumed in any of the event operations analysis completed. As part of the EAW Mitigation, off-site parking and shuttle services will be provided for large events. Therefore, in order to accurately model a maximum capacity event, off-site parking and shuttle services were assumed to accommodate approximately 800 event-patrons and pick-up/drop-off was assumed on the west side of the Arena.

Event Arrival Volume Profiles

Peaks are expected to occur for vehicular and pedestrian traffic within the arrival and departure peak hours. As part of the EAW, 15-minute pre-event arrival distributions were developed based on detector data collected before Minnesota Twins/Vikings games and modified for the UST site to reflect higher peaks (closer event arrivals to game time) given UST is not in a downtown setting with nearby pre-event entertainment options. To better understand similar event types, ramp entering data was collected at four (4) Minnesota Gopher hockey/basketball games to review pre-event arrival distributions for similar Division-1 athletic events. Results of the data collection efforts determined that the pre-event arrival distributions for Minnesota Gopher events were more spread out than what was assumed within the EAW. Therefore, while the pre-event arrival distributions were not changed as part of this addendum, they may be more conservative than what is experienced in the field.

Operations Review

An operations analysis was conducted for both pre-event and post-event conditions during a maximum capacity weeknight event (i.e., basketball game) to determine the potential transportation impacts associated with the current APF access assumptions. The operations analysis was completed using VISSIM software, which is a more detailed microsimulation software than Synchro/SimTraffic that can better capture event operations and pedestrian/vehicle interactions. Note that based on discussions with the project team, the analysis was focused on the Grand Avenue/APF Access, Cretin Avenue/Grand Avenue, and Cretin Avenue/Summit Avenue intersections. In addition to the base assumptions identified within the EAW, various mitigation assumptions were also assumed within the analysis such as:

- Off-site parking and shuttle services were assumed to accommodate approximately 800 event patrons and pick-up/drop-offs were assumed on the west side of the Arena.
- Traffic control officers were assumed at the Cretin Avenue/Grand Avenue and Cretin Avenue/Summit Avenue intersections.
- Cones were assumed to provide two storage lanes for vehicles entering the APF, and two parking attendants (one per lane) were assumed to be checking pre-paid parking tickets during pre-event conditions.

Note the previous analysis assumed that APF users would have a direct pedestrian connection to/from the Arena. Therefore, the following pedestrian routing scenarios for APF users were analyzed from an operational and safety perspective:

- **EAW Scenario** – This scenario is representative of the "No Mitigation" and "With Mitigation" analysis completed within the EAW. The west side of the APF was assumed to provide a direct pedestrian connection between the APF and the Arena. The "With Mitigation" analysis mainly consisted of implementing designated pedestrian routes to limit any pedestrian crossings of Grand Avenue or the APF ramp.
- **APF Crossing** – Pedestrians to/from the APF are assumed to enter/exit the northeast APF stairwell, utilize the sidewalk on the south side of Grand Avenue, and cross the APF vehicular access. Parking attendants and/or traffic control officers are assumed to be located at the APF vehicular access to safely manage the pedestrian/vehicular interactions.
- **Cretin/Grand Crossing** – Pedestrians to/from the APF are assumed to enter/exit the northeast APF stairwell and cross Grand Avenue at the Cretin Avenue/Grand Avenue intersection. All APF users are assumed to utilize the sidewalk on the north side of Grand Avenue. The sidewalk on the south side of Grand Avenue is assumed to be closed through the use of barricades, cones, and/or wayfinding signage.

Max Capacity - Pre-Event Operations

An illustrative summary of the pre-event operations is shown in Figure 1. With the APF primarily utilized for event parking (691 spaces), over 1,700 pedestrians are expected to exit the ramp during the pre-event peak hour. This results in a pedestrian/vehicular conflict for APF users that reduces vehicle efficiencies entering the ramp and aligns with "Issue 1A" within the EAW.

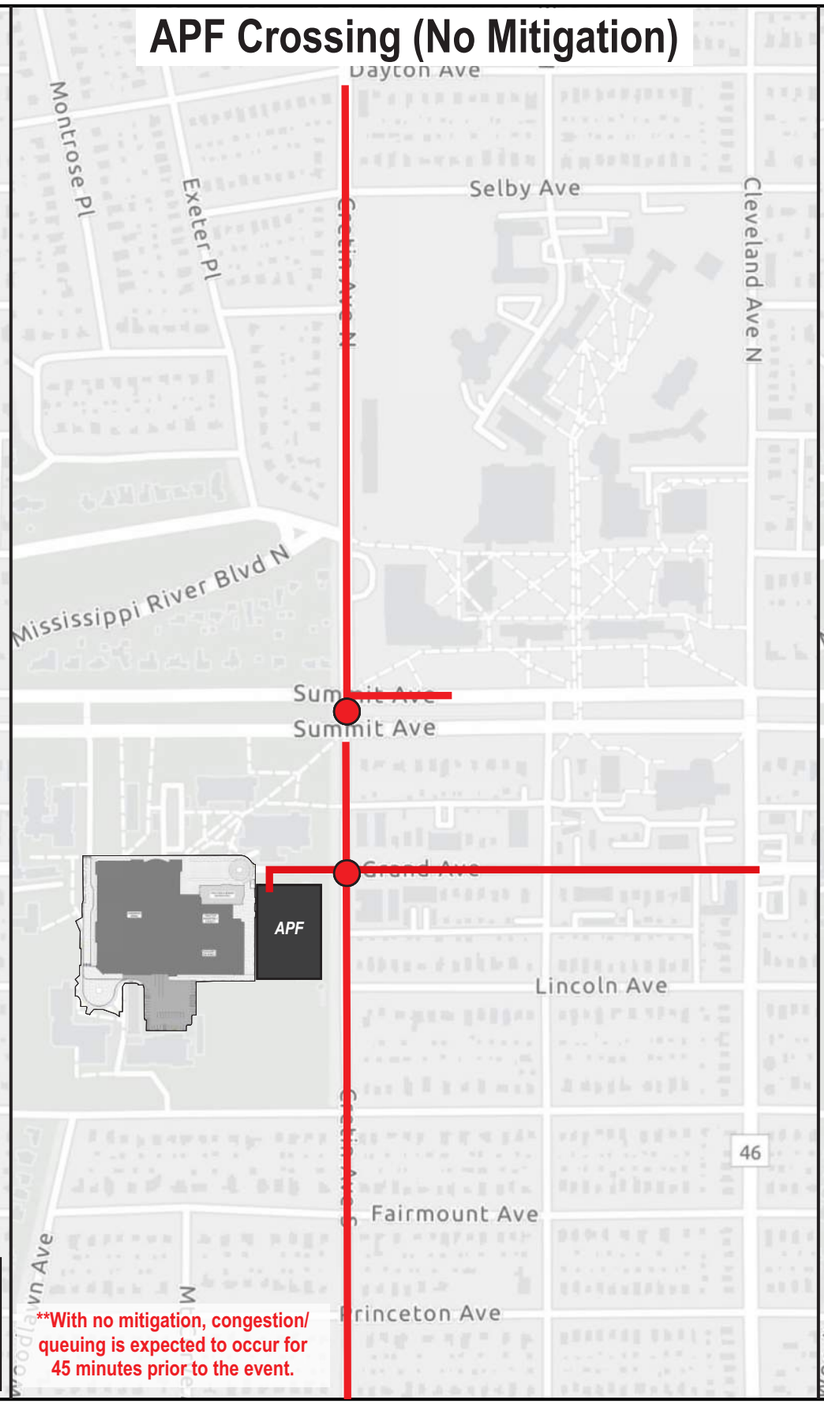
Under the APF Crossing alternative, maximum queues are expected to extend to Dayton Avenue to the north and Sargent Avenue to the south during pre-event conditions. Note these operations are expected to be worse than the "No Mitigation" analysis scenario within the EAW.

The Cretin/Grand Crossing alternative operates much better than the APF Crossing alternative. This is due to a combination of larger pedestrian storage areas/crossing widths and that the pedestrian crossing at the intersection provides the ability (i.e. functions as a meter) to help clear APF entering queues. Under this scenario, maximum queues are expected to extend to Riverwood Place to the north and Goodrich Avenue to the south during pre-event conditions, which is similar to maximum queues within the "No Mitigation" analysis scenario within the EAW. Additional mitigation strategies/improvements are recommended to help improve these conditions and are summarized in the following section.

DRAFT SUBJECT TO CHANGE

EAW Scenario

APF Crossing (No Mitigation)



Cretin/Grand Crossing (No Mitigation)

SRF

02416489
January 2024

Max Capacity - Pre-Event Operations Comparison

UST Multipurpose Arena EAW Transportation Study - APF Access Addendum

City of St. Paul

Figure 1

Max Capacity - Post-Event Operations

While some post-event congestion is expected on adjacent roadways, the bottleneck is generally expected to be exiting the APF ramp. Therefore, post-event operations were summarized based on APF clearing times and shown in Table 1. Note these clearing times represent the total amount of time it takes to clear the APF ramp and does not represent the average delay that each APF user is expected to experience. Additional mitigation strategies/improvements are recommended to help improve these conditions and are summarized in the following section.

Table 1. APF Ramp Clearing Times

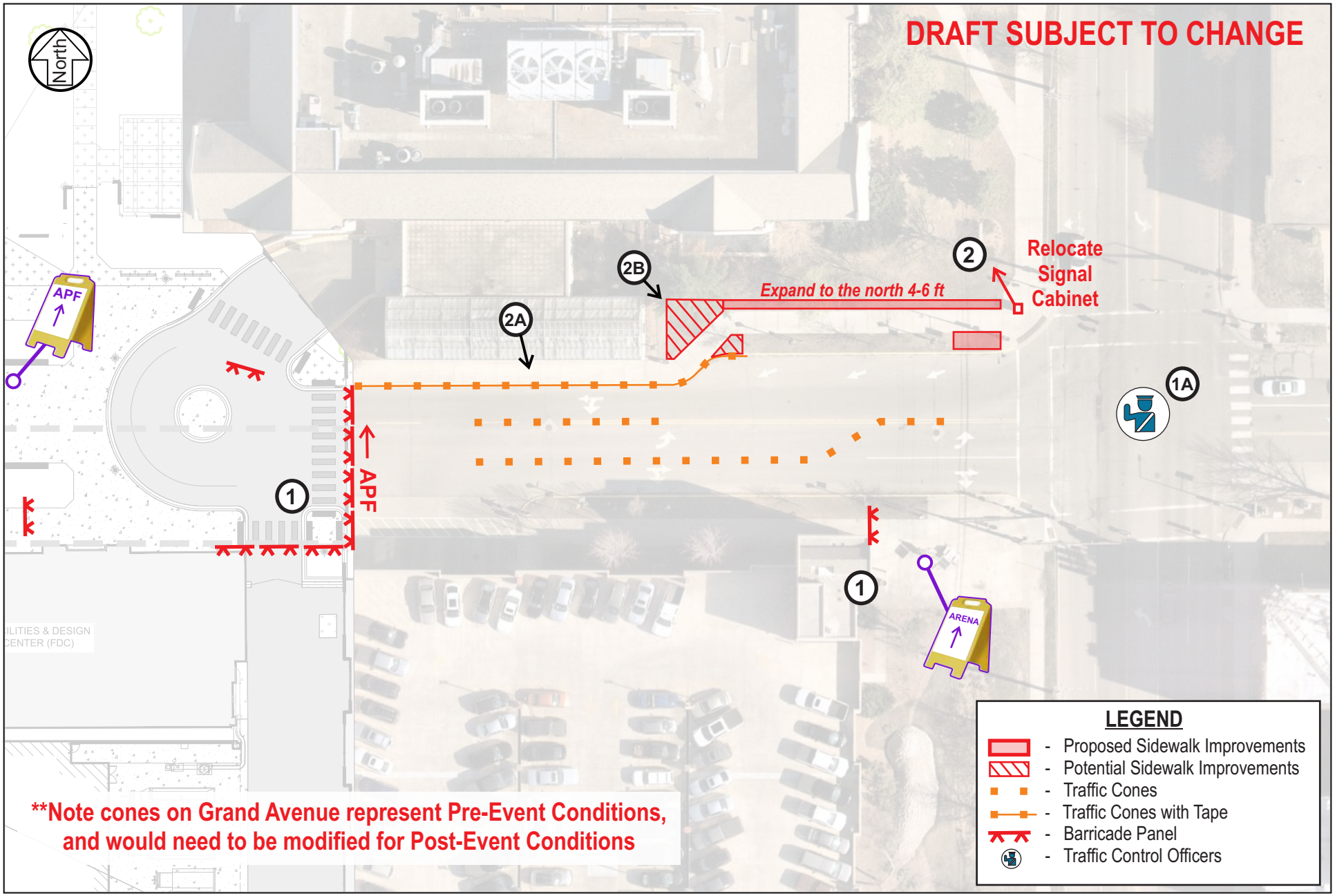
Scenario	Clearing Times
EAW Scenario (with Mitigation)	10-20 min
APF Crossing	30-45 min
Cretin/Grand Crossing	20-35 min

Event Management Recommendations

Based on the operations review, without a direct pedestrian connection from the APF to Arena, operations are expected to operate similar or worse than the "No Mitigation" scenario within the EAW. This is largely due to the amount of pedestrians that are expected to cross the vehicular entrance to the APF or the Cretin Avenue/Grand Avenue intersection. Therefore, the following mitigation strategies are recommended to help reduce event congestion and are summarized below and illustrated in Figure 2. With the mitigation improvements (1 and 2 only), the site is anticipated to operate similar to the "With Mitigation" scenario within the EAW, as shown in Figure 3.

1) Implement the "Cretin/Grand Crossing" alternative by closing the sidewalk on the South side of Grand Avenue and provide wayfinding signage to direct pedestrians to/from the Cretin Avenue/Grand Avenue intersection. The sidewalk closure can be accomplished through a combination of barricades, cones, and wayfinding signage.
    a. Note multiple traffic control officers will need to be provided at the Cretin Avenue/Grand Avenue intersection in order to implement this alternative.

2) Widen the pedestrian facilities and crossings on the west side of the Cretin Avenue/Grand Avenue intersection and relocate the existing signal cabinet in the northwest quadrant, to help manage event pedestrian demand. Widening the effective pedestrian crossing width helps reduce pedestrian crossing times, which is expected to provide operational benefits for entering traffic. While the intersection crosswalk markings could be updated to reflect the increased crossing width, constructing the sidewalk improvements alone (in addition to clearing snow) is expected to be enough for pedestrians to utilize the space as an effective crossing. In addition, traffic control officers and/or "Stop Here on Red" signage officers can help ensure eastbound vehicles don't intrude on the effective crosswalk.



SRF

Max Capacity Mitigation Strategies

UST Multipurpose Arena EAW Transportation Study - APF Access Addendum

City of St. Paul

02416489
January 2024

Figure 2

DRAFT SUBJECT TO CHANGE

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January 2024

Operations Analysis with Mitigation

UST Multipurpose Arena EAW Transportation Study - APF Access Addendum

City of St. Paul

Figure 3

a. Note the sidewalk immediately south of the medical garden is only approximately 8-feet wide and has limited flexibility for expansion. While this section may be a slight bottleneck for pedestrians, there is expected to be enough pedestrian storage on both sides (i.e. the APF plaza and the Cretin/Grand NW sidewalk improvements) to limit any pedestrian queuing issues. Additional cones with tape or other devices should be provided directly south of the sidewalk, adjacent to the medical garden, to limit any pedestrian spillover onto the roadway.

b. Additional sidewalk space could be considered east of the medical garden section to help funnel pedestrians during pre-event conditions.

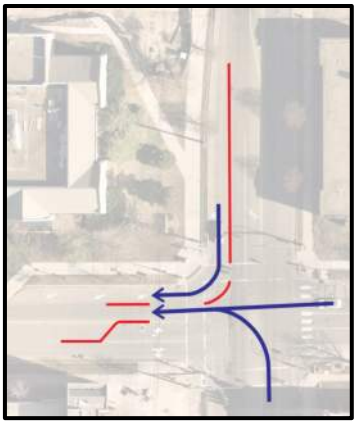
3) Provide incentives to arrive early/stay late before and after an event. As mentioned previously, the pre-event operations analysis may be conservative based on data collected at similar facilities. Additional incentives could further spread-out arrival/departure times, which could provide operational and safety benefits.

Other Considerations

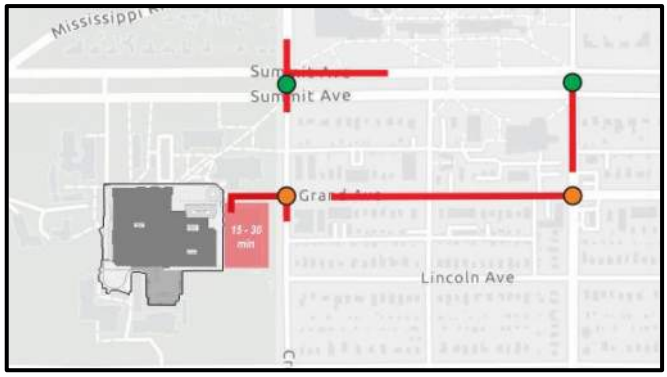
In addition to the strategies identified above, the following event management considerations are provided below and could be considered in the future if needed. Further discussion should occur with the project team as part of the Event Traffic Management Plan.

- Pre-event operations will be heavily dependent on APF service times/parking ticket checks entering the ramp. It should be noted that the analysis assumed two parking attendants (one per entering lane) would be checking pre-paid parking tickets. These operations will need to continue to be monitored and if queuing impacts occur the following strategies could be considered:
  - Increase entering efficiency by either providing additional parking attendants, utilizing one of the ramp exit lanes for entering, and/or refining the pre-paid parking system.
  - Relocate parking ticket checks to within the ramp to provide additional vehicular storage.

- A southbound right-turn only lane could be considered at the Cretin Avenue/Grand Avenue intersection during pre-event conditions. This strategy could be implemented through the use of cones, signage, and traffic control officers, and would provide the ability to allow southbound right-turn movements to occur simultaneously to northbound-left or westbound-thru movements. While this traffic control strategy could provide operational/queueing benefits, it would likely require a traffic control contractor, additional traffic control officers, and may be difficult to implement in the field. Therefore, this strategy should only be considered in the future if queueing issues occur.



- With the use of traffic control officers, the eastbound left-turn movement could be restricted during post-event conditions by converting the eastbound left-turn lane to an eastbound-thru and the eastbound thru-right to a right-turn only lane. Restricting the left-turn movement would greatly reduce pedestrian/vehicular conflicts along Cretin Avenue. A sensitivity analysis test was performed under the Cretin/Grand Crossing alternative, with the eastbound left-turn movement restricted. Results of the analysis, which is summarized in the inset, indicate that the APF ramp is expected to be cleared in 15 to 30 minutes under this scenario.
    - This is anticipated to be the most efficient strategy to clear post-event congestion from the APF ramp and on the adjacent roadway network with the current APF pedestrian access. Post-event congestion is expected to be displaced to the Cleveland Avenue/Grand Avenue and Cleveland Avenue/Summit Avenue intersections, as shown in the inset, which would likely require implementing event signal timing modifications. The turn restrictions at Cretin Avenue, however, will result in a less direct route for event patrons and some users may use alternative local roadways to reach their destination.



    - Further discussion with the project team should occur as part of the ETMP on whether to implement this strategy.
- The pedestrian facilities at the Cretin Avenue/Summit Avenue intersection are expected to be adequate. Traffic control officers are still recommended at the intersection during post-event conditions, to help clear traffic volumes from the APF ramp and improve pedestrian safety. If the eastbound left-turn restrictions are implemented at Cretin Avenue/Grand Avenue (see above), traffic control officers may no longer be needed at this location from an operations perspective.

Next Steps (Event Traffic Management Plan)

As part of the EAW Mitigation, an Event Traffic Management Plan (ETMP) is required to be developed, in consultation with the City of Saint Paul PED and Public Works Departments. As the project proceeds into the next phase, further refinement of the potential mitigation strategies is expected. The ETMP is expected to be a "living document" and mitigation/management strategies will be refined as events occur and a better understanding of event operations are experienced.

Facilities Management

Mail PHP
2115 Summit Avenue
St. Paul, MN 55105-1096
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Telephone: 1(651) 962-6530

March 1, 2024

Ms. Tia Anderson
Principal City Planner
City of St. Paul, Department of Safety and Inspections
375 Jackson Street
Saint Paul, MN 55104

Re: Anderson Parking Facility Access to the Lee & Penny Anderson Multipurpose Arena

Dear Ms. Anderson,

The University of St. Thomas (St. Thomas), with the assistance of Ryan Companies (Ryan), are currently working through the Site Plan Review (SPR) process for the proposed Lee & Penny Anderson Multipurpose Arena project located on St. Thomas' South Campus parcel. The Project Team has been evolving the project design to balance St. Thomas' campus operations, programming and operations of the multipurpose arena building, and the financial commitments to the arena project, which have resulted in changes to pedestrian access from one of the intended parking locations for events.

The multipurpose arena is anticipated to use many existing parking ramps and lots within St. Thomas' campus for event parking, one of which is the Anderson Parking Facility (APF) located directly to the east of the proposed arena location. The initial project design indicated a skyway connection to be added from the APF ramp to the arena building, but as the project design and cost modeling have advanced the skyway was removed and the intended pedestrian route is through the existing northeast stair tower, crossing Grand Ave at the Cretin Ave intersection, and routing along the north side of Grand Ave to the main arena entry on the north side of the proposed building. A memo was provided by SRF Consulting, titled "APF Access Addendum" and dated January 23, 2024, indicating that this pedestrian route is proposed to be similar to the skyway connection if mitigation measures were put in place, which St. Thomas intends to implement through the project design and operations of the arena.

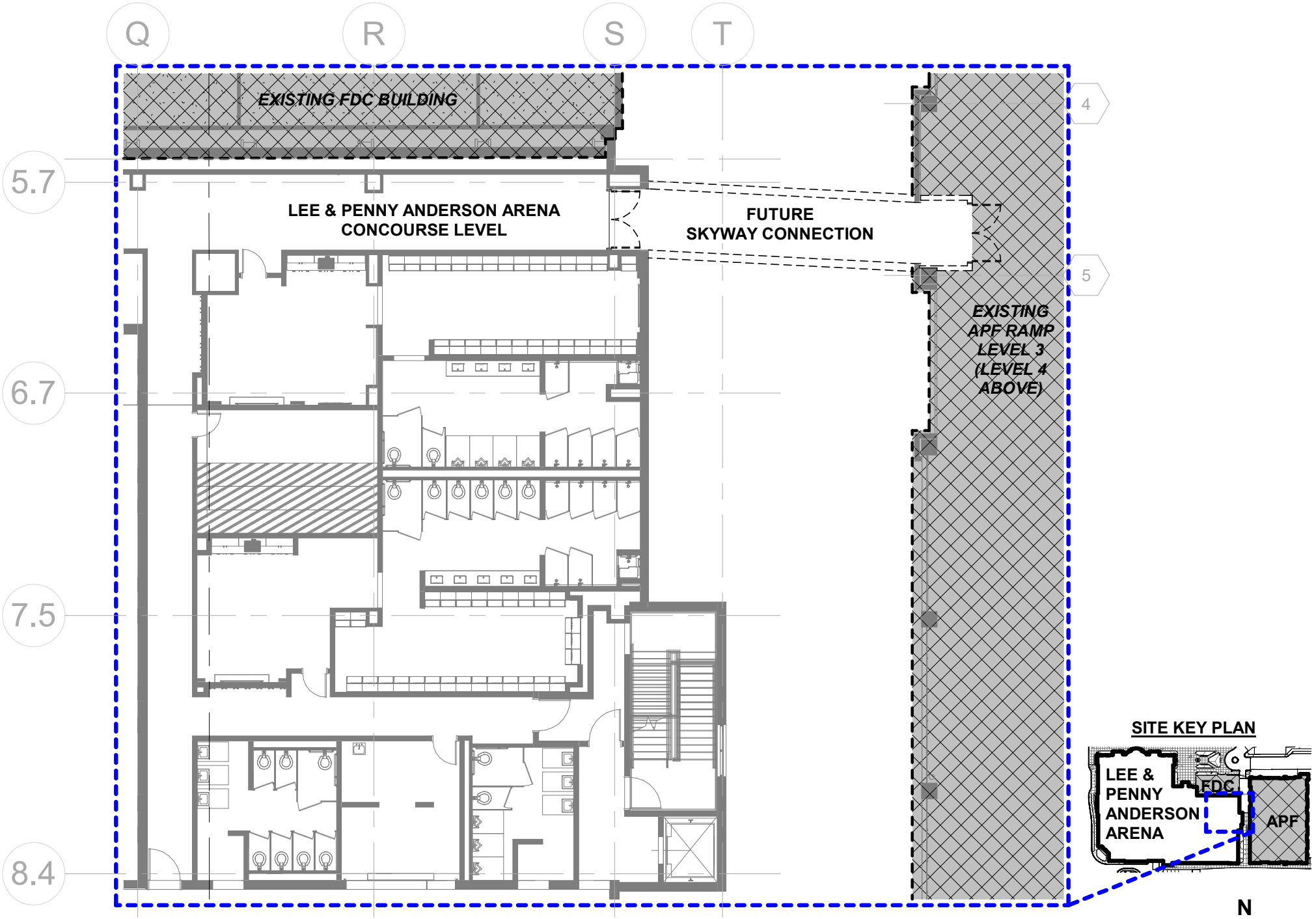
Through the SPR comments received from City Staff in February 2024, staff requested a letter from St. Thomas indicating their commitment to implementing an alternate access solution in the future if event operations become problematic. This letter serves as an acknowledgment from St. Thomas regarding their commitment to improving access to and from the APF ramp if event operations are deemed problematic. Access improvements include modifications to the mitigation measures as identified in the APF Access Addendum or physical improvements to the APF structure itself. Physical improvements to the APF structure could include a skyway connection from the western side of the APF directly to the arena building across the alley between the buildings, a vertical circulation element exterior to the APF structure that would allow pedestrian access directly to the northeast arena plaza, or another improvement to the structure as identified at that time. An exhibit is included with this letter to show one

potential future improvements (the skyway connection) and how that is being integrated into the initial project design of the arena.

We are excited to continue moving the Lee & Penny Anderson Multipurpose Arena project forward and hope that this letter addresses the comment by City staff. Please reach out if there are any questions or clarifications regarding the request.

Sincerely,

Jim Brummer
Vice President for Facilities Management
University of St. Thomas

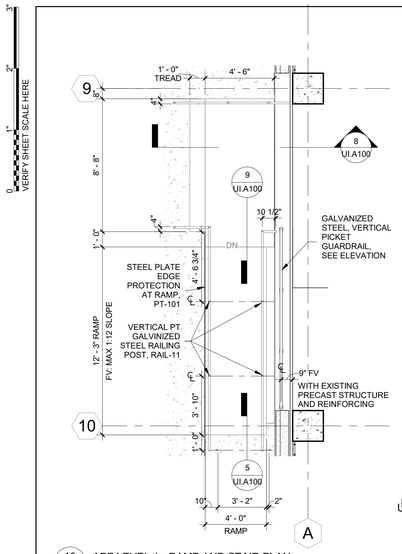


1 CONCOURSE LEVEL - FUTURE SKYWAY CONNECTION TO APF

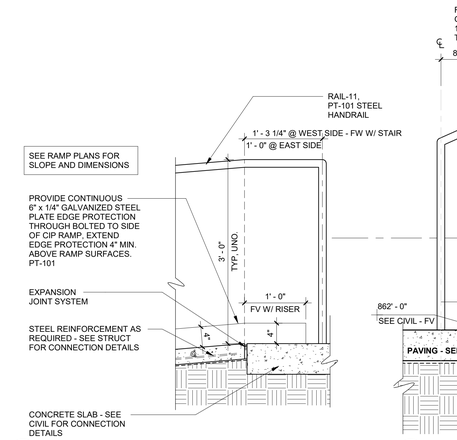
1/16" = 1'-0"

WE BUILD STORIES

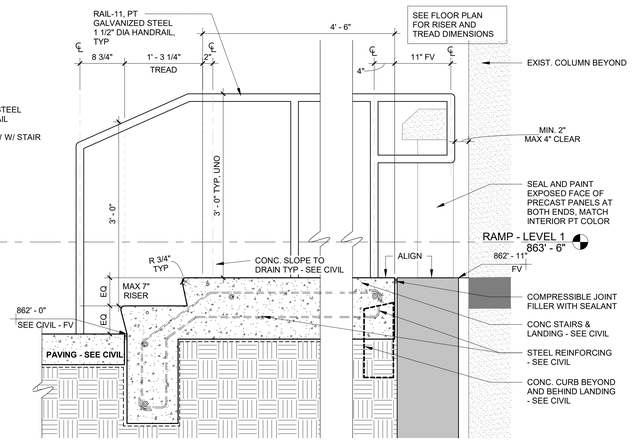
RYAN



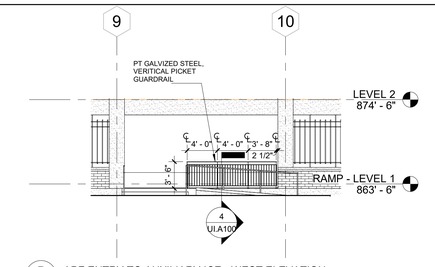
10 APF LEVEL 1 - RAMP AND STAIR PLAN
U1.A100 1/4" = 1'-0"



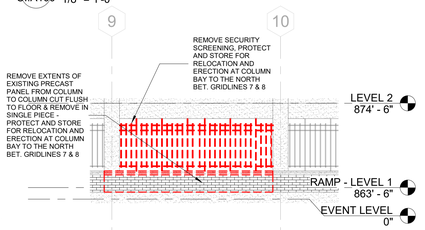
9 RAMP - HANDRAIL EXTENSION - TOP
U1.A100 1" = 1'-0"



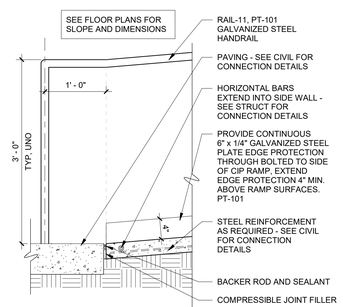
8 SECTIONA AT STAIR LANDING
U1.A100 1" = 1'-0"



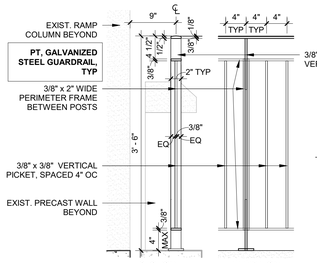
7 APF ENTRY TO AUXILIARY ICE - WEST ELEVATION
U1.A100 1/8" = 1'-0"



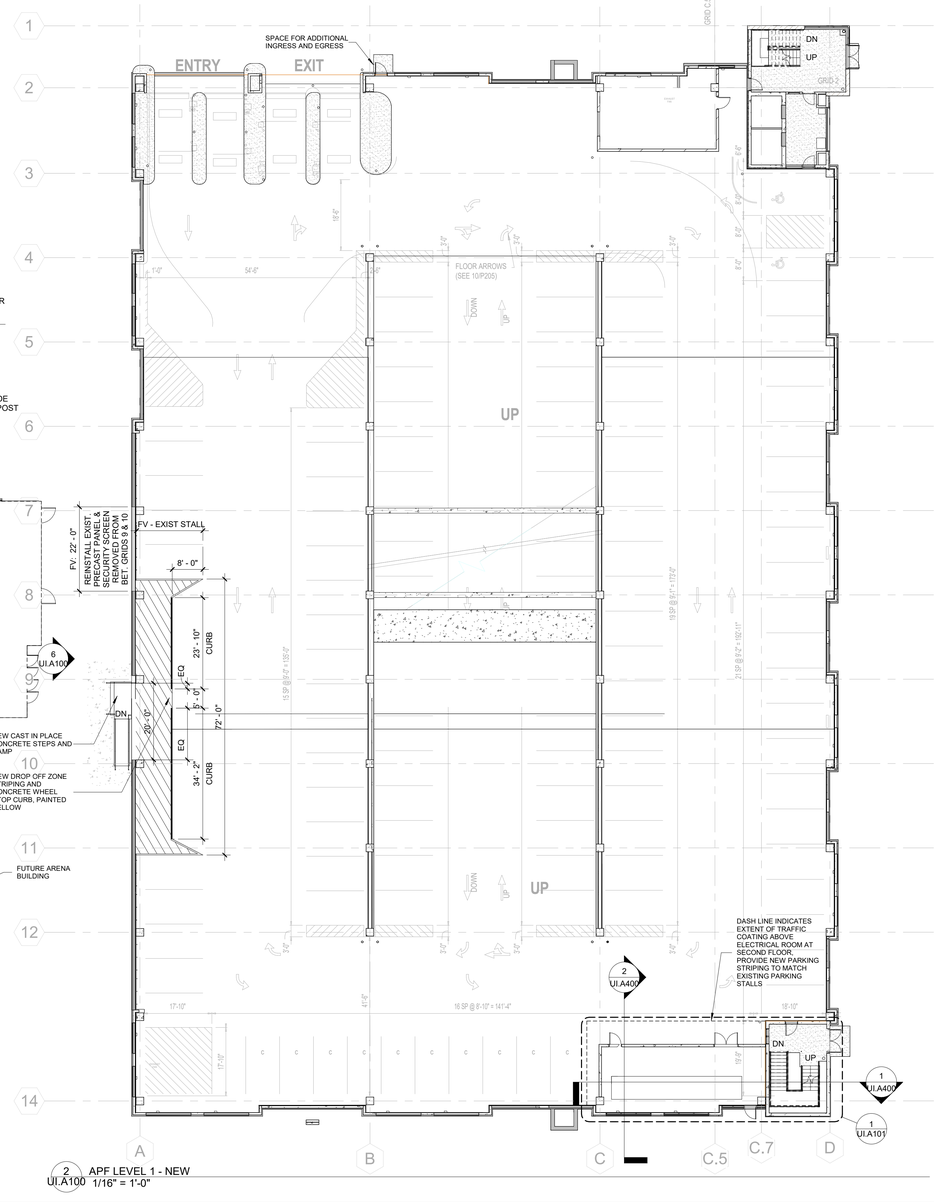
6 APF ENTRY TO AUXILIARY ICE - WEST ELEVATION (DEMO)
U1.A100 1/8" = 1'-0"



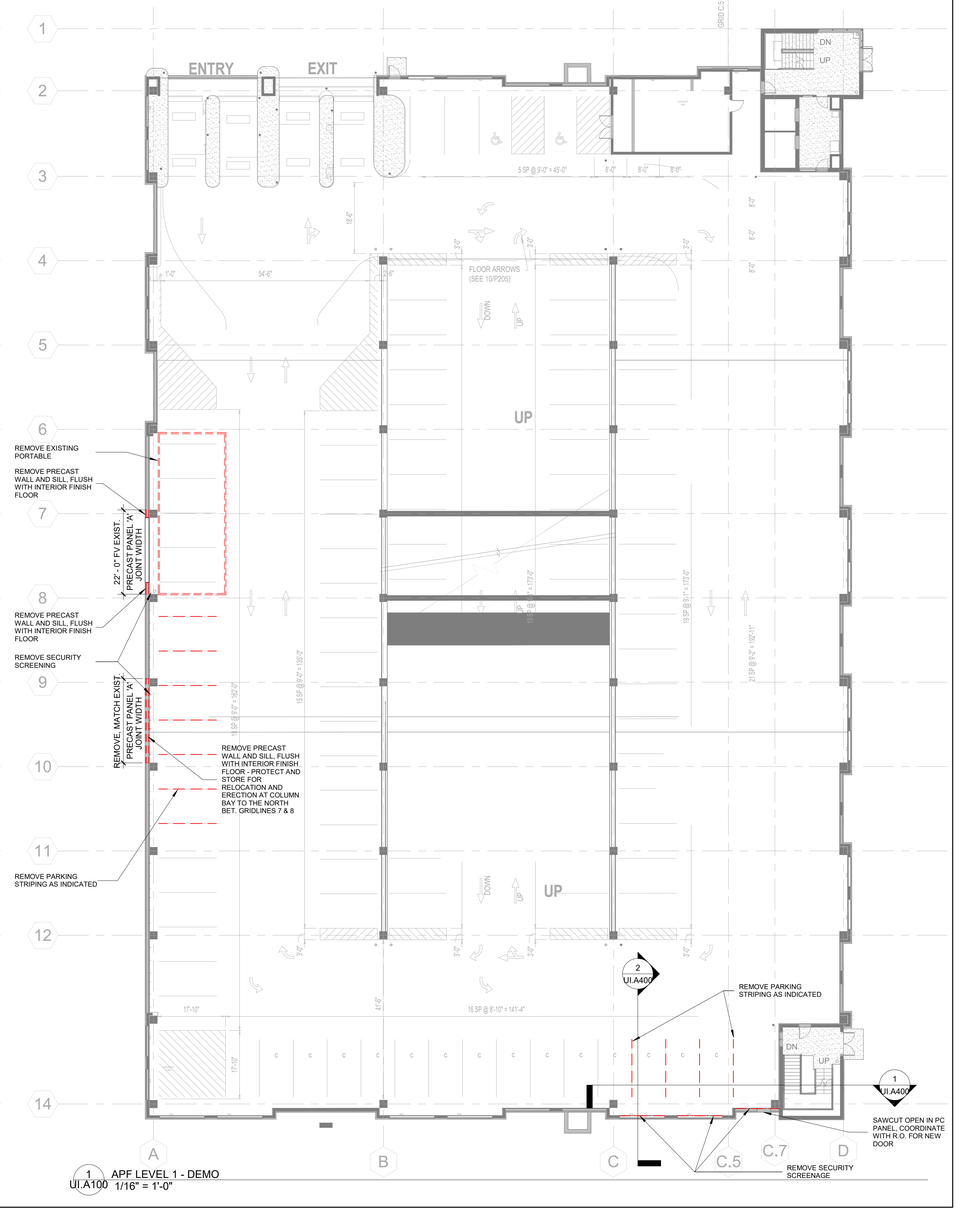
5 RAMP - HANDRAIL EXTENSION - BOTTOM
U1.A100 1" = 1'-0"



4 APF GUARDRAIL SECTION & TYP POST ELEVATION
U1.A100 1" = 1'-0"



2 APF LEVEL 1 - NEW
U1.A100 1/16" = 1'-0"



1 APF LEVEL 1 - DEMO
U1.A100 1/16" = 1'-0"

DEMOLITION GENERAL NOTES

1. CONTRACTOR TO VERIFY DIMENSIONS AND CONDITIONS SHOWN ON THESE DRAWINGS ANY OMISSIONS, DISCREPANCIES, OR CONFLICTS MUST BE REPORTED TO THE ARCHITECT IMMEDIATELY.
2. CONTRACTOR SHALL PROTECT ALL EXISTING CONSTRUCTION TO REMAIN. PROVIDE TEMPORARY BARRICADES AND PROTECTION TO PREVENT INJURY TO PEOPLE AND DAMAGE TO ADJACENT CONSTRUCTION TO REMAIN.
3. FLOORS TO BE PREPPED AND CLEANED TO RECEIVE NEW FINISHES, TYPICAL IN EFFECTED AREAS.
4. REMOVE EXISTING CONSTRUCTION AS SHOWN.
5. CONTRACTOR SHALL PATCH ALL SURFACES DISTURBED BY DEMOLITION
6. CONTRACTOR SHALL PROVIDE TEMPORARY ENCLOSURES AT WINDOW AND DOOR OPENINGS AS REQUIRED.
7. THE EXISTING INSTALLATION AS SHOWN ON THE DRAWINGS MAY NOT BE COMPLETELY ACCURATE IN ALL RESPECTS WITH REGARD TO QUANTITIES, LOCATIONS, ETC... AND IS SHOWN PRIMARILY TO GENERALLY ILLUSTRATE THE DEGREE OF DEMOLITION WORK INVOLVED. DEMOLITION WORK SHALL BE INCLUSIVE IN AREA SHOWN.
8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR DEMOLITION OF EXISTING MATERIALS AS SHOWN AS NECESSARY TO ACCOMPLISH THE WORK INDICATED ON THE DRAWINGS. MATERIALS SHOWN TO BE REMOVED AND NOT REUSED SHALL BECOME THE PROPERTY OF THE CONTRACTOR AND SHALL BE REMOVED FROM THE SITE UNLESS NOTED OTHERWISE.
9. WHEN UTILITY SYSTEMS NEED TO BE REMOVED, PROVIDE CAP, VALVE, PLUG, OR SEAL TO MEET CODE REQUIREMENTS AND MAINTAIN CONTINUUM OF THE SYSTEM.
10. DURING DEMOLITION ACTIVITIES, MAINTAIN FDC BUILDING SO IT REMAINS WATER TIGHT AND WEATHER TIGHT.
11. UNLESS DEMOLISHED MATERIAL IS INDICATED TO REMAIN, OR TO BE TURNED OVER TO THE OWNER, REMOVE MATERIAL FROM PROJECT SITE AND DISPOSE OF LEGALLY.
12. THE CONTRACTOR IS TO PROTECT THE EXISTING FDC BUILDING STRUCTURE AND FINISHES TO REMAIN.
13. THE CONTRACTOR IS TO CAP AND PROTECT ALL UTILITES AS ENCOUNTERED. THE CONTRACTOR SHALL DISCONNECT AND REMOVE UNUSED CONDUIT AND OTHER RACEWAYS NO LONGER IN USE.
14. WHERE ENTIRE BUILDINGS ARE INDICATED FOR REMOVAL REMOVE ALL STRUCTURE, FINISHES, ENCLOSURES, ROOFS, FLOORS, FOUNDATIONS IN THEIR ENTIRETY, WALLS, INTERIOR PARTIONS, MEP SYSTEMS.
15. CONTRACTOR TO COORDINATE REMOVAL OF FIXTURES AND FFE DESIRED TO BE RETAINED BY OWNER IN BUILDINGS INDICATED FOR REMOVAL.
16. REFER TO CIVIL REMOVAL NOTES ON C002 & C140A.

RYAN

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Minneapolis, MN 55415
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1801 McGee Street, Suite 200
Kansas City, MO 66210
816-421-2640 tel
816-421-2650 fax
WWW.CRAWFORDARCH.COM

OWNER

University of St. Thomas
St. Paul, MN

CONSULTANTS

PROJECT INFORMATION

LEE & PENNY ANDERSON MULTIPURPOSE ARENA

2260 SUMMIT AVE ST.
PAUL, MN 55105

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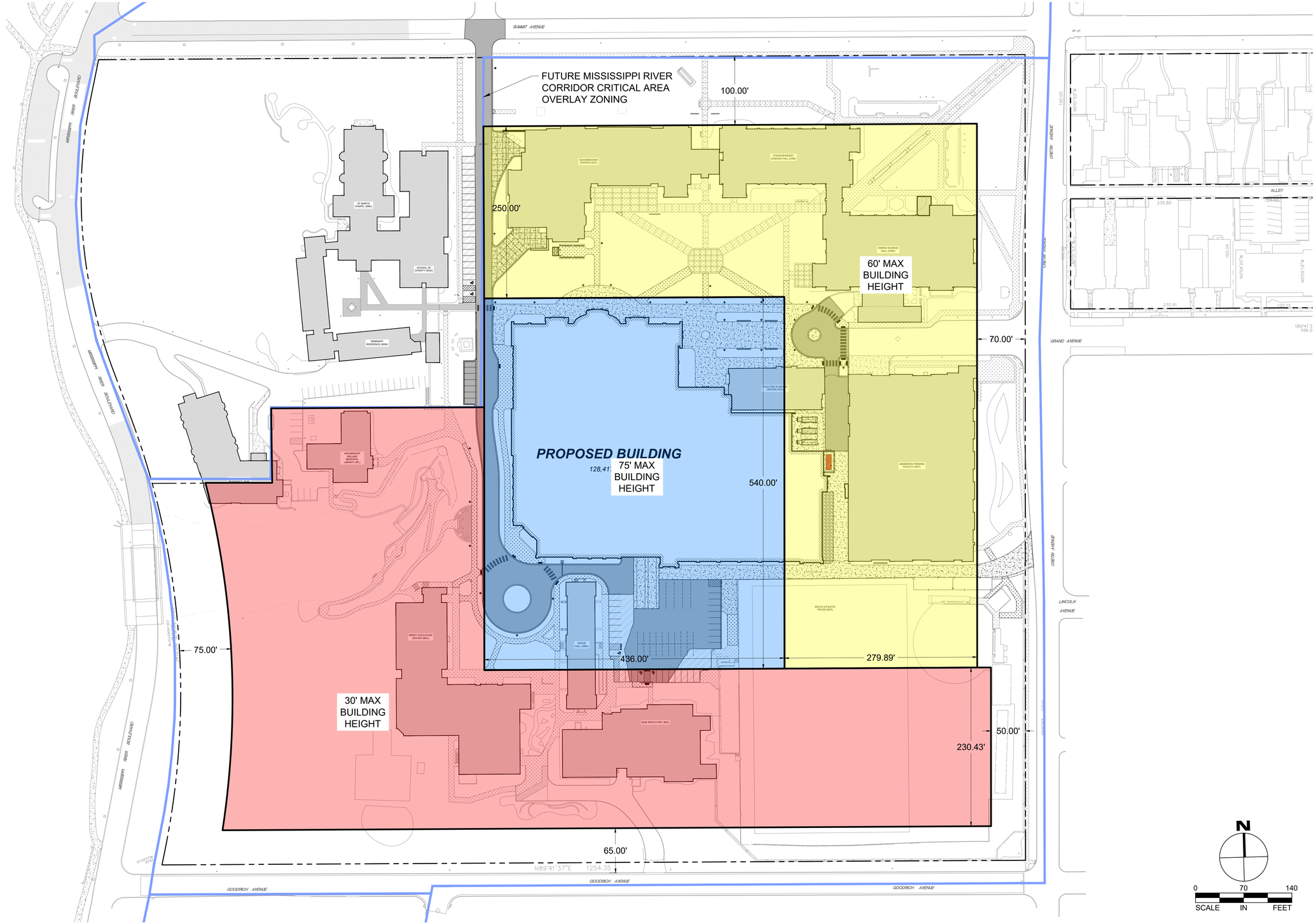
PROJ. NO.
701480

ISSUE RECORD		
ISSUE #	DATE	DESCRIPTION
1	03/01/2024	BUILDING PERMIT SET

APF ELECTRICAL ROOM

U1.A100

3/4/2024 4:56:18 PM



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SCALE IN FEET

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UST Multipurpose Arena • CUP Setbacks & Heights Exhibit • 09.01.2023