INTERWEST

October 30, 2020

Mr. Dave Wells, P.E.
City of Greeley
1001 9th Avenue
Greeley, CO 80631

Re: 35th Avenue Widening Design Drainage and Erosion Control Memorandum for 100% Submittal

Dear Dave,

We are pleased to submit for your review and approval this memorandum explaining the drainage impacts from the proposed 35th Avenue Widening Design project. Included in this memo is a section discussing Construction Erosion Control which will be useful to the contractor in their development of the SWMP for a CDPHE Discharge Permit. The 35th Avenue Widening Design project includes design of a new cross-section of the existing two lane rural paved road to a new urban arterial section. The new section will have four through lanes, two in each direction, on-street bike lanes, curb, gutter and sidewalk. The project also includes landscaped medians and tree lawns. Finally, roundabouts will be installed at the intersections of 35th Avenue and “C” and “F” Streets.

The area of the project is located within the City of Greeley Grapevine Drainage Basin.

Please refer to the attached Final Drainage Map depicting the area with its surrounding developments. This map also depicts the proposed drainage basins and shows street and inlet capacities and carryover flows.

Several drainage reports were referenced for this memo and include but are not limited to:

- Final Storm Drainage Report for Stoneybrook by QCI Development Service Group, Inc., dated September 27, 1995
- City of Greeley Comprehensive Drainage Plan Grapevine Basin Final Report by Anderson Consulting Engineers, Inc. dated March 8, 2006
- Union Colony Fire Station #3 Final Drainage Report by KBN Engineers, dated May 5, 2006
- Final Drainage and Erosion Control Report Faith Bible Baptist Church Building addition by Ridgeline Consultants, Inc., dated January 12, 2011
- As Built of Bestway Detention Pond by Anderson Consulting Engineers, Inc. dated June 2012
- Final Drainage Report for Stoneybrook Lot 4 by Atwell, LLC, dated August 21, 2020

Storm Drainage Analysis and Design Criteria for this project were implemented from the City of Greeley "Drainage Criteria and Construction Specifications Storm Drainage Volume II" (DCCS) and the "Urban Storm Drainage Criteria Manual" (USDCM) by Urban Drainage and Flood Control District (UDFCD) recently renamed to Mile High Flood District (MHFD).

Onsite drainage improvements were designed based on the 10-year (minor) storm event and the 100-year (major) storm event. Runoff was calculated using the Rational Method, and rainfall intensities for the 10-year and the 100-year storm return frequencies were obtained from Figure 3-1 of the DCCS. One-hour point rainfall data for the storm events is identified in Table 3-2 of the DCCS. Runoff coefficients based on soil type were determined from Table 6.4 from the USDCM. Time of concentrations were developed using equations from the USDCM. All runoff calculations and applicable charts and graphs are included in the attachments.

Street flows were determined based on the new cross-section of one-half of 35th Avenue from the centerline to the right-of way. Street capacity and inlet sizing was based on the minor and major storms (10- and 100-year, respectively) and the street section is a 4-lane minor arterial. Street flows and inlet sizing were determined based on the UDFCD UD-Inlet V4.05 Workbook. Storm system capacity was analyzed using Bentley® StormCAD modeling software. Bentley® software was also used for channel, weir and curb cut analysis (FlowMaster) and existing and proposed culvert analysis (CulvertMaster).

The project has two outfalls, the Bestway Pond and the 35th Avenue Outfall Channel (AKA The Grapevine Channel). The existing 35th Avenue Storm Sewer and several short new storm systems will be used as conveyance to these outfalls. The existing 35th Avenue Storm Sewer has been abandoned between 2nd Street and the Greeley No. 3 Canal.

Bestway Pond Outfall

Several basins located south of the Greeley No. 3 Canal will outfall to the Bestway Pond and are labeled as basins A, B, C, D, E, F and O, P, Q and R.

The portion of the project that is located between W. 4th Street and W. 2nd Street will drain to proposed on-grade Type R inlets that will route flow via proposed storm pipe laterals to the existing 35th Avenue Storm Sewer that routes flow north and west to the existing Bestway Pond.

The basins that are conveyed thus are denoted as Basins A, B, C, D, O, P and Q.

Basins A, B, C, and D contain the east half of 35th Avenue. Basin A flows north to an on-grade 10' Type R inlet at design point B and is split into two basins, A1 and A2. Basin A2 contains a portion of the Faith Baptist Church property that drains into 35th Avenue. Basin A1 is the adjacent portion of 35th Avenue. The proposed inlet at design point B will tie-in to the existing outlet system (via a proposed storm lateral Storm 2) that drains the Faith Baptist Church's detention pond and will contain a SNOUT® and sump for water quality treatment. The existing church site releases a detained flow of 0.9 cfs from the pond. This flow was included in the storm system analysis. Overflow from the inlet at design point B will travel north in the curb and gutter of 35th to basin C. The SNOUT® system will be discussed in the Water Quality section of this memo.

Basin C flows to an on-grade 10' Type R inlet at design point C. Any overflow from this inlet will travel north to the cross pan at design point D (2nd Street). Overflow from this cross-pan will drain east to existing combination inlets on W. 2nd Street that drain to the existing 35th Avenue Storm Sewer. However, for the purposes of analysis, it was assumed that all flow from basin D travels north in the curb and gutter to basin E. The proposed inlet at design point C will contain a SNOUT® and sump for water quality treatment and will drain via a proposed lateral (Storm 3) to the existing 35th Avenue Storm Sewer.

Basins O, P and Q contain the west half of 35th Avenue. Basin O includes 20 cfs from 4th Street overflow from the southwest corner of the intersection. Refer to the attachments for this off-site flow study. Flow from this basin travels north in the curb and gutter of 35th to the on-grade 10' Type R inlet at design point O. Overflow from this inlet will travel north in the curb and gutter to the on-grade 10' Type R inlet at design point P. This proposed storm system lateral discharges into the existing 35th Avenue Storm Sewer and is labeled as Storm 1. Storm 1 incorporates a SAFL Baffle in a 4-foot diameter manhole with sump. SAFL Baffles will be discussed in the Water Quality section of this memo. Overflow from the inlet at design point P will travel north in the curb and gutter to the on-grade 10' Type R inlet at design point Q.

Basin Q flows to an on-grade 10' Type R inlet at design point Q. Any overflow from this inlet will travel north to the inlet at design point R. The proposed inlet at design point Q will contain a SNOUT® and sump for water quality treatment and will drain via a proposed lateral (Storm 3) to the existing 35th Avenue Storm Sewer.

Basins E, F and R are located along the abandoned stretch of the 35th Avenue Storm Sewer. Basins E and F contain the east half of 35th Avenue and Basin R the west half.

Basin E is adjacent to the Fire Station and will drain north along the curb and gutter of 35th Avenue to basin F. Basins F and R drain north along the curb and gutter to on-grade 10’ Type R inlets that will be placed on the existing storm system (Storm 4) that drains the Fire Station’s pond (14.4 cfs) west to the Bestway Pond. A SAFL Baffle will be incorporated into this existing system for water quality treatment. Overflow from the inlet at design point R will flow north in the curb and gutter of 35th to design point S. Overflow from the inlet at design point F will flow to design point G.

The Bestway Pond releases 189 cfs into an existing 8’W x 2’H RCBC that conveys flows under the Greeley No. 3 Canal and then ties into the existing 35th Avenue Storm Sewer that continues north of the abandoned section of storm system and to the 35th Ave Outfall Channel. Please refer to the attachments for supporting documentation regarding the Bestway Pond, and the First Baptist Church and Fire Station #3 release rates.

35th Avenue Outfall Channel

The remainder of the basins will outfall to the 35th Avenue Outfall Channel either directly or via the existing 35th Avenue Storm Sewer and are labeled as G, H, I, J, K, L, M, N, S, T, U, V, W, X and Y.

Basins G, H, and I are the east half of the road and will drain north via curb and gutter to proposed on-grade or sump inlets that will route flow via proposed storm pipe laterals to the existing 35th Avenue Storm Sewer that then routes flow north and east to the 35th Avenue Outfall Channel. Flow from Basins G and H will drain to a seven-foot curb cut and an area inlet (sump) located in the landscape area between the curb and gutter and the sidewalk at design point H (Village Drive). This inlet will include a Flexstorm® inlet filter for water quality treatment and is a part of proposed storm lateral Storm 5. Basin I includes the southeast portion of the roundabout at "C" Street and will drain to curb cuts and a water quality bioswale located in the landscape area between the curb and gutter and the sidewalk and finally an area inlet (sump) located at design point I. The area inlet drains via Storm 7 to the existing Storm Sewer of 35th. The bioswale system and Flexstorm® filters will be discussed in the Water Quality section of this memo.

Basins S and T (which includes the roadway west and south of the roundabout at "C" Street) will drain to a 10' Type R sump inlet at design point T. This proposed inlet and storm system (Storm 6) will drain north, cross under "C" Street and discharge to the existing Stoneybrook pond located at the northwest corner of the "C" Street roundabout.

Basins U and V include the west portion of the roundabout at 35th Avenue and "C" Street and drain west to an existing pan that drains directly into the existing Stoneybrook detention pond.

The Stoneybrook outfall from the existing pond will be upsized to the 35th Avenue Outfall Channel with this project. Due to the grading of the roundabout at 35th and "C" Street, a reduction of about 0.7 ac-ft of the existing Stoneybrook detention pond volume will occur. With this reduction, the available volume becomes 11.3 ac-ft. A new 36-inch outlet pipe with an adjacent 3-inch high weir wall and 1.7-foot wide notch will create 3 inches of water quality depth above the permanent water surface (0.67 ac-ft). This water quality volume will drain in 12 hours at a rate of 0.68 cfs. The existing pond does not have a water quality component today and 100.9 acres drain to the pond. Required water quality volume for the proposed Stoneybrook Lot 4 project and the portion of 35th Avenue draining to the pond is 0.41 ac-ft. The additional 0.26 ac-ft of water quality storage will enhance the water quality for the portion of the existing Stoneybrook site that currently has none.

Above the water quality weir, the new 36-inch pipe will allow 45 cfs release during the 100-year event and will drain to the 35th Ave Outfall Channel just north of "C" Street roundabout as it does today. The 100-year release rate from the pond has been increased so that the available 10.6 ac-ft of remaining volume is adequate. Preliminary drainage plans for the Stoneybrook Lot 4 project showed a water quality pond only and a free release of the 100-year storm at 48.5 cfs. The original Stoneybrook design (which built the existing pond), had a design release rate of 10.7 cfs. With the new routing of Stoneybrook Lot 4 to the existing pond, and increasing the release rate to 45 CFS, the net reduction to the Outfall Channel is 14.2 CFS.

Basins J and K include the east portion of the roundabout at 35th Avenue and “C” Street and drain to 5’ Type R sump inlets and a manhole that contains a SAFL Baffle for water quality treatment. These inlets will drain north via a new storm system (Storm 8) to the 35th Avenue Outfall Channel and will include 19 cfs currently draining to an existing 24-inch CMP culvert crossing “C” Street from Friendly Village. The 19 cfs was determined based on the current capacity of the existing culvert. The Master Drainage Plan shows that 151 cfs will drain off of Friendly Village, but most of this water today overtops “C” Street (170cfs minus the existing culvert flow) and does not reach the existing pipe or intersection with 35th. Please refer to attachments for Master Plan information.

The 35th Avenue Outfall Channel just north of “C” Street will need to convey a total of 406 cfs. An analysis of the cross-section of the Channel with proposed grading at its narrowest point has been included in the attachments to ensure capacity is still being maintained.

Basins L, M1, X1, and W are located in between the two roundabouts of “C” and “F” Streets. Basins L and M1 contain the east half of 35th Avenue and drain to 5’ Type R sump inlets with SAFL Baffle water quality devices installed in nearby downstream manholes. These inlets drain east via new storm systems (Storm 10 and 11) that discharge into the 35th Avenue Outfall Channel. Basins W and X1 contain the west half of 35th Avenue and drain to curb cuts and bioswale systems. Each bioswale contains an area inlet that connects to the new storm systems (10 and 11) that drain east. A Flexstorm® inlet filter for water quality treatment will be in the bioswale area inlets (design points W and X1) of each of the storm systems.

Basins X2 and M2 are the south portion of the roundabout at 35th Avenue and “F” Street and drain south to 5’ Type R sump inlets. These inlets will drain east via a new storm system (Storm 12) that ties into the 35th Avenue Outfall Channel. The inlet at X2 will include 21 cfs currently draining to an existing 18-inch CMP culvert crossing “F” Street. The 21 cfs was determined based on the current capacity of the existing culvert. Analysis is included in the attachments. A SAFL Baffle for water quality treatment will be in the furthest downstream inlet (DP M2).

Basins Y and N include the north portion of the roundabout at 35th Avenue and “F” Street and extend north to the existing railroad crossing. These basins drain to 5’ Type R sump inlets that drain east via a new storm system (Storm 13) that ties into the 35th Avenue Outfall Channel. A SNOUT® and sump for water quality treatment will be in the furthest downstream inlet (DP N).

Dry wells are proposed in areas on the north side of “F” Street where a small amount of drainage is trapped. These structures will extend and connect to the existing alluvium.

The 35th Avenue Outfall Channel will cross under “F” Street via an extension of the existing twin 5’ x 7’ box culverts.   An analysis of the twin culverts with proposed flow of 511 cfs has been included in the attachments to ensure capacity is still being maintained.

Water Quality

Water Quality will be accomplished at several locations using several varieties of permanent Best Management Practices (BMPs).

Inlet filters (Flexstorm®) are high-efficiency filter bags designed to fit into inlet structures where minor storms flow through the inlet bags and larger storms overtop the edges of the bad and flow into the inlet. It is a reusable structural BMP that prevents siltation and pollution of downstream discharge channels, ponds and rivers. The inlet filters (four total) will be installed in the 36" diameter area inlets at design point H, I, W and X1. Please refer to the attached ADS information packet that discusses the removal efficiency of these products.

SAFL Baffle is a stormwater treatment system placed into structures with a sump below the outlet pipe invert. It captures and retains sediment by stopping the rotating scour suction that take place during high flow conditions. Six total SAFL Baffles with sumps (5 manholes and 1 inlet) will be installed for this project. Please refer to the attached Upstream Technologies report summarizing the results of analyses of sediment removal efficiency for these six locations.

The *SNOUT® system with a sump* is a structural BMP that forms a baffle in the structure which collects floatable debris and free-oils while solids sink to the bottom of the sump. The SNOUT® and sump is installed at the downstream most structure in the series of inlets and manholes of a storm system. Four SNOUT® and sumps will be installed in structures at design points B, C, N and Q where no other treatment method was possible. Please refer to the attached information packet regarding the removal efficiencies and sizing of the SNOUT®s and sumps.

BMP *bioswales* are engineered, depressed landscape areas that are designed to capture and filter the water quality capture volume. The bioswale required drain time is 12 hours. There are three bioswales proposed for this project. All are in the landscape area between the curb and gutter and the sidewalk of the areas adjacent to basins I, W and X1. Bioswale I provides 34% of the required WQCV. Bioswale W provides 51% and Bioswale X1 31% of the required WQCV. This capacity is diminished because a 12-inch depth in the bioswale is not possible due to the constraints of their location between the sidewalk and curb and gutter. Flexstorm® Filters will be placed on the area inlets draining the bioswales because of the shortage of volume.

Finally, *water quality capture volume* will be provided in the existing Stoneybrook pond and could be added to the Bestway pond. The Bestway pond accepts basins A through F and O through R and would require 0.16 ac-ft for treatment for a 40 hour drain time (this would require a modification of the outlet structure and is not included in this project).

The existing Stoneybrook pond was not designed for water quality or to detain the Lot 4 area currently in development review. Interwest reviewed the original project acreage and added Lot 4 and the portion of 35th draining to it (basins S, T, U and V) when studying the pond (a total of 100.9 acres, 41 percent impervious with a major C value of 0.62). Ideally, the pond would have 1.5 ac-ft of water quality. The 3-inch tall by 1.7-foot long weir notch will provide a portion of this ideal water quality volume (0.67 ac-ft). The pond outlet pipe has been increased in size to release 45 cfs with the spillway maintained at the elevation of 4872.6 feet. Please refer to the attachments for the Stoneybrook pond information.

Table 1: Water Quality Summary Table

	INLET FILTER 82% Removal	**SAFL BAFFLE 80% Removal**	**SNOUT HOOD 58% Removal**	**BIOSWALE Appx 40% WQCV**	**STONEYBROOK POND 100% WQCV**
BASINS TREATED	G, H, I, W, X1	J, K, L, M1, M2, O, P, W*, X1, X2	A1, A2, B, C, N, Q, Y	I, W, X1	S, T, U, V
AREA (acres)	3.12	4.03	2.84	2.30	2.01

A weighted average of the treatment of all the basins (accounting for basins with multiple types of treatment) yields an average of 86% removal.

Inspection and maintenance requirements for each of these structural BMPs is included on the Storm Sewer Plan and Profile sheets included in this memo.

Construction Erosion Control

Management of stormwater runoff during construction activities is required for the protection of water resources and is based on the rate of erosion occurring on the disturbed areas.

The total surface area of the proposed disturbance is 14.7 acres. The total (Phase 1 and 2) area and volume of the excavation is 5.4 acres and 10,200 cy, respectively. The area and volume of the fill on site is 9.3 acres and 19,050 cy, respectively.

The existing soil types on site in the disturbed areas consists of Caruso clay loam (64.6%), Nunn clay loam (7.7%), and Nunn clay loam, wet (27.7%) which are classified as Type D and C, respectively by the Natural Resources Conservation Service. Please refer to Table 2.1 for additional soil characteristics.

Table 1: On-site Soil Characteristics

Soil Type	Percent of Site	Hydrologic Soil Group	K Factor[1]	Wind Group[2]
Otero sandy loam, 1 to 3% slopes	57.6%	**A**	0.15	3
Otero sandy loam, 3 to 5% slopes	0.3%	**A**	0.15	3
Aquolls and Aquents, gravelly substratum	37.8%	**D**	0.24	8
Olney fine sandy loam, 1 to 3 percent slopes	3.3%	**B**	0.24	3

[1]K factors range from 0.02 to 0.69. The higher value, the more susceptible the soil is to sheet and rill erosion by water.

[2]Soils assigned to wind group 1 are the most susceptible to wind erosion, soils assigned to wind group 8 are the least susceptible.

Overall, the soils on site can be classified as moderately erodible. Please refer to the attachments for the on-site soil information from the NRCS Soil Survey of Weld County.

The following is a description of the ***structural*** construction best management practices (BMPs) that will be provided for this project. These BMPs were determined based on the recommendations of the USDCM.

Concrete Washout Area (CWA)

Concrete washout area is a specific area of the construction site designed to receive wash water from washing of tools and concrete mixer chutes, liquid concrete waste from dump trucks, mobile batch mixer or pump trucks. Concrete waste is to be removed as needed to maintain BMP function (typically when filled to about two-thirds of its capacity). The concrete waste should be collected and delivered to a designated offsite disposal location. Once the use of the washout site is terminated, accumulated solid waste, including concrete waste and any contaminated soils must be removed from the site to prevent on-site disposal of solid waste.

Vehicle Tracking Control (VTC)

Vehicle tracking pad is intended to trap mud and sediment within coarse grain material and provide clean access to public roadways. Wherever construction vehicle access routes intersect paved public roads a vehicle tracking control pad shall be installed to minimize the transport of sediment (mud) by runoff or vehicles tracking onto the paved surface. Pads shall be inspected for degradation and refurbished when necessary to obtain their intended result. The pad shall be removed only when there is no longer the potential for vehicle tracking to occur and is typically after the site has been stabilized.

Check Dam (CD)

Check dams are temporary grade control structures placed in drainage channels to limit the erosivity of stormwater by reducing flow velocity. They are constructed from rock, gravel bags, sand bags or proprietary devices. The primary function is to reduce the velocity of concentrated flows, but a secondary benefit is sediment trapping upstream of the structure. Accumulated sediment should be removed before the depth upstream of the check dam is ½ of the crest height. Replace missing rocks causing voids in the check dam or if gravel bags or sandbags are used, replace or repair torn or displaced bags. Check dams in permanent channel should be removed when perennial grasses have become established. All the rock and accumulated sediment should be removed, and the area stabilized.

Sediment Control Log (SCL)

Sediment control logs are a linear roll made of natural materials such as straw, coconut fiber or other fibrous material trenched into the ground and held with a wooden stake. They are used as a barrier to intercept sheet flow runoff from disturbed areas and will be used in perimeter control and at the toe of slope for this project. Accumulated sediment should be removed before the depth is one-half the height of the sediment log. Any damage to the sediment log should be repaired by replacing the damage section. Once the upstream area is stabilized the logs can be removed and properly disposed.

Rock Sock (RS)

Rock socks are constructed of gravel that has been wrapped by wire mesh or a geotextile to form an elongated cylindrical filter. Rock socks will be placed at an angle in the curb line for this project to further reduce sediment loading to storm sewer inlets. Vehicle traffic may cause displacement or breakage and therefore rock socks shall be inspected for damage and repaired or replaced, as necessary. Sediment shall be removed by sweeping or vacuuming as needed to maintain the functionality of the BMP and is typically when sediment has accumulated behind the rock sock to one-half the sock's height. Rock socks shall be removed, and properly disposed once upstream stabilization is complete.

Inlet Protection (IP)

Inlet protection consists of permeable barriers installed around an inlet to filter runoff and remove sediment prior to entering a storm drain inlet. Inlet protection will be placed at all existing and proposed sump and on-grade inlets as well as curb cuts and area inlets. Inlets located on a slope (on-grade) will also include curb socks in the gutter leading to the inlet. Inlets protection should be inspected frequently. Inspector shall look for tears, improper installation and displaced BMPs. Sediment accumulation shall be removed typically when it reaches no more than half the storage capacity of the inlet protection. Inlet protection must be removed and properly disposed of when the drainage area for the inlet has reached final stabilization.

The following is a description of the ***non-structural*** construction best management practices (BMPs) that will be provided for this project. These BMPs were determined based on the recommendations of the USDCM.

If there are any low sloped areas exposed during land disturbing activity (stripping, grading, utility installations, stockpiling, filling, etc.) they shall be kept in a roughened condition by ripping or disking along land contours until mulch, vegetation or other permanent erosion control is installed.

If there are any steep sloped areas exposed during land disturbing activity (stripping, grading, utility installations, stockpiling, filling, etc.) they shall have slope protection. The contractor shall use a "tracked" vehicle, run perpendicular to slope so that the tracking runs on the contour to inhibit rill/gully erosion; the contractor may use other windrow-type methods as necessary.

No soil shall remain exposed by land disturbing activity for more than thirty (30) days. At that time temporary or permanent erosion control seed/mulch, landscaping, etc. is required.

Additional Non-Structural Practices are strongly encouraged such as minimizing the disturbance of soils and vegetation, providing educational materials on disposal /recycling, spill prevention / clean up, identification and elimination of illicit discharges, promotion of street sweeping and the development of public education programs.

The Grading and Erosion Control Plan is attached along with the proposed BMP details. Also included in the attachments is the Construction Schedule. This information can be used by the contractor to obtain a CDPHE Construction Stormwater Discharge Permit. The contractor may also be required to obtain a Colorado Dewatering Permit for the construction of the project.

The Poudre River FEMA Floodplain exists in the northern portion of the site. This area is currently being restudied with the CHAMP effort, but today none of the project is located in the effective FEMA floodway. The project will require a floodplain use permit for the areas proposing fill in the flood fringe. The permit application is attached to this memo.

This letter follows the standards set forth in the Greeley DCCS and UDFCD manual. The proposed drainage design will effectively route stormwater runoff through the project to ponds, channels and storm sewer systems and water quality facilities.

We appreciate your time and consideration in reviewing this submittal. If you have any questions or comments, please contact me at (970) 460-8471.

Sincerely,

Michael Oberlander, P.E.
Colorado Professional Engineer 34288

COLORADO LICENSED PROFESSIONAL ENGINEER
MICHAEL PAUL OBERLANDER
34288
10/30/20

Attachments

City of Greeley Authorized Representative, Dave Wells, hereby certifies that the drainage facilities for 35th Avenue Widening shall be constructed according to the design presented in this report. I understand that the City of Greeley does not and will not assume liability for drainage facilities designed and/or certified by my Engineer. I also understand that the City of Greeley relies on the representations of others to establish that drainage facilities are designed and constructed in compliance with City guidelines, standards, or specifications. Review by the City of Greeley can therefore in no way limit or diminish any liability, which I or any other party may have with respect to the design or construction of such facilities.

Name of Responsible Party

____

Authorized Signature   Date

Attest:____

Notary Public Authorized Signature   Date

CITY OF GREELEY
FLOODPLAIN DEVELOPMENT PERMIT APPLICATION

Property Owner: City of Greeley (Dave Wells) Date: 10-30-2020

Owner Address: 35th Avenue between C Street and F Street

Phone - Home: 970-350-9796 Business:

Legal Description of Property:

Lot: NA Block: NA Subdivision: NA

Property Address: 35th Avenue between C Street and F Street

Assessor Parcel No. Longitude: Latitude:

Contractor: TBD Phone:

Contractor Address: TBD

Date of Construction: 2021

PROJECT DESCRIPTION **(check all that apply)**

- [ ] Single-Family Residential
- [ ] Multifamily Residential
- [ ] Manufactured Home
- [ ] Nonresidential
- [ ] Accessory Structure
- [ ] Addition
- [ ] Remodel

- [ ] New Construction
- [ ] Substantial Improvement
- [ ] Fill Material
- [ ] Excavation
- [ ] Watercourse Alteration
- [ ] Flood Damage Repair
- [X] Other: Roadway and Utility Improvements

Brief Description of Proposed Development in the Floodplain:

Roadway widening and utility main installations in the flood fringe.

The proposed Structure is to be

- [ ] Elevated
- [ ] Floodproofed
- [X] N/A

Does this project involve Federal Funds? [ ] (Check the box if yes)

Floodplain Information

Floodplain Name: Cache la Poudre River

Ashcroft Draw	Eaton Draw	Sheep Draw
Cache la Poudre River	John Law Ditch	South Platte River
Coal Bank Creek	Sand Creek	

The FEMA base flood elevation is 4672 feet above geodetic datum at the structure location and elevations are based on the: NAVD 1988 vertical datum

The lowest floor of the structure is proposed to be built at an elevation of NA feet above the NAVD 1988 vertical datum

Is the property or site located in Floodway? ☐ Yes ☒ No

A floodplain development permit map shall be submitted as part of the application requirements. The map shall be drawn to scale and shall be a minimum of 8½" x 11" (or another suitable size when approved by the Floodplain Administrator) and shall, at a minimum, contain the following:

- ✓ The name and address of the property owner.
- ✓ A scale and north arrow.
- ✓ Existing topographic elevation information around the building site above mean sea level, with datum referenced to NAVD 1988.
- ✓ Note indicating the benchmark and datum used to determine the project elevations.
- ✓ Water surface elevation of the 100 year flood (BFE) at the building site.
- ✓ The boundary of the floodplain area and any regulatory cross-sections on the property.
- ✓ The location, dimensions and lowest floor elevations of the existing and proposed structures.
- ✓ The higest and lowest proposed ground elevations adjacent to any proposed structures.

Approval of the FDP is a determination by the Floodplain Administrator that the proposed development has been reviewed and is in compliance with floodplain management regulations. It is not a comprehensive design review and does not constitute approval or warranty of the design. It does not imply or create, and the City expressly disclaims, any liability on the part of the City or any official or employee thereof for any flood damages that result from reliance on the FDP.

No construction or development will commence until the FDP is approved. The FDP will expire one-hundred and eighty (180) days after the approval date unless development has commenced.

By signing below, I agree that:

The proposed development will be done in accordance with floodplain management regulations (*see Chapter 18.34, Article II, Greeley Municipal Code*) and all other applicable federal, state or local regulations.

I have obtained all other permits applicable to the proposed development. The floodplain development permit (FDP) will be considered void if all applicable permits have not been obtained.

Signature of Property Owner or Legally Authorized Representative ____________ Date: ____________

City Use Only

Received By ____________ Date: ____________

Approved ☐ Yes ☐ No

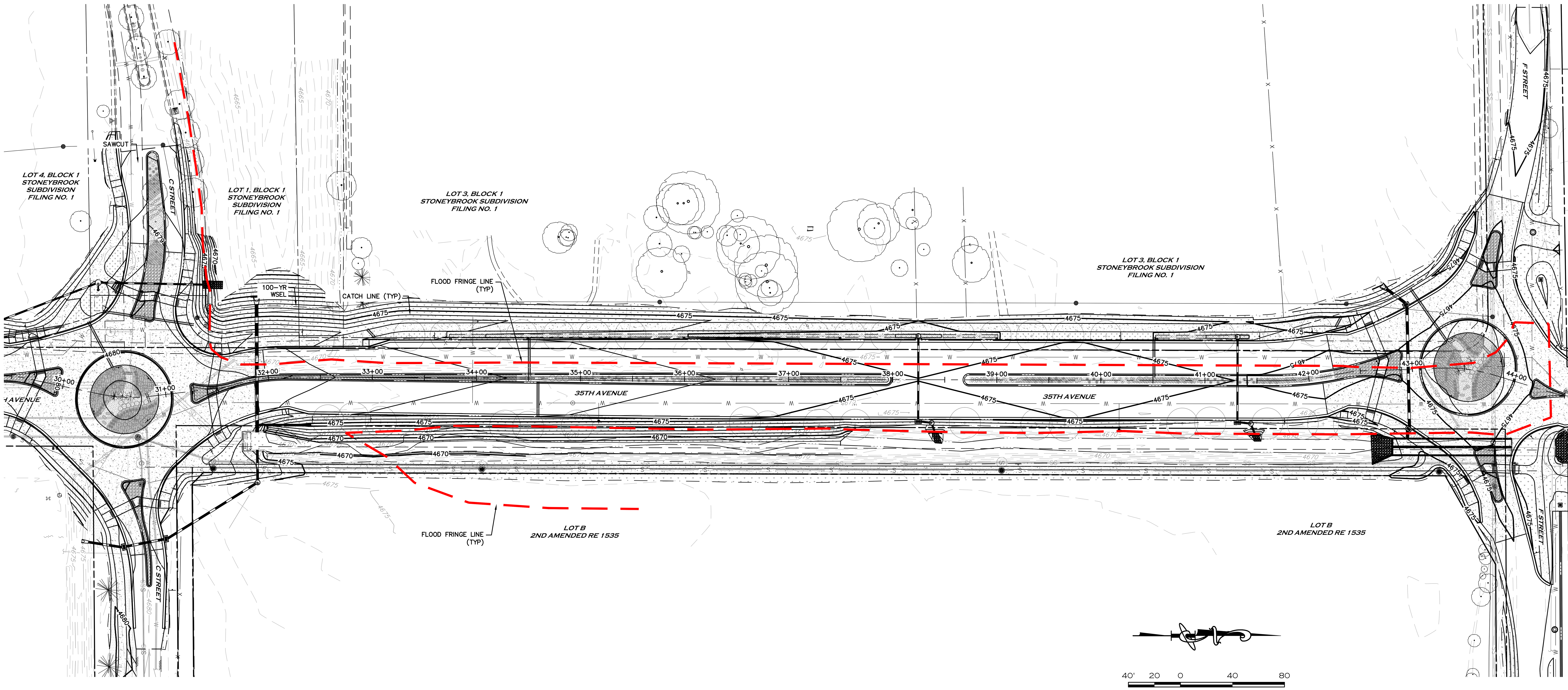
Federal Action Required? (CLOMR, LOMR, LOMA, 404) ☐ Yes ☐ No

Special Conditions: None

Permit Number ____________

City of Greeley Floodplain Administrator Signature ____________ Date: ____________

City Use Only



CALL UTILITY NOTIFICATION
CENTER OF COLORADO
811
CALL 2-BUSINESS DAYS IN ADVANCE
BEFORE YOU DIG, GRADE, OR EXCAVATE
FOR THE MARKING OF UNDERGROUND
MEMBER UTILITIES.

BID SET
NOT FOR CONSTRUCTION

INTERWEST CONSULTING GROUP
1218 W. Ash, Suite A
Windsor, Colorado 80550
Phone: (970) 674-3300
Fax: (970) 674-3303

City of Greeley Colorado

35TH AVENUE WIDENING

FLOOD FRINGE MAP

DATE: 10/30/20
SCALE (H): 1"=40'
SCALE (V): N/A
DESIGNED BY: LAJ
CHECKED BY: MPO

PROJ. NO. 1397-083-00

DRAINAGE MAP
AND
HYDROLOGY

INTERWEST

DRAINAGE MAP

OCTOBER 2020

DRAINAGE SUMMARY TABLE

Design Point	Tributary Sub-basin	Area (ac)	tc (min)	C(10)	Q(10) (cfs)	CARRY OVER FROM DP	CARRY OVER Q(10) (cfs)	Q(10)tot (cfs)	C(100)	Q(100) (cfs)	CARRY OVER FROM DP	CARRY OVER Q(100) (cfs)	Q(100)tot (cfs)
A*	A*	1.08	5.0	0.75	5.0			5.0	0.83	8.7			8.7
B	B	0.34	5.0	0.62	1.3			1.3	0.76	2.5			2.5
B	A+B	1.42	5.0	0.72	6.3			6.3	0.81	11.1			11.1
C	C	0.23	5.0	0.71	1.0	B	1.2	2.2	0.80	1.8	B	4.2	6.0
D	D	0.23	5.0	0.77	1.1			1.1	0.84	1.8	C	0.9	2.7
E	E	0.53	5.0	0.67	2.2			2.2	0.78	4.0			4.0
E	D+E	0.76	5.0	0.70	3.2			3.2	0.80	5.8	C	0.9	6.7
F	F	0.31	5.0	0.61	1.1			1.1	0.75	2.2			2.2
F	D+E+F	1.06	5.0	0.67	4.4			4.4	0.78	8.0	C	0.9	8.9
G	G	0.16	5.0	0.50	0.5	F	0.3	0.8	0.68	1.1	F	2.6	3.7
H	H	0.66	5.0	0.78	3.1	F	0.3	3.4	0.85	5.4	F	2.6	8.0
H	G+H	0.82	5.0	0.72	3.6	F	0.3	3.9	0.81	6.4	F	2.6	9.0
I	I	0.90	7.0	0.71	3.5			3.5	0.80	6.4			6.4
J	J	0.29	5.0	0.63	1.1			1.1	0.76	2.1			2.1
K	K	0.19	5.0	0.70	0.8			0.8	0.80	1.5			1.5
L	L	0.80	9.9	0.80	3.0			3.0	0.85	5.2			5.2
M1	M1	0.21	5.0	0.77	1.0			1.0	0.84	1.7			1.7
M2	M2	0.26	5.0	0.76	1.2			1.2	0.83	2.1			2.1
N	N	0.28	5.0	0.68	1.2			1.2	0.79	2.1			2.1
O	O	0.29	5.0	0.79	1.4			1.4	0.85	2.4	OS	20.0	22.4
P	P	0.33	5.0	0.77	1.5			1.5	0.84	2.6	O	12.6	15.2
Q	Q	0.59	5.0	0.75	2.7			2.7	0.83	4.7	P	7.0	11.7
R	R	0.71	5.0	0.76	3.3			3.3	0.83	5.7	Q	4.4	10.1
S	S	0.87	5.0	0.76	4.0			4.0	0.83	7.0	R	3.3	10.3
T	T	0.70	5.7	0.71	3.0			3.0	0.81	5.3	R	3.3	8.6
T	S+T	1.57	7.8	0.74	6.2			6.2	0.82	10.9	R	3.3	14.2
U	U	0.25	5.0	0.67	1.0			1.0	0.78	1.9			1.9
V	V	0.20	5.0	0.72	0.9			0.9	0.81	1.6			1.6
W	W	1.07	10.3	0.68	3.5			3.5	0.79	6.3			6.3
X1	X1	0.32	5.0	0.65	1.3			1.3	0.77	2.4			2.4
X2	X2	0.28	5.0	0.75	1.3			1.3	0.83	2.3			2.3
Y	Y	0.32	5.0	0.65	1.3			1.3	0.77	2.4			2.4
	OS	18.76		0.15	7			7	0.49	26			26

RUNOFF COEFFICIENTS & % IMPERVIOUS

LOCATION: 35th Avenue Widening
PROJECT NO: 1397-083-00
COMPUTATIONS BY: es
SUBMITTED BY: INTERWEST CONSULTING GROUP
DATE: 6/1/2020

Soils Group B

Recommended % Impervious from Table 6-3 UDFCD, January 2016

	% Impervious
Streets (paved):	100
Drive & walks:	90
Roofs:	90
Lawns (sandy soil):	2
Undeveloped areas (lawns, clayey soil):	2

SUBBASIN DESIGNATION	TOTAL AREA (ac.)	TOTAL AREA (sq.ft)	STREET AREA (sq.ft)	WALK AREA (sq.ft)	ROOF AREA (sq.ft)	LAWN AREA (sq.ft)	% Impervious	MINOR COEFF. (C_2)	MINOR COEFF. (C_5)	MINOR COEFF. (C_{10})	MAJOR COEFF. (C_{100})
A1	0.46	19,931	14,651	2,692	0	2,587	86%	0.70	0.73	0.75	0.83
A2	0.63	27,290	20,598	1,505	1,233	3,955	85%	0.69	0.72	0.74	0.82
A*	1.08	47,221	35,250	4,197	1,233	6,542	85%	0.70	0.72	0.75	0.83
B	0.34	14,752	8,621	1,815	0	4,315	70%	0.55	0.58	0.62	0.76
A+B	1.42	61,973	43,871	6,012	1,233	10,857	82%	0.66	0.69	0.72	0.81
C	0.23	9,886	6,544	1,502	0	1,840	80%	0.65	0.68	0.71	0.80
D	0.23	9,878	7,691	1,107	0	1,081	88%	0.72	0.75	0.77	0.84
E	0.53	23,054	17,290	0	0	5,763	76%	0.60	0.63	0.67	0.78
D+E	0.76	32,932	24,982	1,107	-	6,844	79%	0.64	0.67	0.70	0.80
F	0.31	13,316	7,933	1,270	0	4,113	69%	0.54	0.57	0.61	0.75
D+E+F	1.06	46,249	32,914	2,377	-	10,957	76%	0.61	0.64	0.67	0.78
G	0.16	7,112	3,293	599	0	3,220	55%	0.42	0.45	0.50	0.68
H	0.66	28,589	21,607	4,254	0	2,728	89%	0.73	0.76	0.78	0.85
G+H	0.82	35,701	24,899	4,853	-	5,948	82%	0.67	0.70	0.72	0.81
I	0.90	39,349	26,471	5,505	0	7,373	80%	0.65	0.68	0.71	0.80
J	0.29	12,432	6,866	2,119	0	3,447	71%	0.56	0.59	0.63	0.76
K	0.19	8,273	5,837	821	0	1,614	80%	0.65	0.67	0.70	0.80
L	0.80	34,755	30,839	882	0	3,034	91%	0.75	0.78	0.80	0.85
M1	0.21	9,311	8,221	0	0	1,090	89%	0.73	0.75	0.77	0.84
M2	0.26	11,193	7,522	2,421	0	1,250	87%	0.71	0.74	0.76	0.83
N	0.28	12,163	8,873	434	0	2,856	77%	0.62	0.64	0.68	0.79
O	0.29	12,461	9,940	1,410	0	1,111	90%	0.74	0.77	0.79	0.85
P	0.33	14,220	11,323	1,258	0	1,639	88%	0.72	0.75	0.77	0.84
Q	0.59	25,572	19,237	2,718	0	3,617	85%	0.70	0.72	0.75	0.83
R	0.71	30,717	22,768	4,276	0	3,673	87%	0.71	0.74	0.76	0.83
S	0.87	37,739	29,618	3,216	0	4,905	86%	0.71	0.73	0.76	0.83
T	0.70	30,586	20,391	4,733	0	5,461	81%	0.66	0.68	0.71	0.81
S+T	1.57	68,324	50,009	7,949	-	10,366	84%	0.68	0.71	0.74	0.82
U	0.25	10,707	5,966	2,264	0	2,477	75%	0.60	0.63	0.67	0.78
V	0.20	8,634	5,692	1,466	0	1,476	82%	0.66	0.69	0.72	0.81
W	1.07	46,698	29,167	7,381	0	10,150	77%	0.62	0.65	0.68	0.79
X1	0.32	14,020	8,517	1,927	0	3,576	74%	0.59	0.62	0.65	0.77
X2	0.28	12,355	8,145	2,598	0	1,612	85%	0.70	0.72	0.75	0.83
Y	0.32	14,055	9,618	635.556	0	3,801	73%	0.58	0.61	0.65	0.77
A+B+C+D+E+F+O+P+Q+R	4.62	201,078	146,596	19,554	1,233	33,695	83%	0.67	0.70	0.73	0.81
L+M1+W+X1+X2	2.69	117,138	84,888	12,788	-	19,461	83%	0.67	0.70	0.73	0.81
OS (undev. Stoneybrook)	18.76	817,380	16,348	0	0	0	2%	0.01	0.05	0.15	0.49
RG	0.0012856	56	36	8	-	12	77%	0.62	0.65	0.68	0.79

*A basin combines A1 and A2

OS Undeveloped Stoneybrook is majority D soils, used CUHP to generate Hydrograph for 10-year and 100-year events (Basin is greater than 5 acres)

	2-Year	5-Year	10-Year	100-Year	Table 6-4 UDFCD, January 2016
C_B	0.84i^1.169	0.86i^1.088	0.81i+0.057	0.47i+0.426	i=%imperviousness (expressed as decimal)

Table 6-3. Recommended percentage imperviousness values

Land Use or Surface Characteristics	Percentage Imperviousness (%)
Business:	
Downtown Areas	95
Suburban Areas	75
Residential lots (lot area only):	
Single-family	
2.5 acres or larger	12
0.75 – 2.5 acres	20
0.25 – 0.75 acres	30
0.25 acres or less	45
Apartments	75
Industrial:	
Light areas	80
Heavy areas	90
Parks, cemeteries	10
Playgrounds	25
Schools	55
Railroad yard areas	50
Undeveloped Areas:	
Historic flow analysis	2
Greenbelts, agricultural	2
Off-site flow analysis (when land use not defined)	45
Streets:	
Paved	100
Gravel (packed)	40
Drive and walks	90
Roofs	90
Lawns, sandy soil	2
Lawns, clayey soil	2

Table 6-4. Runoff coefficient equations based on NRCS soil group and storm return period

NRCS Soil Group	Storm Return Period						
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
A	$C_A = 0.84i^{1.302}$	$C_A = 0.86i^{1.276}$	$C_A = 0.87i^{1.232}$	$C_A = 0.88i^{1.124}$	$C_A = 0.85i+0.025$	$C_A = 0.78i+0.110$	$C_A = 0.65i+0.254$
B	$C_B = 0.84i^{1.169}$	$C_B = 0.86i^{1.088}$	$C_B = 0.81i+0.057$	$C_B = 0.63i+0.249$	$C_B = 0.56i+0.328$	$C_B = 0.47i+0.426$	$C_B = 0.37i+0.536$
C/D	$C_{C/D} = 0.83i^{1.122}$	$C_{C/D} = 0.82i+0.035$	$C_{C/D} = 0.74i+0.132$	$C_{C/D} = 0.56i+0.319$	$C_{C/D} = 0.49i+0.393$	$C_{C/D} = 0.41i+0.484$	$C_{C/D} = 0.32i+0.588$

TIME OF CONCENTRATION

LOCATION: 35th Avenue Widening
PROJECT NO: 1397-083-00
COMPUTATIONS BY: es
SUBMITTED BY: INTERWEST CONSULTING GROUP
DATE: 6/1/2020

SUB-BASIN DATA			INITIAL /OVERLAND TIME (ti)				TRAVEL TIME / GUTTER OR CHANNEL FLOW (tt)							tc CHECK (URBANIZED BASIN)		FINAL tc	REMARKS
DESIGN PONIT	SUBBASIN(s) (1)	Area (ac) (2)	C_5 (3)	Length (ft) (4)	Slope (ft/ft) (5)	ti (min) (6)	Length (ft) (7)	Slope (ft/ft) (8)	Land Type	K (9)	Vel. (ft/s) (10)	tt (min) (11)	tc ti-tt	L = (ft) (12)	tc=(l/180)+10 (min) (13)	(min) (14)	
A*	A*	1.08	0.72	5	0.020	1.2	375	0.019	F	20.0	2.8	2.3	3.5	380	12.1	5.0	
B	B	0.34	0.58	5	0.020	1.7	220	0.019	F	20.0	2.8	1.3	3.0	225	11.3	5.0	
B	A+B	1.42	0.69	5	0.020	1.3	595	0.019	F	20.0	2.8	3.6	4.9	600	13.3	5.0	
C	C	0.23	0.68	5	0.020	1.4	175	0.019	F	20.0	2.8	1.1	2.4	180	11.0	5.0	
D	D	0.23	0.75	5	0.020	1.1	175	0.022	F	20.0	3.0	1.0	2.1	180	11.0	5.0	
E	E	0.53	0.63	5	0.020	1.5	250	0.022	F	20.0	3.0	1.4	2.9	255	11.4	5.0	
E	D+E	0.76	0.67	5	0.020	1.4	425	0.022	F	20.0	3.0	2.4	3.8	430	12.4	5.0	
F	F	0.31	0.57	5	0.020	1.7	180	0.016	F	20.0	2.5	1.2	2.9	185	11.0	5.0	
F	D+E+F	1.06	0.64	5	0.020	1.5	605	0.020	F	20.0	2.8	3.5	5.0	610	13.4	5.0	
G	G	0.16	0.45	5	0.020	2.1	175	0.016	F	20.0	2.5	1.2	3.3	180	11.0	5.0	
H	H	0.66	0.76	5	0.020	1.1	550	0.030	F	20.0	3.5	2.6	3.8	555	13.1	5.0	
H	G+H	0.82	0.70	5	0.020	1.3	725	0.027	F	20.0	3.3	3.7	5.0	730	14.1	5.0	
I	I	0.90	0.68	5	0.020	1.4	525	0.006	F	20.0	1.5	5.6	7.0	530	12.9	7.0	
J	J	0.29	0.59	5	0.020	1.6	125	0.006	F	20.0	1.5	1.3	3.0	130	10.7	5.0	
K	K	0.19	0.67	5	0.020	1.4	125	0.006	F	20.0	1.5	1.3	2.7	130	10.7	5.0	
L	L	0.80	0.78	5	0.020	1.0	750	0.005	F	20.0	1.4	8.8	9.9	755	14.2	9.9	
M1	M1	0.21	0.75	5	0.020	1.1	150	0.005	F	20.0	1.4	1.8	2.9	155	10.9	5.0	
M2	M2	0.26	0.74	5	0.020	1.2	100	0.005	F	20.0	1.4	1.2	2.4	105	10.6	5.0	
N	N	0.28	0.64	5	0.020	1.5	235	0.005	F	20.0	1.4	2.8	4.3	240	11.3	5.0	
O	O	0.29	0.77	5	0.020	1.1	160	0.019	F	20.0	2.8	1.0	2.0	165	10.9	5.0	
P	P	0.33	0.75	5	0.020	1.1	195	0.019	F	20.0	2.8	1.2	2.3	200	11.1	5.0	
Q	Q	0.59	0.72	5	0.020	1.2	410	0.019	F	20.0	2.8	2.5	3.7	415	12.3	5.0	
R	R	0.71	0.74	5	0.020	1.2	550	0.022	F	20.0	3.0	3.1	4.3	555	13.1	5.0	
S	S	0.87	0.73	5	0.020	1.2	750	0.030	F	20.0	3.5	3.6	4.8	755	14.2	5.0	
T	T	0.70	0.68	5	0.020	1.4	400	0.006	F	20.0	1.5	4.3	5.7	405	12.3	5.7	
T	S+T	1.57	0.71	5	0.020	1.3	1150	0.022	F	20.0	2.9	6.5	7.8	1155	16.4	7.8	
U	U	0.25	0.63	5	0.020	1.5	175	0.020	F	20.0	2.8	1.0	2.6	180	11.0	5.0	
V	V	0.20	0.69	5	0.020	1.3	175	0.010	F	20.0	2.0	1.5	2.8	180	11.0	5.0	
W	W	1.07	0.65	5	0.020	1.5	750	0.005	F	20.0	1.4	8.8	10.3	755	14.2	10.3	
X1	X1	0.32	0.62	5	0.020	1.6	150	0.005	F	20.0	1.4	1.8	3.3	155	10.9	5.0	
X2	X2	0.28	0.72	5	0.020	1.2	100	0.005	F	20.0	1.4	1.2	2.4	105	10.6	5.0	
Y	Y	0.32	0.61	5	0.020	1.6	235	0.005	F	20.0	1.4	2.8	4.4	240	11.3	5.0	

EQUATIONS:

tc = ti + tt — Equation 6-2: final tc = minimum of ti + tt and urbanized basin check - min. recommended tc = 10 min.

$ti = [0.395 (1.1 - C_5) L^{0.5}] / S^{1/3}$ — Equation 6-3 Urban Drainage

tt = L/60Vel. — Equation 6-4 Urban Drainage

$Vel. = KS^{0.5}$ — Equation 6-4 Urban Drainage

Table 6-2 Urban Drainage

Land Type		K
Heavy Meadow	A	2.5
Tillage/field	B	5
Short pasture/lawn	C	7
Nearly bare ground	D	10
Grassed waterway	E	15
Paved areas	F	20

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

RATIONAL METHOD PEAK RUNOFF
(City of Greeley, 2-Yr Storm)

LOCATION: 35th Avenue Widening
PROJECT NO: 1397-083-00
COMPUTATIONS BY: es
SUBMITTED BY: INTERWEST CONSULTING GROUP
DATE: 6/1/2020

	DIRECT RUNOFF						CARRY OVER		TOTAL	REMARKS
Design Point	Tributary Sub-basin	A (ac)	C_2	tc (min)	i (in/hr)	Q (2) (cfs)	from Design Point	Q (2) (cfs)	Q(2)tot (cfs)	
A*	A*	1.08	0.70	5.0	3.62	2.7			2.7	
B	B	0.34	0.55	5.0	3.62	0.7			0.7	
B	A+B	1.42	0.66	5.0	3.62	3.4			3.4	10' ON-GRADE INLET-6
C	C	0.23	0.65	5.0	3.62	0.5			0.5	10' ON-GRADE INLET-7
D	D	0.23	0.72	5.0	3.62	0.6			0.6	CROSS-PAN @ W. 2ND ST
E	E	0.53	0.60	5.0	3.62	1.2			1.2	
E	D+E	0.76	0.64	5.0	3.62	1.8			1.8	
F	F	0.31	0.54	5.0	3.62	0.6			0.6	10' ON-GRADE INLET-8
F	D+E+F	1.06	0.61	5.0	3.60	2.3			2.3	9' TRIPLE TYPE 3 COMBO INLET
G	G	0.16	0.42	5.0	3.62	0.2			0.2	CROSS-PAN @ FIRE STATION DRIVE
H	H	0.66	0.73	5.0	3.62	1.7			1.7	
H	G+H	0.82	0.67	5.0	3.62	2.0			2.0	7' CC & NEENAH DRAIN GRATE R-4349-D AREA INLET-20
I	I	0.90	0.65	7.0	3.28	1.9			1.9	BIOSWALE W/ NEENAH DRAIN GRATE R-4349-D AREA INLET-9
J	J	0.29	0.56	5.0	3.62	0.6			0.6	5' SUMP INLET-10
K	K	0.19	0.65	5.0	3.62	0.4			0.4	5' SUMP INLET-11
L	L	0.80	0.75	9.9	2.84	1.7			1.7	5' SUMP INLET-12
M1	M1	0.21	0.73	5.0	3.62	0.6			0.6	5' SUMP INLET-13
M2	M2	0.26	0.71	5.0	3.62	0.7			0.7	5' SUMP INLET-14
N	N	0.28	0.62	5.0	3.62	0.6			0.6	5' SUMP INLET-15
O	O	0.29	0.74	5.0	3.62	0.8			0.8	10' ON-GRADE INLET-1
P	P	0.33	0.72	5.0	3.62	0.9			0.9	10' ON-GRADE INLET-2
Q	Q	0.59	0.70	5.0	3.62	1.5			1.5	10' ON-GRADE INLET-3
R	R	0.71	0.71	5.0	3.62	1.8			1.8	10' ON-GRADE INLET-4
S	S	0.87	0.71	5.0	3.62	2.2			2.2	
T	T	0.70	0.66	5.7	3.51	1.6			1.6	
T	S+T	1.57	0.68	7.8	3.18	3.4			3.4	10' SUMP INLET-5
U	U	0.25	0.60	5.0	3.62	0.5			0.5	
V	V	0.20	0.66	5.0	3.62	0.5			0.5	
W	W	1.07	0.62	10.3	2.80	1.9			1.9	BIOSWALE W/ NEENAH DRAIN GRATE R-4349-D AREA INLET-16
X1	X1	0.32	0.59	5.0	3.62	0.7			0.7	BIOSWALE W/ NEENAH DRAIN GRATE R-4349-D AREA INLET-17
X2	X2	0.28	0.70	5.0	3.62	0.7			0.7	5' SUMP INLET-18
Y	Y	0.32	0.58	5.0	3.62	0.7			0.7	5' SUMP INLET-19

$Q = C\,iA$ Equation 6-1 Urban Drainage
Q = peak discharge (cfs)
C = runoff coefficient
i = rainfall intensity (in/hr) from 2-yr Rainfall
A = drainage area (acres)

RATIONAL METHOD PEAK RUNOFF
(City of Greeley, 10-Yr Storm)

LOCATION: 35th Avenue Widening
PROJECT NO: 1397-083-00
COMPUTATIONS BY: es
SUBMITTED BY: INTERWEST CONSULTING GROUP
DATE: 6/1/2020

	DIRECT RUNOFF						CARRY OVER		TOTAL	REMARKS
Design Point	Tributary Sub-basin	A (ac)	C_{10}	tc (min)	i (in/hr)	Q (10) (cfs)	from Design Point	Q (10) (cfs)	Q(10)tot (cfs)	
A*	A*	1.08	0.75	5.0	6.12	5.0			5.0	
B	B	0.34	0.62	5.0	6.12	1.3			1.3	
B	A+B	1.42	0.72	5.0	6.12	6.3			6.3	10' ON-GRADE INLET-6
C	C	0.23	0.71	5.0	6.12	1.0	B	1.20	2.2	10' ON-GRADE INLET-7
D	D	0.23	0.77	5.0	6.12	1.1			1.1	CROSS-PAN @ W. 2ND ST
E	E	0.53	0.67	5.0	6.12	2.2			2.2	
E	D+E	0.76	0.70	5.0	6.12	3.2			3.2	
F	F	0.31	0.61	5.0	6.12	1.1			1.1	10' ON-GRADE INLET-8
F	D+E+F	1.06	0.67	5.0	6.09	4.4			4.4	9' TRIPLE TYPE 3 COMBO INLET
G	G	0.16	0.50	5.0	6.12	0.5	F	0.30	0.8	CROSS-PAN @ FIRE STATION DRIVE
H	H	0.66	0.78	5.0	6.12	3.1	F	0.30	3.4	
H	G+H	0.82	0.72	5.0	6.12	3.6	F	0.30	3.9	7' CC & NEENAH DRAIN GRATE R-4349-D AREA INLET-20
I	I	0.90	0.71	7.0	5.54	3.5			3.5	BIOSWALE W/ NEENAH DRAIN GRATE R-4349-D AREA INLET-9
J	J	0.29	0.63	5.0	6.12	1.1			1.1	5' SUMP INLET-10
K	K	0.19	0.70	5.0	6.12	0.8			0.8	5' SUMP INLET-11
L	L	0.80	0.80	9.9	4.80	3.0			3.0	5' SUMP INLET-12
M1	M1	0.21	0.77	5.0	6.12	1.0			1.0	5' SUMP INLET-13
M2	M2	0.26	0.76	5.0	6.12	1.2			1.2	5' SUMP INLET-14
N	N	0.28	0.68	5.0	6.12	1.2			1.2	5' SUMP INLET-15
O	O	0.29	0.79	5.0	6.12	1.4			1.4	10' ON-GRADE INLET-1
P	P	0.33	0.77	5.0	6.12	1.5			1.5	10' ON-GRADE INLET-2
Q	Q	0.59	0.75	5.0	6.12	2.7			2.7	10' ON-GRADE INLET-3
R	R	0.71	0.76	5.0	6.12	3.3			3.3	10' ON-GRADE INLET-4
S	S	0.87	0.76	5.0	6.12	4.0			4.0	
T	T	0.70	0.71	5.7	5.93	3.0			3.0	
T	S+T	1.57	0.74	7.8	5.38	6.2			6.2	10' SUMP INLET-5
U	U	0.25	0.67	5.0	6.12	1.0			1.0	
V	V	0.20	0.72	5.0	6.12	0.9			0.9	
W	W	1.07	0.68	10.3	4.74	3.5			3.5	BIOSWALE W/ NEENAH DRAIN GRATE R-4349-D AREA INLET-16
X1	X1	0.32	0.65	5.0	6.12	1.3			1.3	BIOSWALE W/ NEENAH DRAIN GRATE R-4349-D AREA INLET-17
X2	X2	0.28	0.75	5.0	6.12	1.3			1.3	5' SUMP INLET-18
Y	Y	0.32	0.65	5.0	6.12	1.3			1.3	5' SUMP INLET-19

$Q = C\,iA$ Equation 6-1 Urban Drainage
Q = peak discharge (cfs)
C = runoff coefficient
i = rainfall intensity (in/hr) from 10-yr Rainfall
A = drainage area (acres)

RATIONAL METHOD PEAK RUNOFF
(City of Greeley, 100-Yr Storm)

LOCATION: 35th Avenue Widening
PROJECT NO: 1397-083-00
COMPUTATIONS BY: es
SUBMITTED BY: INTERWEST CONSULTING GROUP
DATE: 6/1/2020

	DIRECT RUNOFF						CARRY OVER		TOTAL	REMARKS
Design Point	Tributary Sub-basin	A (ac)	C_{100}	tc (min)	i (in/hr)	Q (100) (cfs)	from Design Point	Q (100) (cfs)	Q(100)tot (cfs)	
A*	A*	1.08	0.83	5.0	9.67	8.7			8.7	
B	B	0.34	0.76	5.0	9.67	2.5			2.5	
B	A+B	1.42	0.81	5.0	9.67	11.1			11.1	10' ON-GRADE INLET-6
C	C	0.23	0.80	5.0	9.67	1.8	B	4.2	6.0	10' ON-GRADE INLET-7
D	D	0.23	0.84	5.0	9.67	1.8	C	0.9	2.7	CROSS-PAN @ W. 2ND ST
E	E	0.53	0.78	5.0	9.67	4.0			4.0	
E	D+E	0.76	0.80	5.0	9.67	5.8	C	0.9	6.7	
F	F	0.31	0.75	5.0	9.67	2.2			2.2	10' ON-GRADE INLET-8
F	D+E+F	1.06	0.78	5.0	9.63	8.0	C	0.9	8.9	9' TRIPLE TYPE 3 COMBO INLET
G	G	0.16	0.68	5.0	9.67	1.1	F	2.6	3.7	CROSS-PAN @ FIRE STATION DRIVE
H	H	0.66	0.85	5.0	9.67	5.4	F	2.6	8.0	
H	G+H	0.82	0.81	5.0	9.67	6.4	F	2.6	9.0	7' CC & NEENAH DRAIN GRATE R-4349-D AREA INLET-20
I	I	0.90	0.80	7.0	8.76	6.4			6.4	BIOSWALE W/ NEENAH DRAIN GRATE R-4349-D AREA INLET-9
J	J	0.29	0.76	5.0	9.67	2.1			2.1	5' SUMP INLET-10
K	K	0.19	0.80	5.0	9.67	1.5			1.5	5' SUMP INLET-11
L	L	0.80	0.85	9.9	7.60	5.2			5.2	5' SUMP INLET-12
M1	M1	0.21	0.84	5.0	9.67	1.7			1.7	5' SUMP INLET-13
M2	M2	0.26	0.83	5.0	9.67	2.1			2.1	5' SUMP INLET-14
N	N	0.28	0.79	5.0	9.67	2.1			2.1	5' SUMP INLET-15
O	O	0.29	0.85	5.0	9.67	2.4	OS	20.0	22.4	10' ON-GRADE INLET-1
P	P	0.33	0.84	5.0	9.67	2.6	O	12.6	15.2	10' ON-GRADE INLET-2
Q	Q	0.59	0.83	5.0	9.67	4.7	P	7.0	11.7	10' ON-GRADE INLET-3
R	R	0.71	0.83	5.0	9.67	5.7	Q	4.4	10.1	10' ON-GRADE INLET-4
S	S	0.87	0.83	5.0	9.67	7.0	R	3.3	10.3	
T	T	0.70	0.81	5.7	9.37	5.3	R	3.3	8.6	
T	S+T	1.57	0.82	7.8	8.50	10.9	R	3.3	14.2	10' SUMP INLET-5
U	U	0.25	0.78	5.0	9.67	1.9			1.9	
V	V	0.20	0.81	5.0	9.67	1.6			1.6	
W	W	1.07	0.79	10.3	7.49	6.3			6.3	BIOSWALE W/ NEENAH DRAIN GRATE R-4349-D AREA INLET-16
X1	X1	0.32	0.77	5.0	9.67	2.4			2.4	BIOSWALE W/ NEENAH DRAIN GRATE R-4349-D AREA INLET-17
X2	X2	0.28	0.83	5.0	9.67	2.3			2.3	5' SUMP INLET-18
Y	Y	0.32	0.77	5.0	9.67	2.4			2.4	5' SUMP INLET-19

$Q = C\,iA$ Equation 6-1 Urban Drainage

Q = peak discharge (cfs)
C = runoff coefficient
i = rainfall intensity (in/hr) from 100-yr Rainfall
A = drainage area (acres)

(City of Greeley, 100-Yr Storm)

LOCATION: 35th Avenue Widening
PROJECT NO: 1397-083-00
COMPUTATIONS BY: es
SUBMITTED BY: INTERWEST CONSULTING GROUP
DATE: 6/1/2020

STORM DURATION	STORM FREQUENCY					
	2-YEAR (IN/HR)	5-YEAR (IN/HR)	10-YEAR (IN/HR)	25-YEAR (IN/HR)	50-YEAR (IN/HR)	100-YEAR (IN/HR
5 MIN	3.62	5.19	6.12	7.31	8.73	9.67
10	2.81	4.02	4.75	5.67	6.78	7.51
15	2.37	3.40	4.01	4.79	5.72	6.34
20	2.00	2.86	3.38	4.03	4.81	5.34
25	1.77	2.54	3.00	3.58	4.28	4.74
30	1.64	2.35	2.78	3.22	3.97	4.39
40	1.34	1.92	2.27	2.70	3.23	3.59
50	1.16	1.66	1.96	2.34	2.80	3.10
60 (1HR)	1.04	1.49	1.76	2.10	2.51	2.78
80	0.80	1.14	1.47	1.61	1.91	2.16
100	0.67	0.94	1.20	1.30	1.58	1.79
120 (2HR)	0.58	0.80	0.96	1.14	1.30	1.50
150	0.49	0.66	0.78	0.93	1.10	1.23
180 (3HR)	0.42	0.56	0.67	0.80	0.92	1.05
4 HR	0.33	0.44	0.53	0.62	0.72	0.81
5	0.27	0.36	0.43	0.50	0.57	0.66
6	0.23	0.30	0.37	0.43	0.49	0.57
8	0.20	0.24	0.29	0.34	0.39	0.44
10	0.15	0.20	0.24	0.29	0.32	0.36
12	0.13	0.17	0.20	0.25	0.28	0.31
14	0.11	0.15	0.18	0.23	0.24	0.27
16	0.10	0.13	0.16	0.20	0.22	0.24
18	0.09	0.12	0.14	0.18	0.19	0.21
20	0.08	0.11	0.13	0.17	0.18	0.19
22	0.07	0.10	0.12	0.16	0.16	0.17
24	0.07	0.09	0.11	0.14	0.15	0.16

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
Stoneybrook		0.157	0.096	45.8	4.87	23.8	3.44	8.1	19	68,070	0.42	28,336	40.0	7	28,285	0.35

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
Stoneybrook		0.156	0.096	45.8	4.86	23.8	3.43	8.1	19	68,070	1.80	122,846	50.0	26	122,623	1.38

STREET CAPACITY
AND
INLET SIZING

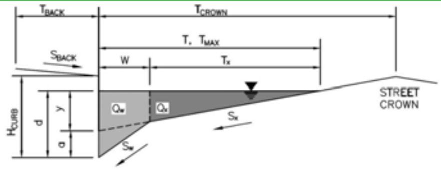
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: 35th Avenue Greeley

Inlet ID: INLET 1 DP O



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	16.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	50.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	38.0	50.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	9.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

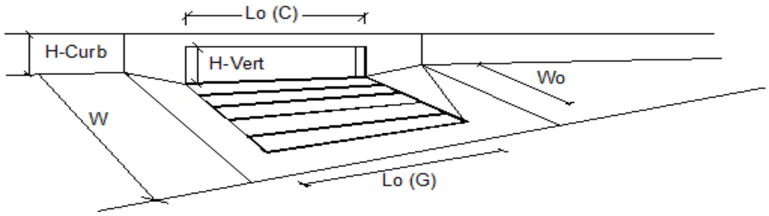
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**26.0**	**114.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.4**	**9.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**12.6**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**44**	**%**

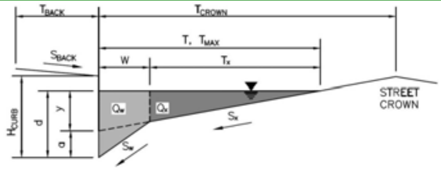
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: 35th Avenue Greeley

Inlet ID: INLET 2 DP P



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	18.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	50.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.019	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	38.0	50.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	10.3	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

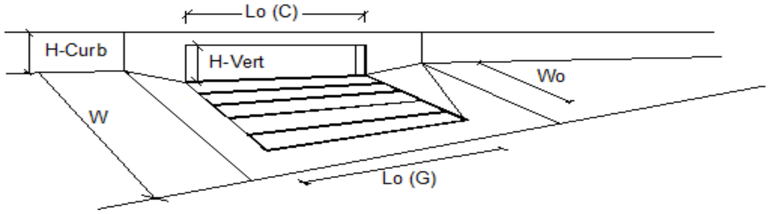
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**25.2**	**136.6**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.5**	**8.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**7.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**54**	**%**

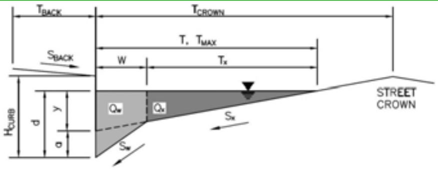
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: 35th Avenue Greeley

Inlet ID: INLET 3 DP B



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	16.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	38.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.019	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	38.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	10.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

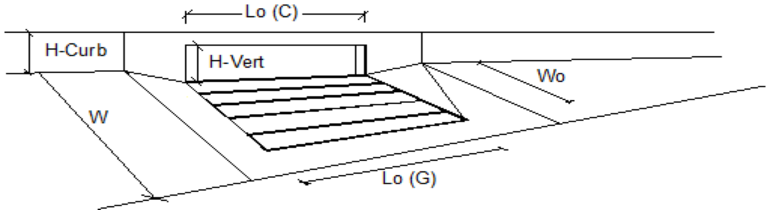
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**25.2**	**121.3**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.3**	**7.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.2**	**4.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**82**	**63**	**%**

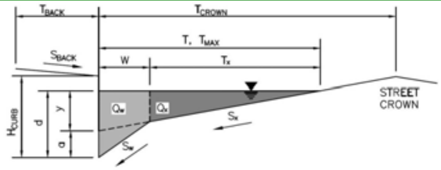
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: 35th Avenue Greeley

Inlet ID: INLET 4 DP Q



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	16.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	48.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.021	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	36.0	48.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	9.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

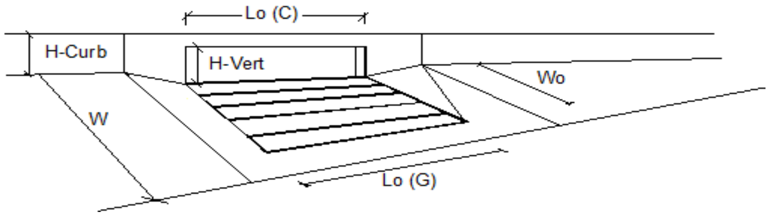
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**26.4**	**113.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



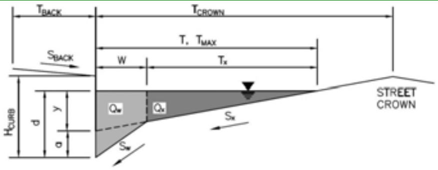
			MINOR	MAJOR	
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**2.7**	**7.3**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**4.4**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**62**	**%**

Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: 35th Avenue Greeley
Inlet ID: INLET 5 DP C



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	16.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	38.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.021	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

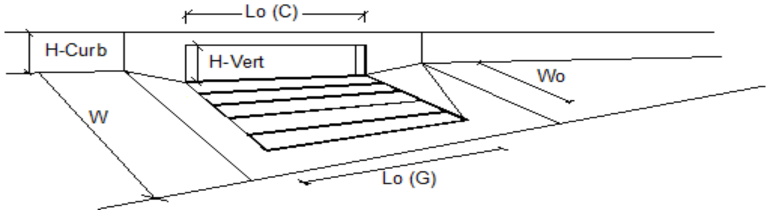
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	38.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	9.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**26.4**	**115.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)			MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**2.2**	**5.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.9**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**85**	**%**

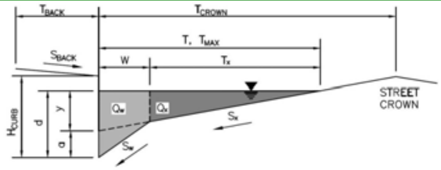
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: 35th Avenue Greeley

Inlet ID: INLET 6 DP R



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	16.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	38.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.016	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	38.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	9.9	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

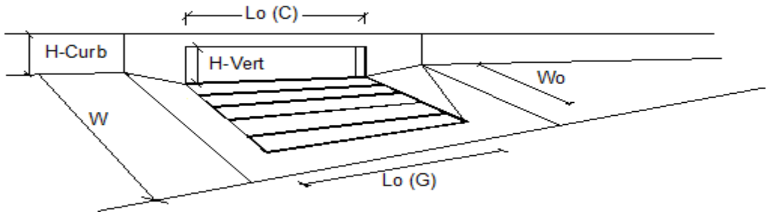
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**23.5**	**125.3**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)			MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**3.3**	**6.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**3.3**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**67**	**%**

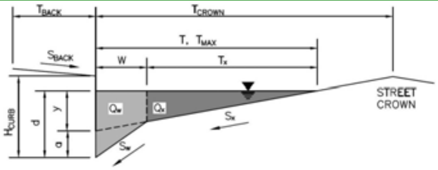
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: 35th Avenue Greeley

Inlet ID: INLET 7 DP F



Gutter Geometry (Enter data in the blue cells)

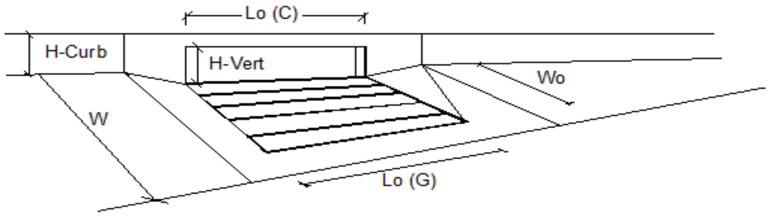
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	16.5		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	38.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.016		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	38.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	9.9	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**23.5**	**125.3**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**4.1**	**6.3**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.3**	**2.6**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**94**	**71**	**%**

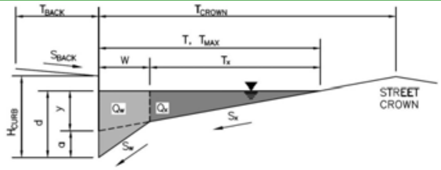
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: 35th Avenue Greeley

Inlet ID: INLET 10 DP T



Gutter Geometry (Enter data in the blue cells)

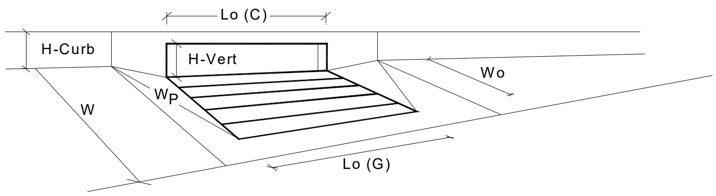
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	16.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	33.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	21.0	33.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.2	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



		MINOR	MAJOR	
Design Information (Input) CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	9.4	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.62	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	0.89	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**10.5**	**22.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	6.2	14.2	cfs

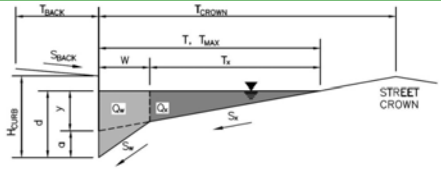
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: 35th Avenue Greeley

Inlet ID: INLET 11 DP J



Gutter Geometry (Enter data in the blue cells)

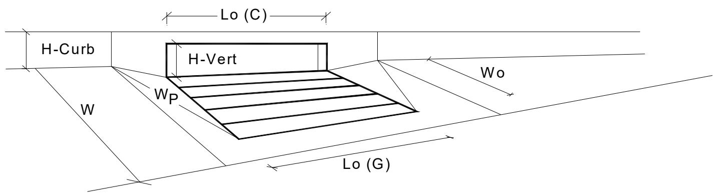
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.5	17.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.8	5.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



		MINOR	MAJOR	
Design Information (Input)				
Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.7	5.7	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

		MINOR	MAJOR	
Low Head Performance Reduction (Calculated)				
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.31	0.31	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.73	0.73	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**4.8**	**4.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.1	2.1	cfs

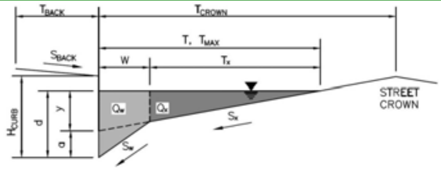
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: 35th Avenue Greeley

Inlet ID: INLET 12 DP K



Gutter Geometry (Enter data in the blue cells)

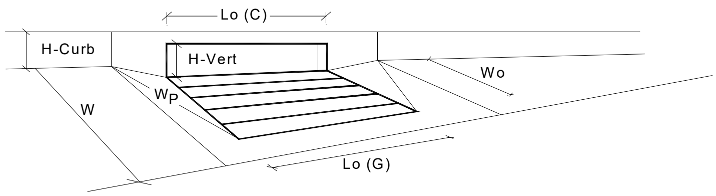
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	12.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.7	4.7	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.7	4.7	inches
Grate Information			MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.22	0.22	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.60	0.60	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

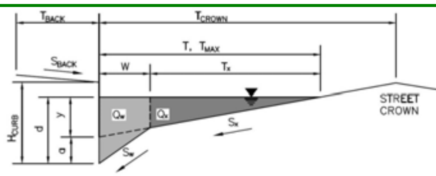
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**3.0**	**3.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.8	1.5	cfs

Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: 35th Avenue Greeley
Inlet ID: INLET 14 DP L

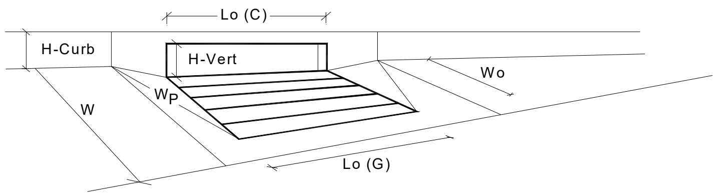


Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	38.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	38.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.9	inches
Check boxes are not applicable in SUMP conditions		☐	☐	
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	7.9	inches
Grate Information			MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.49	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.4**	**9.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.0	5.2	cfs

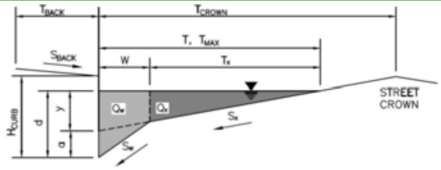
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: 35th Avenue Greeley

Inlet ID: INLET 16 DP M1



Gutter Geometry (Enter data in the blue cells)

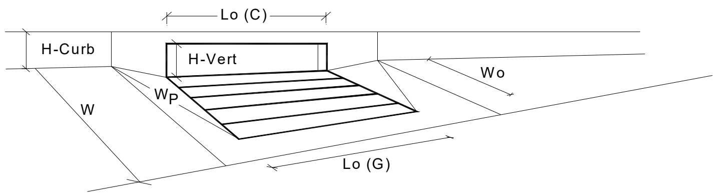
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	33.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	21.0	33.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.9	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



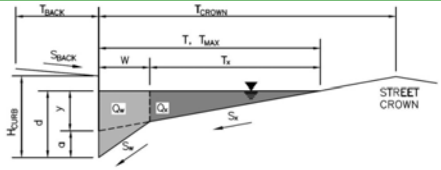
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	7.9	inches
Grate Information			MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.33	0.49	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		Q_a =	**5.4**	**9.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	1.0	1.7	cfs

Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: 35th Avenue Greeley
Inlet ID: INLET 17 DP X2

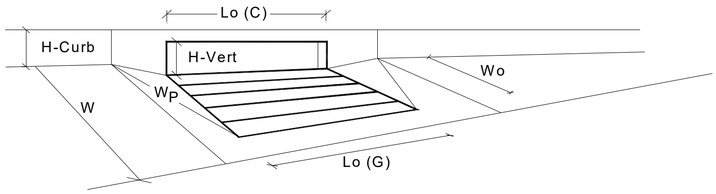


Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.5		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	35.5		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	23.5	35.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	inches
Check boxes are not applicable in SUMP conditions		☐	☐	
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.2	5.2	inches
Grate Information			MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.26	0.26	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.66	0.66	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

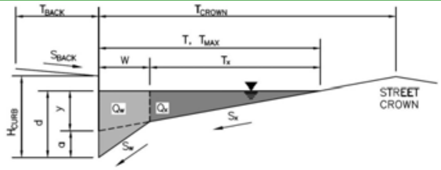
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**3.8**	**3.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.3	2.3	cfs

Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: 35th Avenue Greeley
Inlet ID: INLET 18 DP M2



Gutter Geometry (Enter data in the blue cells)

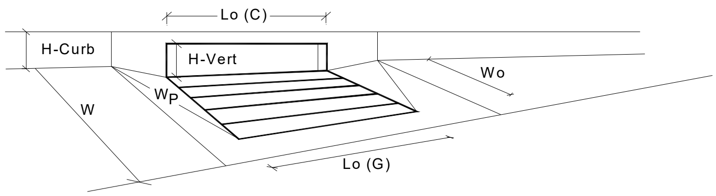
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	34.5	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	22.5	34.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.2	5.2	inches
Grate Information			MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.26	0.26	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.66	0.66	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**3.8**	**3.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.2	2.1	cfs

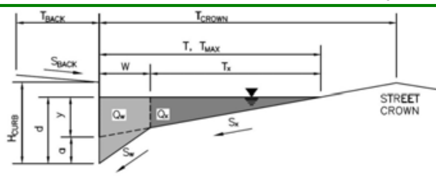
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: 35th Avenue Greeley

Inlet ID: INLET 19 DP N



Gutter Geometry (Enter data in the blue cells)

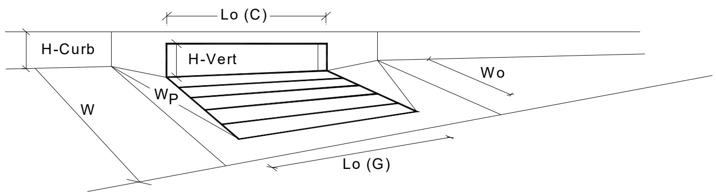
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.9	6.0	inches
Grate Information			MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.24	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.62	0.77	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**3.3**	**5.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.2	2.1	cfs

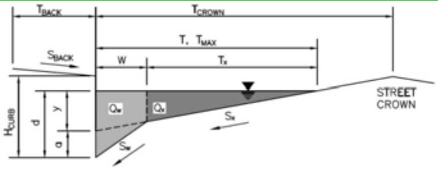
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: 35th Avenue Greeley

Inlet ID: INLET 20 DP Y



Gutter Geometry (Enter data in the blue cells)

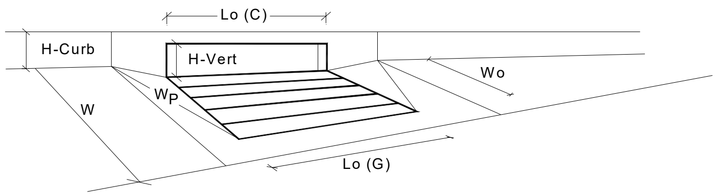
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	28.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	28.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLEET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



			MINOR	MAJOR	
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.4	6.0	inches
Grate Information			MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.28	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.69	0.77	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		Q_a =	**4.1**	**5.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	1.3	2.4	cfs

Area Inlet Capacity @ DP H (INLET-8)

NEENAH R-4349-D MEDIAN DRAIN FRAME, GRATE

LOCATION:	35th Avenue
PROJECT NO:	1397-083-00
COMPUTATIONS BY:	es
SUBMITTED BY:	INTERWEST CONSULTING GROUP
DATE:	2/14/2020

Inlet Data:	Weir Length	10.2	ft
	Open Area	5.4	ft^2

Solve for h using Orifice Equation

$Q = C_o A_o \text{ sqrt}(2gh)$

where
- Q_o = flow through orifice (cfs)
- C_o = orifice discharge coefficient
- g = gravitational acceleration = 32.2 ft/s
- A_o = effective area of the orifice (ft^2)
- h = head on the orifice (ft)

Q_o =	***9.00***	cfs	100-yr Event at DP H
A_o =	2.70	ft^2 (Assume 50% clogged)	
C_o =	0.65		

Solve for h: 0.41 ft

Solve for h using Weir Equation

$Q = CLH^{3/2}$

where
- C = weir coefficient
- H = overflow height
- L = length of the weir

Q =	9.00	cfs
C =	3.00	
L =	10.2	ft

Solve for H: 0.44 ft

WEIR CONTROLS	**Q=**	**9.00**	**cfs**
	Required Head d=	**0.44**	**ft**
Available Head Prior to Overtopping		**0.58**	**ft**

Area Inlet Capacity

R-4349-D DOME GRATE @ DP X1 (Inlet-15)

LOCATION:	35th Avenue
PROJECT NO:	1397-083-00
COMPUTATIONS BY:	es
SUBMITTED BY:	INTERWEST CONSULTING GROUP
DATE:	2/14/2020

Inlet Data: Weir Length 10.2 ft
Open Area 5.4 ft^2

Solve for h using Orifice Equation

$Q = C_o A_o \text{ sqrt}(2gh)$

where
Q_o = flow through orifice (cfs)
C_o = orifice discharge coefficient
g = gravitational acceleration = 32.2 ft/s
A_o = effective area of the orifice (ft^2)
h = head on the orifice (ft)

Q_o =	***2.40***	cfs	100-yr Event at DP X1
A_o =	2.70	ft^2 (Assume 50% clogged)	
C_o =	0.65		

Solve for h: 0.03 ft

Solve for h using Weir Equation

$Q = CLH^{3/2}$

where
C = weir coefficient
H = overflow height
L = length of the weir

Q =	2.40	cfs
C =	3.00	
L =	10.2	ft

Solve for H: 0.18 ft

WEIR CONTROLS Q= 2.40 cfs
Required Head d= 0.18 ft

Available Head Prior to Overtopping 0.50 ft

R-4349-D DOME GRATE @ DP I AND W (Inlets 9 and 13)

LOCATION:	35th Avenue
PROJECT NO:	1397-083-00
COMPUTATIONS BY:	es
SUBMITTED BY:	INTERWEST CONSULTING GROUP
DATE:	2/14/2020

Inlet Data: Weir Length 10.2 ft
Open Area 5.4 ft^2

Solve for h using Orifice Equation

$Q = C_o A_o \text{ sqrt}(2gh)$

where
Q_o = flow through orifice (cfs)
C_o = orifice discharge coefficient
g = gravitational acceleration = 32.2 ft/s
A_o = effective area of the orifice (ft^2)
h = head on the orifice (ft)

Q_o =	***6.40***	cfs	100-yr Event at DP I and W
A_o =	2.70	ft^2 (Assume 50% clogged)	
C_o =	0.65		

Solve for h: 0.21 ft

Solve for h using Weir Equation

$Q = CLH^{3/2}$

where
C = weir coefficient
H = overflow height
L = length of the weir

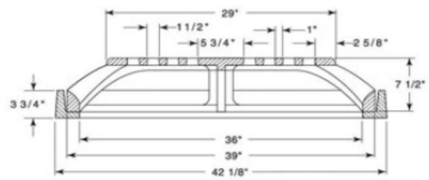
Q =	6.40	cfs
C =	3.00	
L =	10.2	ft

Solve for H: 0.35 ft

WEIR CONTROLS Q= 6.40 cfs
Required Head d= 0.35 ft

Available Head Prior to Overtopping 0.50 ft

R-4349-D



You may need to scroll horizontally to view all table columns.

Description	Square Feet Open	Weir Perimeter Lineal Feet	O Dia.	O.D. Lugs	Dia. Bhv.	Ht. Bhv.	No. Lugs	Size Bars	Size Op.	Pipe Size	Grate Overall	Grate Top Size	Frame Overall	Height Grate	Height Frame	Diameter
Median Drain Frame, Grate	5.4	10.2														

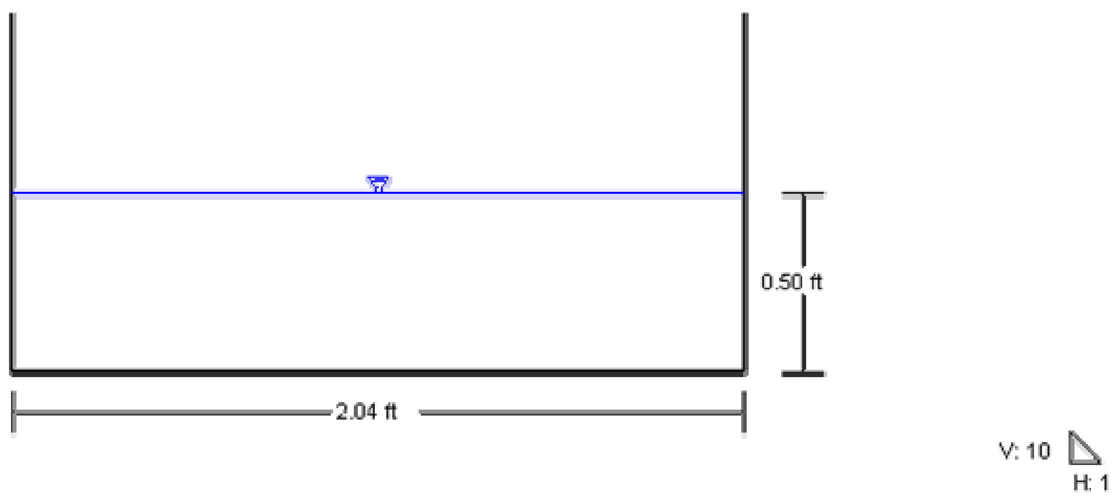
All dimensions are listed in inches unless otherwise noted.

Heavy Duty
For use in narrow median on divided highways, freeways or expressways. Provides large capacity drainage when required during heavy rainfalls.

Cross Section for X1 Curb Cut

Project Description		
Flow Element:	Rectangular Weir	
Solve For:	Crest Length	

Section Data		
Discharge:	2.40	ft³/s
Headwater Elevation:	0.50	ft
Crest Elevation:	0.00	ft
Tailwater Elevation:	0.00	ft
Weir Coefficient:	3.33	US
Crest Length:	2.04	ft
Number of Contractions:	0	



Worksheet for X1 Curb Cut

Project Description		
Flow Element:	Rectangular Weir	
Friction Method:	Manning Formula	
Solve For:	Crest Length	

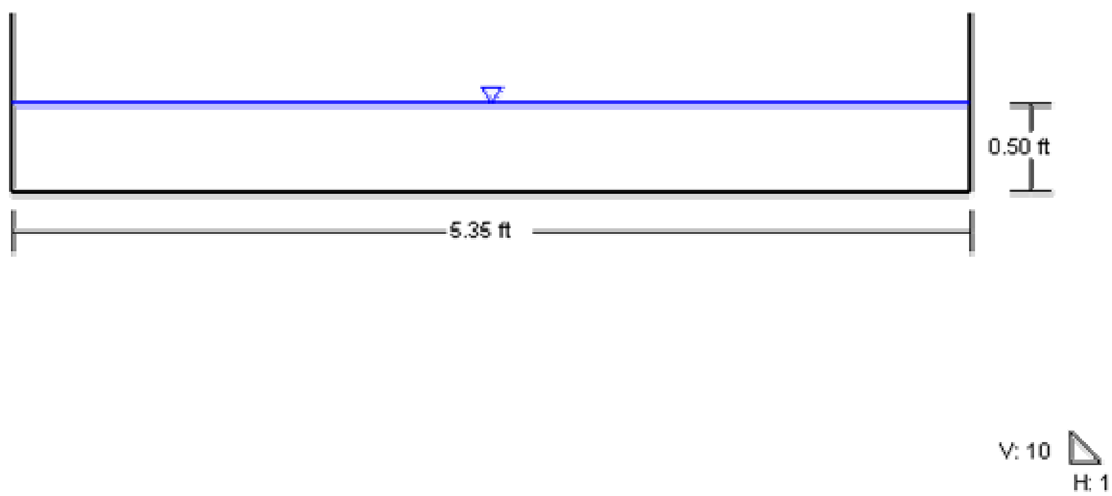
Input Data		
Discharge:	2.40	ft^3/s
Headwater Elevation:	0.50	ft
Crest Elevation:	0.00	ft
Tailwater Elevation:	0.00	ft
Weir Coefficient:	3.33	US
Number of Contractions:	0	

Results		
Crest Length:	2.04	ft
Headwater Height Above Crest:	0.50	ft
Tailwater Height Above Crest:	0.00	ft
Flow Area:	1.02	ft^2
Velocity:	2.35	ft/s
Wetted Perimeter:	3.04	ft
Top Width:	2.04	ft

Cross Section for W Curb Cut

Project Description		
Flow Element:	Rectangular Weir	
Solve For:	Crest Length	

Section Data		
Discharge:	6.30	ft^3/s
Headwater Elevation:	0.50	ft
Crest Elevation:	0.00	ft
Tailwater Elevation:	0.00	ft
Weir Coefficient:	3.33	US
Crest Length:	5.35	ft
Number of Contractions:	0	



Worksheet for W Curb Cut

Project Description		
Flow Element:	Rectangular Weir	
Friction Method:	Manning Formula	
Solve For:	Crest Length	

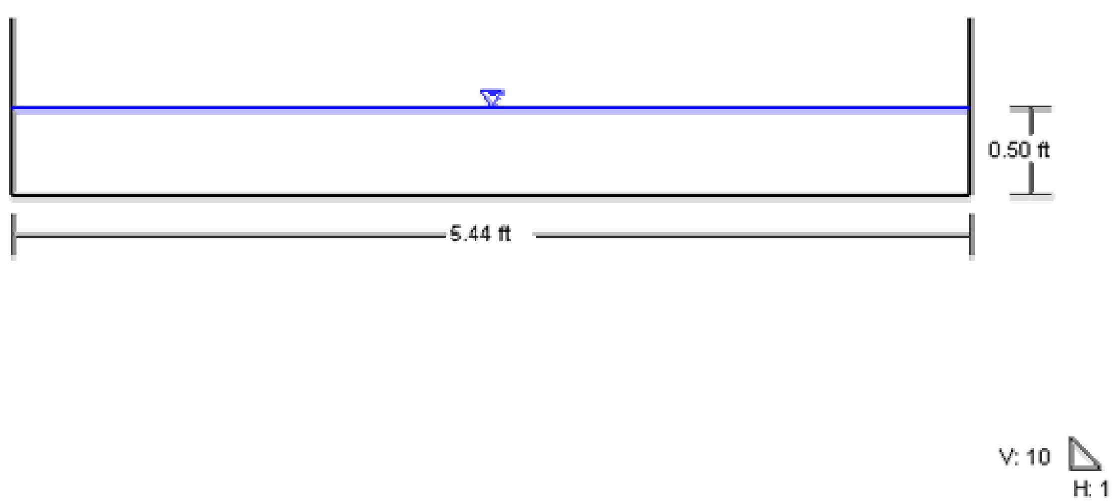
Input Data		
Discharge:	6.30	ft^3/s
Headwater Elevation:	0.50	ft
Crest Elevation:	0.00	ft
Tailwater Elevation:	0.00	ft
Weir Coefficient:	3.33	US
Number of Contractions:	0	

Results		
Crest Length:	5.35	ft
Headwater Height Above Crest:	0.50	ft
Tailwater Height Above Crest:	0.00	ft
Flow Area:	2.68	ft^2
Velocity:	2.35	ft/s
Wetted Perimeter:	6.35	ft
Top Width:	5.35	ft

Cross Section for I Curb Cut

Project Description		
Flow Element:	Rectangular Weir	
Solve For:	Crest Length	

Section Data		
Discharge:	6.40	ft^3/s
Headwater Elevation:	0.50	ft
Crest Elevation:	0.00	ft
Tailwater Elevation:	0.00	ft
Weir Coefficient:	3.33	US
Crest Length:	5.44	ft
Number of Contractions:	0	



Worksheet for I Curb Cut

Project Description		
Flow Element:	Rectangular Weir	
Friction Method:	Manning Formula	
Solve For:	Crest Length	

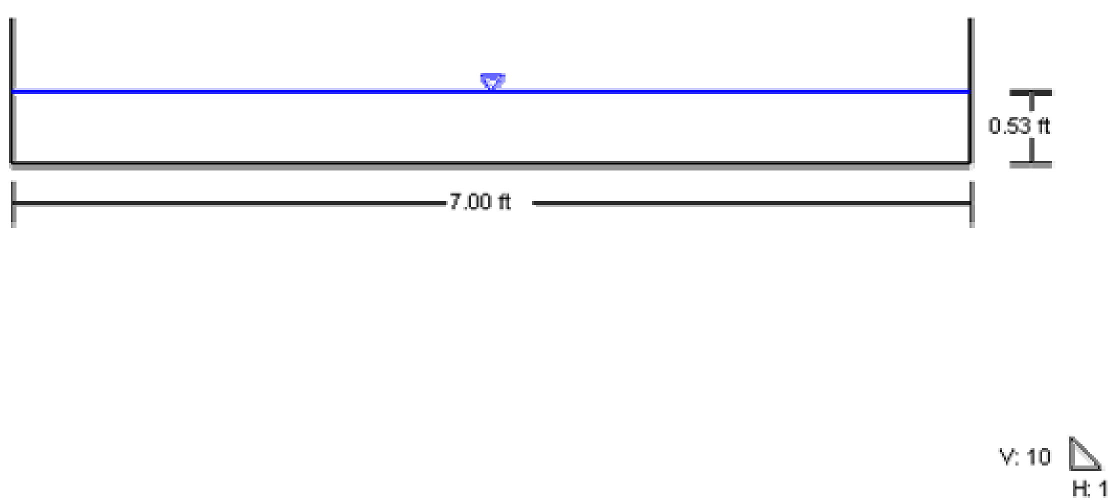
Input Data		
Discharge:	6.40	ft³/s
Headwater Elevation:	0.50	ft
Crest Elevation:	0.00	ft
Tailwater Elevation:	0.00	ft
Weir Coefficient:	3.33	US
Number of Contractions:	0	

Results		
Crest Length:	5.44	ft
Headwater Height Above Crest:	0.50	ft
Tailwater Height Above Crest:	0.00	ft
Flow Area:	2.72	ft²
Velocity:	2.35	ft/s
Wetted Perimeter:	6.44	ft
Top Width:	5.44	ft

Cross Section for H Curb Cut

Project Description		
Flow Element:	Rectangular Weir	
Solve For:	Crest Length	

Section Data		
Discharge:	9.00	ft³/s
Headwater Elevation:	0.53	ft
Crest Elevation:	0.00	ft
Tailwater Elevation:	0.00	ft
Weir Coefficient:	3.33	US
Crest Length:	7.00	ft
Number of Contractions:	0	



Worksheet for H Curb Cut

Project Description		
Flow Element:	Rectangular Weir	
Friction Method:	Manning Formula	
Solve For:	Crest Length	

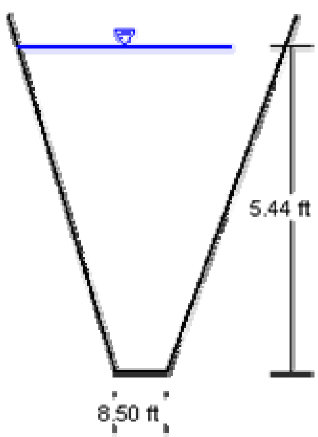
Input Data		
Discharge:	9.00	ft^3/s
Headwater Elevation:	0.53	ft
Crest Elevation:	0.00	ft
Tailwater Elevation:	0.00	ft
Weir Coefficient:	3.33	US
Number of Contractions:	0	

Results		
Crest Length:	7.00	ft
Headwater Height Above Crest:	0.53	ft
Tailwater Height Above Crest:	0.00	ft
Flow Area:	3.71	ft^2
Velocity:	2.42	ft/s
Wetted Perimeter:	8.06	ft
Top Width:	7.00	ft

Cross Section for 9-29-20 35th Outfall Channel N. of C

Project Description		
Flow Element:	Trapezoidal Channel	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.030	
Channel Slope:	0.00100	ft/ft
Normal Depth:	5.44	ft
Left Side Slope:	3.00	ft/ft (H:V)
Right Side Slope:	2.00	ft/ft (H:V)
Bottom Width:	8.50	ft
Discharge:	406.00	ft³/s



Worksheet for 9-29-20 35th Outfall Channel N. of C

Project Description		
Flow Element:	Trapezoidal Channel	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Roughness Coefficient:	0.030	
Channel Slope:	0.00100	ft/ft
Left Side Slope:	3.00	ft/ft (H:V)
Right Side Slope:	2.00	ft/ft (H:V)
Bottom Width:	8.50	ft
Discharge:	406.00	ft^3/s

Results		
Normal Depth:	5.44	ft
Flow Area:	120.05	ft^2
Wetted Perimeter:	37.84	ft
Top Width:	35.68	ft
Critical Depth:	3.07	ft
Critical Slope:	0.01098	ft/ft
Velocity:	3.38	ft/s
Velocity Head:	0.18	ft
Specific Energy:	5.61	ft
Froude Number:	0.33	
Flow Type:	Subcritical	

GVF Input Data		
Downstream Depth:	0.00	ft
Length:	0.00	ft
Number Of Steps:	0	

GVF Output Data		
Upstream Depth:	0.00	ft
Profile Description:	N/A	
Headloss:	0.00	ft
Downstream Velocity:	0.00	ft/s
Upstream Velocity:	0.00	ft/s
Normal Depth:	5.44	ft
Critical Depth:	3.07	ft
Channel Slope:	0.00100	ft/ft

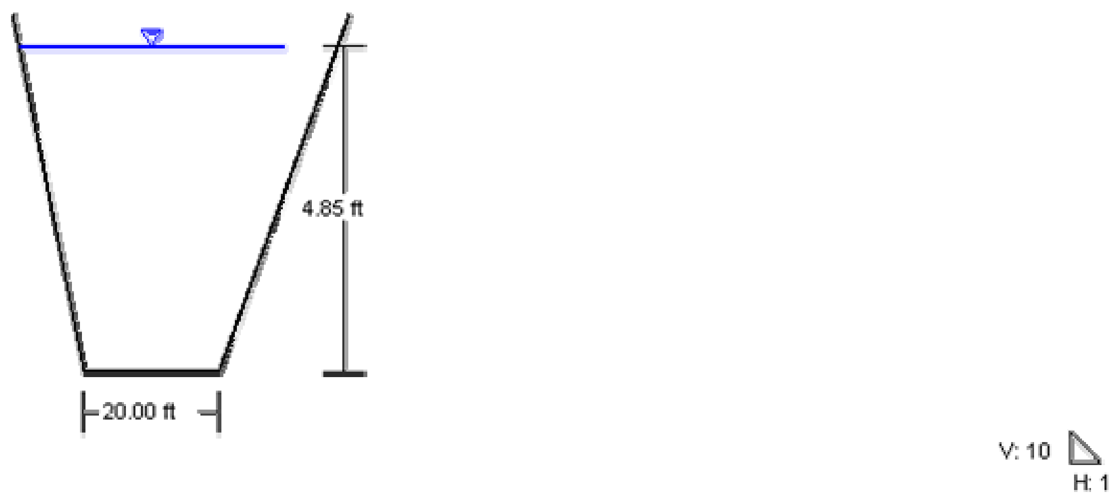
Worksheet for 9-29-20 35th Outfall Channel N. of C

Critical Slope:	0.01098	ft/ft

Cross Section for 35th Outfall Channel N. of RR

Project Description		
Flow Element:	Trapezoidal Channel	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.030	
Channel Slope:	0.00100	ft/ft
Normal Depth:	4.85	ft
Left Side Slope:	2.00	ft/ft (H:V)
Right Side Slope:	2.00	ft/ft (H:V)
Bottom Width:	20.00	ft
Discharge:	516.00	ft³/s



Worksheet for 35th Outfall Channel N. of RR

Project Description		
Flow Element:	Trapezoidal Channel	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Roughness Coefficient:	0.030	
Channel Slope:	0.00100	ft/ft
Left Side Slope:	2.00	ft/ft (H:V)
Right Side Slope:	2.00	ft/ft (H:V)
Bottom Width:	20.00	ft
Discharge:	516.00	ft^3/s

Results		
Normal Depth:	4.85	ft
Flow Area:	144.12	ft^2
Wetted Perimeter:	41.70	ft
Top Width:	39.41	ft
Critical Depth:	2.51	ft
Critical Slope:	0.01080	ft/ft
Velocity:	3.58	ft/s
Velocity Head:	0.20	ft
Specific Energy:	5.05	ft
Froude Number:	0.33	
Flow Type:	Subcritical	

GVF Input Data		
Downstream Depth:	0.00	ft
Length:	0.00	ft
Number Of Steps:	0	

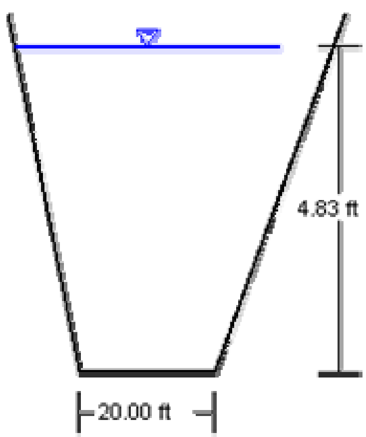
GVF Output Data		
Upstream Depth:	0.00	ft
Profile Description:	N/A	
Headloss:	0.00	ft
Downstream Velocity:	0.00	ft/s
Upstream Velocity:	0.00	ft/s
Normal Depth:	4.85	ft
Critical Depth:	2.51	ft
Channel Slope:	0.00100	ft/ft

Worksheet for 35th Outfall Channel N. of RR

Critical Slope:	0.01080	ft/ft

Cross Section for 35th Outfall Channel N. of F

Project Description		
Flow Element:	Trapezoidal Channel	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	
Section Data		
Roughness Coefficient:	0.030	
Channel Slope:	0.00100	ft/ft
Normal Depth:	4.83	ft
Left Side Slope:	2.00	ft/ft (H:V)
Right Side Slope:	2.00	ft/ft (H:V)
Bottom Width:	20.00	ft
Discharge:	511.00	ft³/s



Worksheet for 35th Outfall Channel N. of F

Project Description		
Flow Element:	Trapezoidal Channel	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Roughness Coefficient:	0.030	
Channel Slope:	0.00100	ft/ft
Left Side Slope:	2.00	ft/ft (H:V)
Right Side Slope:	2.00	ft/ft (H:V)
Bottom Width:	20.00	ft
Discharge:	511.00	ft^3/s

Results		
Normal Depth:	4.83	ft
Flow Area:	143.12	ft^2
Wetted Perimeter:	41.58	ft
Top Width:	39.31	ft
Critical Depth:	2.50	ft
Critical Slope:	0.01081	ft/ft
Velocity:	3.57	ft/s
Velocity Head:	0.20	ft
Specific Energy:	5.02	ft
Froude Number:	0.33	
Flow Type:	Subcritical	

GVF Input Data		
Downstream Depth:	0.00	ft
Length:	0.00	ft
Number Of Steps:	0	

GVF Output Data		
Upstream Depth:	0.00	ft
Profile Description:	N/A	
Headloss:	0.00	ft
Downstream Velocity:	0.00	ft/s
Upstream Velocity:	0.00	ft/s
Normal Depth:	4.83	ft
Critical Depth:	2.50	ft
Channel Slope:	0.00100	ft/ft

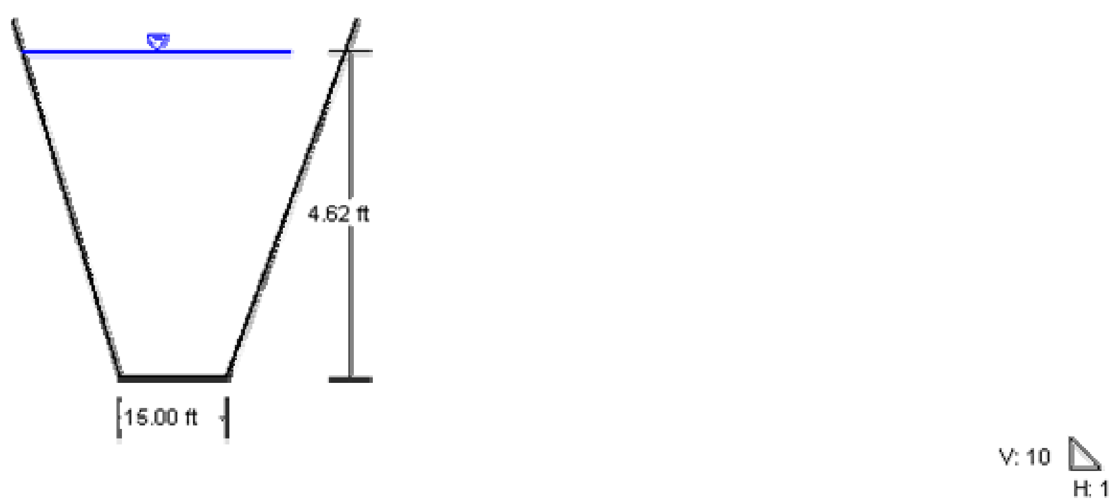
Worksheet for 35th Outfall Channel N. of F

Critical Slope:	0.01081	ft/ft

Cross Section for 35th Outfall Channel @ Storm 10

Project Description		
Flow Element:	Trapezoidal Channel	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.030	
Channel Slope:	0.00100	ft/ft
Normal Depth:	4.62	ft
Left Side Slope:	3.00	ft/ft (H:V)
Right Side Slope:	2.00	ft/ft (H:V)
Bottom Width:	15.00	ft
Discharge:	406.00	ft^3/s



Worksheet for 35th Outfall Channel @ Storm 10

Project Description		
Flow Element:	Trapezoidal Channel	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Roughness Coefficient:	0.030	
Channel Slope:	0.00100	ft/ft
Left Side Slope:	3.00	ft/ft (H:V)
Right Side Slope:	2.00	ft/ft (H:V)
Bottom Width:	15.00	ft
Discharge:	406.00	ft^3/s

Results		
Normal Depth:	4.62	ft
Flow Area:	122.68	ft^2
Wetted Perimeter:	39.94	ft
Top Width:	38.10	ft
Critical Depth:	2.46	ft
Critical Slope:	0.01109	ft/ft
Velocity:	3.31	ft/s
Velocity Head:	0.17	ft
Specific Energy:	4.79	ft
Froude Number:	0.33	
Flow Type:	Subcritical	

GVF Input Data		
Downstream Depth:	0.00	ft
Length:	0.00	ft
Number Of Steps:	0	

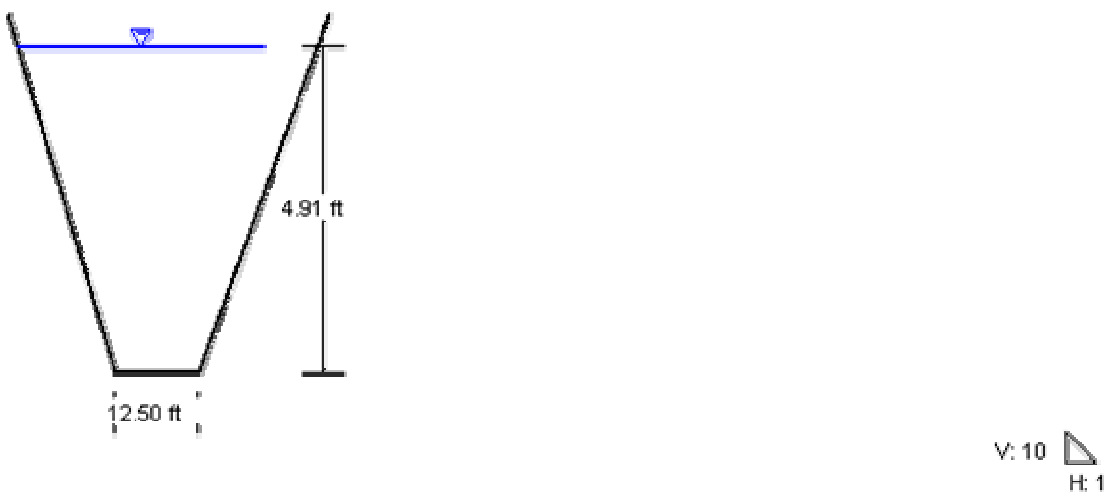
GVF Output Data		
Upstream Depth:	0.00	ft
Profile Description:	N/A	
Headloss:	0.00	ft
Downstream Velocity:	0.00	ft/s
Upstream Velocity:	0.00	ft/s
Normal Depth:	4.62	ft
Critical Depth:	2.46	ft
Channel Slope:	0.00100	ft/ft

Critical Slope:	0.01109	ft/ft

Cross Section for 35th Outfall Channel @ Storm 11

Project Description		
Flow Element:	Trapezoidal Channel	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.030	
Channel Slope:	0.00100	ft/ft
Normal Depth:	4.91	ft
Left Side Slope:	3.00	ft/ft (H:V)
Right Side Slope:	2.00	ft/ft (H:V)
Bottom Width:	12.50	ft
Discharge:	406.00	ft^3/s



Worksheet for 35th Outfall Channel @ Storm 11

Project Description		
Flow Element:	Trapezoidal Channel	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Roughness Coefficient:	0.030	
Channel Slope:	0.00100	ft/ft
Left Side Slope:	3.00	ft/ft (H:V)
Right Side Slope:	2.00	ft/ft (H:V)
Bottom Width:	12.50	ft
Discharge:	406.00	ft³/s

Results		
Normal Depth:	4.91	ft
Flow Area:	121.49	ft²
Wetted Perimeter:	38.98	ft
Top Width:	37.03	ft
Critical Depth:	2.66	ft
Critical Slope:	0.01103	ft/ft
Velocity:	3.34	ft/s
Velocity Head:	0.17	ft
Specific Energy:	5.08	ft
Froude Number:	0.33	
Flow Type:	Subcritical	

GVF Input Data		
Downstream Depth:	0.00	ft
Length:	0.00	ft
Number Of Steps:	0	

GVF Output Data		
Upstream Depth:	0.00	ft
Profile Description:	N/A	
Headloss:	0.00	ft
Downstream Velocity:	0.00	ft/s
Upstream Velocity:	0.00	ft/s
Normal Depth:	4.91	ft
Critical Depth:	2.66	ft
Channel Slope:	0.00100	ft/ft

Worksheet for 35th Outfall Channel @ Storm 11

Critical Slope:	0.01103	ft/ft

Summary of Channel Cross-Sections

Cross-Section Station	Edge of Walk Elevation (ft)	406 cfs WSEL (ft)	406 cfs Depth (ft)	511 cfs WSEL (ft)	511 cfs Depth (ft)
33+00	4674.75	4673.85	5.18	4674.53	5.86
34+00	4674.75	4674.10	5.56	4674.60	6.06
35+00	4674.75	4673.92	5.51	4674.65	6.24
36+00	4674.75	4673.75	5.47	4674.38	6.10
37+00	4674.75	4673.39	5.24	4674.01	5.86
38+00	4674.75	4673.06	5.38	4673.70	6.02
39+00	4674.75	4673.41	5.66	4674.03	6.28
40+00	4674.75	4673.37	5.80	4674.02	6.45
41+00	4674.75	4673.19	5.55	4674.17	6.53

Worksheet for 33+00 406 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.00130	ft/ft
Discharge:	406.00	ft³/s

Options		
Current Roughness Weighted Methc	ImprovedLotters	
Open Channel Weighted Roughness	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	4673.85	ft
Elevation Range:	4668.67 to 4677.31 ft	
Flow Area:	120.29	ft²
Wetted Perimeter:	36.74	ft
Top Width:	33.96	ft
Normal Depth:	5.18	ft
Critical Depth:	2.73	ft
Critical Slope:	0.01514	ft/ft
Velocity:	3.38	ft/s
Velocity Head:	0.18	ft
Specific Energy:	5.35	ft
Froude Number:	0.32	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00.00, 4677.31)	(0+55.96, 4674.89)	0.035

Section Geometry

Station	Elevation
0+00.00	4677.31
0+00.38	4677.31

Worksheet for 33+00 406 cfs

Station	Elevation
0+21.30	4670.33
0+26.29	4668.67
0+38.80	4668.67
0+40.91	4670.51
0+45.01	4674.10
0+47.96	4674.75
0+55.96	4674.89

Cross Section for 33+00 406 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.035	
Channel Slope:	0.00130	ft/ft
Normal Depth:	5.18	ft
Elevation Range:	4668.67 to 4677.31 ft	
Discharge:	406.00	ft³/s

Worksheet for 33+00 511 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.00130	ft/ft
Discharge:	511.00	ft³/s

Options		
Current Roughness Weighted Methc	ImprovedLotters	
Open Channel Weighted Roughness	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	4674.53	ft
Elevation Range:	4668.67 to 4677.31 ft	
Flow Area:	144.64	ft²
Wetted Perimeter:	41.25	ft
Top Width:	38.22	ft
Normal Depth:	5.86	ft
Critical Depth:	3.11	ft
Critical Slope:	0.01467	ft/ft
Velocity:	3.53	ft/s
Velocity Head:	0.19	ft
Specific Energy:	6.05	ft
Froude Number:	0.32	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00.00, 4677.31)	(0+55.96, 4674.89)	0.035

Section Geometry

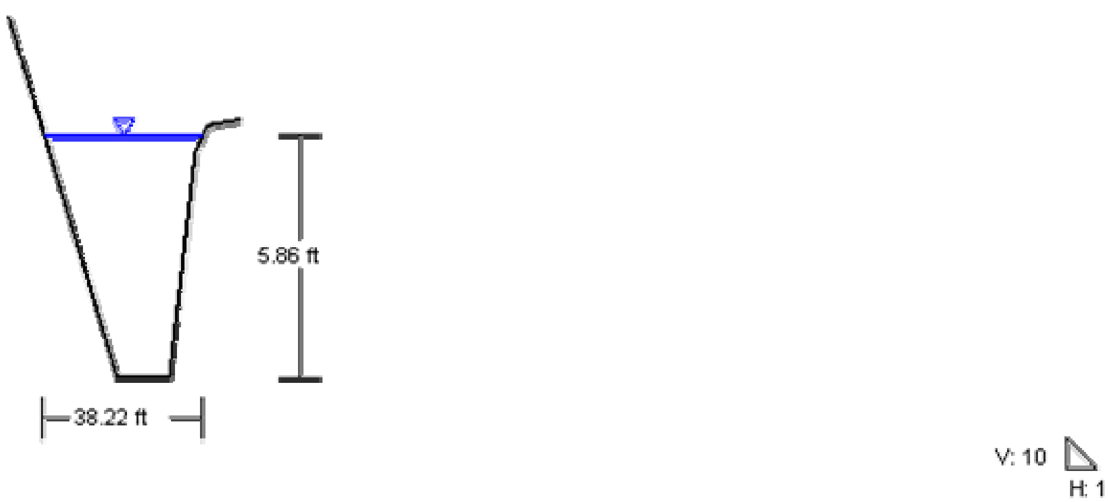
Station	Elevation
0+00.00	4677.31
0+00.38	4677.31

Worksheet for 33+00 511 cfs

Station	Elevation
0+21.30	4670.33
0+26.29	4668.67
0+38.80	4668.67
0+40.91	4670.51
0+45.01	4674.10
0+47.96	4674.75
0+55.96	4674.89

Cross Section for 33+00 511 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	
Section Data		
Roughness Coefficient:	0.035	
Channel Slope:	0.00130	ft/ft
Normal Depth:	5.86	ft
Elevation Range:	4668.67 to 4677.31 ft	
Discharge:	511.00	ft^3/s



Worksheet for 34+00 406 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.00130	ft/ft
Discharge:	406.00	ft³/s

Options		
Current Roughness Weighted Methc	ImprovedLotters	
Open Channel Weighted Roughness	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	4674.10	ft
Elevation Range:	4668.54 to 4676.79 ft	
Flow Area:	121.74	ft²
Wetted Perimeter:	37.85	ft
Top Width:	35.53	ft
Normal Depth:	5.56	ft
Critical Depth:	3.09	ft
Critical Slope:	0.01496	ft/ft
Velocity:	3.34	ft/s
Velocity Head:	0.17	ft
Specific Energy:	5.73	ft
Froude Number:	0.32	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00.00, 4676.79)	(0+54.97, 4674.89)	0.035

Section Geometry

Station	Elevation
0+00.00	4676.79
0+00.37	4676.79

Worksheet for 34+00 406 cfs

Station	Elevation
0+23.34	4669.13
0+25.14	4668.54
0+33.66	4668.54
0+38.10	4671.01
0+43.50	4674.00
0+46.96	4674.75
0+54.97	4674.89

Cross Section for 34+00 406 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.035	
Channel Slope:	0.00130	ft/ft
Normal Depth:	5.56	ft
Elevation Range:	4668.54 to 4676.79 ft	
Discharge:	406.00	ft³/s

Worksheet for 34+00 511 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.00130	ft/ft
Discharge:	511.00	ft³/s

Options		
Current Roughness Weighted Metho	ImprovedLotters	
Open Channel Weighted Roughness	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	4674.60	ft
Elevation Range:	4668.54 to 4676.79 ft	
Flow Area:	145.99	ft²
Wetted Perimeter:	42.22	ft
Top Width:	39.70	ft
Normal Depth:	6.06	ft
Critical Depth:	3.33	ft
Critical Slope:	0.01450	ft/ft
Velocity:	3.50	ft/s
Velocity Head:	0.19	ft
Specific Energy:	6.25	ft
Froude Number:	0.32	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00.00, 4676.79)	(0+54.97, 4674.89)	0.035

Section Geometry

Station	Elevation
0+00.00	4676.79
0+00.37	4676.79

Worksheet for 34+00 511 cfs

Station	Elevation
0+23.64	4668.54
0+33.66	4668.54
0+38.10	4671.01
0+43.50	4674.00
0+46.96	4674.75
0+54.97	4674.89

Cross Section for 34+00 511 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.035	
Channel Slope:	0.00130	ft/ft
Normal Depth:	6.06	ft
Elevation Range:	4668.54 to 4676.79 ft	
Discharge:	511.00	ft³/s

Worksheet for 35+00 406 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.00130	ft/ft
Discharge:	406.00	ft³/s

Options		
Current Roughness Weighted Methc	ImprovedLotters	
Open Channel Weighted Roughness	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	4673.92	ft
Elevation Range:	4668.41 to 4676.28 ft	
Flow Area:	120.17	ft²
Wetted Perimeter:	36.65	ft
Top Width:	34.03	ft
Normal Depth:	5.51	ft
Critical Depth:	3.01	ft
Critical Slope:	0.01503	ft/ft
Velocity:	3.38	ft/s
Velocity Head:	0.18	ft
Specific Energy:	5.69	ft
Froude Number:	0.32	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00.00, 4676.28)	(0+53.97, 4674.89)	0.035

Section Geometry

Station	Elevation
0+00.00	4676.28
0+00.37	4676.28

Worksheet for 35+00 406 cfs

Station	Elevation
0+21.05	4669.38
0+23.98	4668.41
0+33.52	4668.41
0+35.15	4669.54
0+41.69	4674.08
0+45.96	4674.75
0+53.97	4674.89

Cross Section for 35+00 406 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.035	
Channel Slope:	0.00130	ft/ft
Normal Depth:	5.51	ft
Elevation Range:	4668.41 to 4676.28 ft	
Discharge:	406.00	ft^3/s

Worksheet for 35+00 511 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.00130	ft/ft
Discharge:	511.00	ft³/s

Options		
Current Roughness Weighted Methc	ImprovedLotters	
Open Channel Weighted Roughness	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	4674.65	ft
Elevation Range:	4668.41 to 4676.28 ft	
Flow Area:	146.95	ft²
Wetted Perimeter:	42.92	ft
Top Width:	40.09	ft
Normal Depth:	6.24	ft
Critical Depth:	3.42	ft
Critical Slope:	0.01458	ft/ft
Velocity:	3.48	ft/s
Velocity Head:	0.19	ft
Specific Energy:	6.43	ft
Froude Number:	0.32	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00.00, 4676.28)	(0+53.97, 4674.89)	0.035

Section Geometry

Station	Elevation
0+00.00	4676.28
0+00.37	4676.28

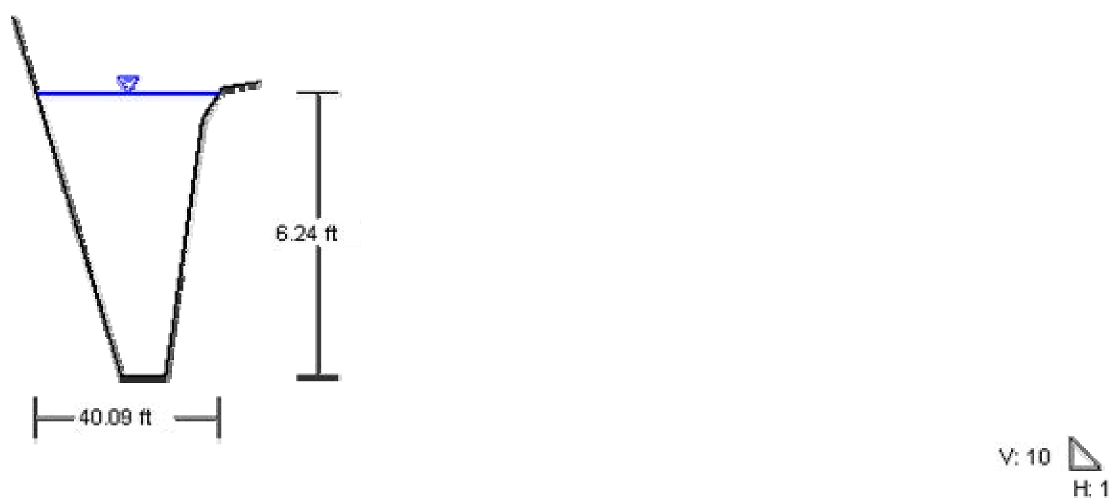
Worksheet for 35+00 511 cfs

Station	Elevation
0+21.05	4669.38
0+23.98	4668.41
0+33.52	4668.41
0+35.15	4669.54
0+41.69	4674.08
0+45.96	4674.75
0+53.97	4674.89

Cross Section for 35+00 511 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.035	
Channel Slope:	0.00130	ft/ft
Normal Depth:	6.24	ft
Elevation Range:	4668.41 to 4676.28 ft	
Discharge:	511.00	ft³/s



Worksheet for 36+00 406 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.00130	ft/ft
Discharge:	406.00	ft³/s

Options		
Current Roughness Weighted Metho	ImprovedLotters	
Open Channel Weighted Roughness	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	4673.75	ft
Elevation Range:	4668.28 to 4675.76 ft	
Flow Area:	120.21	ft²
Wetted Perimeter:	36.68	ft
Top Width:	34.06	ft
Normal Depth:	5.47	ft
Critical Depth:	2.98	ft
Critical Slope:	0.01503	ft/ft
Velocity:	3.38	ft/s
Velocity Head:	0.18	ft
Specific Energy:	5.65	ft
Froude Number:	0.32	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00.00, 4675.76)	(0+53.06, 4674.89)	0.035

Section Geometry

Station	Elevation
0+00.00	4675.76
0+00.38	4675.76

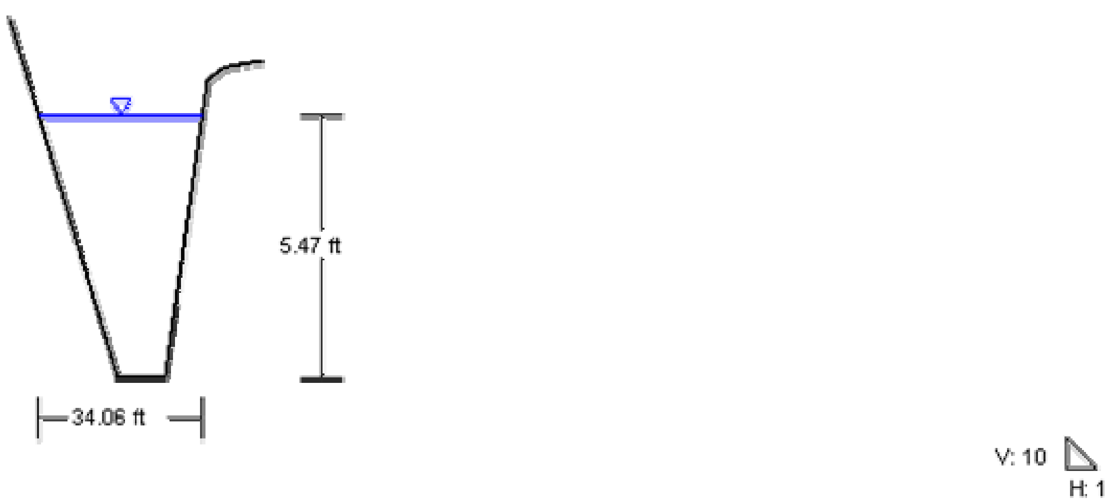
Worksheet for 36+00 406 cfs

Station	Elevation
0+22.83	4668.28
0+32.70	4668.28
0+34.17	4669.31
0+41.51	4674.49
0+45.05	4674.75
0+53.06	4674.89

Cross Section for 36+00 406 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.035	
Channel Slope:	0.00130	ft/ft
Normal Depth:	5.47	ft
Elevation Range:	4668.28 to 4675.76 ft	
Discharge:	406.00	ft³/s



Worksheet for 36+00 511 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.00130	ft/ft
Discharge:	511.00	ft³/s

Options		
Current Roughness Weighted Methc	ImprovedLotters	
Open Channel Weighted Roughness	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	4674.38	ft
Elevation Range:	4668.28 to 4675.76 ft	
Flow Area:	142.53	ft²
Wetted Perimeter:	39.76	ft
Top Width:	36.84	ft
Normal Depth:	6.10	ft
Critical Depth:	3.38	ft
Critical Slope:	0.01458	ft/ft
Velocity:	3.59	ft/s
Velocity Head:	0.20	ft
Specific Energy:	6.30	ft
Froude Number:	0.32	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00.00, 4675.76)	(0+53.06, 4674.89)	0.035

Section Geometry

Station	Elevation
0+00.00	4675.76
0+00.38	4675.76

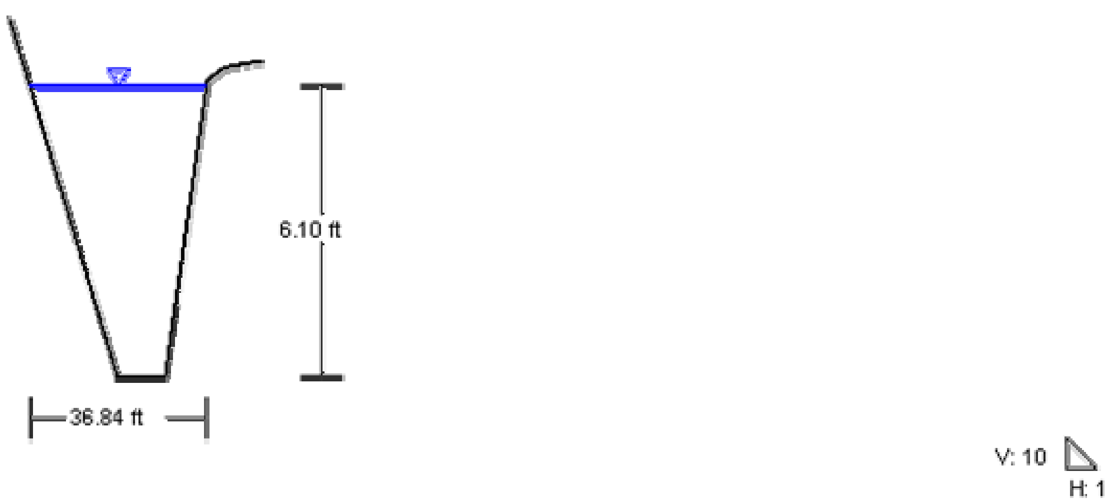
Worksheet for 36+00 511 cfs

Station	Elevation
0+22.83	4668.28
0+32.70	4668.28
0+34.17	4669.31
0+41.51	4674.49
0+45.05	4674.75
0+53.06	4674.89

Cross Section for 36+00 511 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.035	
Channel Slope:	0.00130	ft/ft
Normal Depth:	6.10	ft
Elevation Range:	4668.28 to 4675.76 ft	
Discharge:	511.00	ft^3/s



Worksheet for 37+00 406 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.00130	ft/ft
Discharge:	406.00	ft³/s

Options		
Current Roughness Weighted Methc	ImprovedLotters	
Open Channel Weighted Roughness	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	4673.39	ft
Elevation Range:	4668.15 to 4675.26 ft	
Flow Area:	121.05	ft²
Wetted Perimeter:	37.33	ft
Top Width:	34.89	ft
Normal Depth:	5.24	ft
Critical Depth:	2.82	ft
Critical Slope:	0.01503	ft/ft
Velocity:	3.35	ft/s
Velocity Head:	0.17	ft
Specific Energy:	5.41	ft
Froude Number:	0.32	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00.00, 4675.26)	(0+52.89, 4674.89)	0.035

Section Geometry

Station	Elevation
0+00.00	4675.26
0+00.38	4675.26

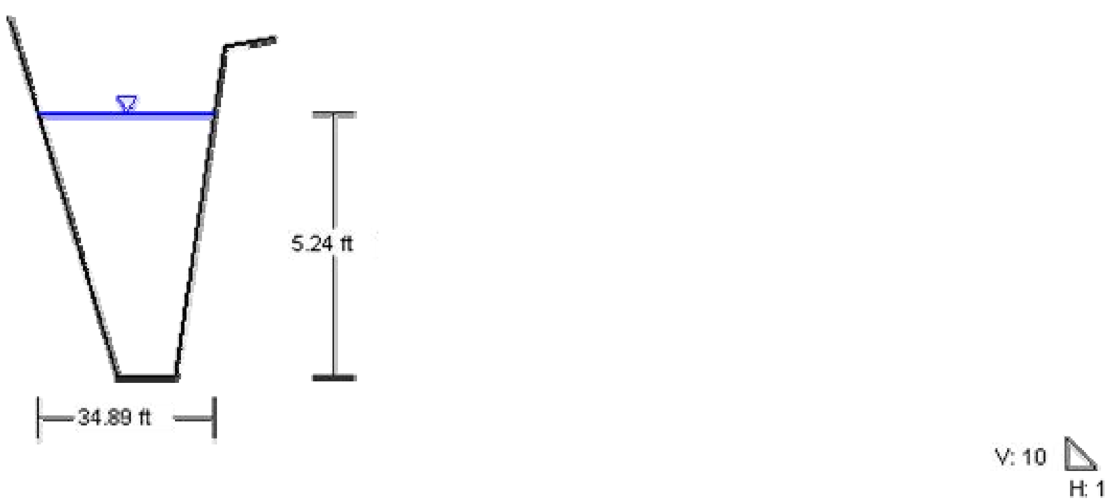
Worksheet for 37+00 406 cfs

Station	Elevation
0+21.72	4668.15
0+33.06	4668.15
0+35.21	4669.60
0+42.86	4674.71
0+52.89	4674.89

Cross Section for 37+00 406 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.035	
Channel Slope:	0.00130	ft/ft
Normal Depth:	5.24	ft
Elevation Range:	4668.15 to 4675.26 ft	
Discharge:	406.00	ft^3/s



Worksheet for 37+00 511 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.00130	ft/ft
Discharge:	511.00	ft³/s

Options		
Current Roughness Weighted Methc	ImprovedLotters	
Open Channel Weighted Roughness	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	4674.01	ft
Elevation Range:	4668.15 to 4675.26 ft	
Flow Area:	143.43	ft²
Wetted Perimeter:	40.39	ft
Top Width:	37.66	ft
Normal Depth:	5.86	ft
Critical Depth:	3.20	ft
Critical Slope:	0.01457	ft/ft
Velocity:	3.56	ft/s
Velocity Head:	0.20	ft
Specific Energy:	6.05	ft
Froude Number:	0.32	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00.00, 4675.26)	(0+52.89, 4674.89)	0.035

Section Geometry

Station	Elevation
0+00.00	4675.26
0+00.38	4675.26

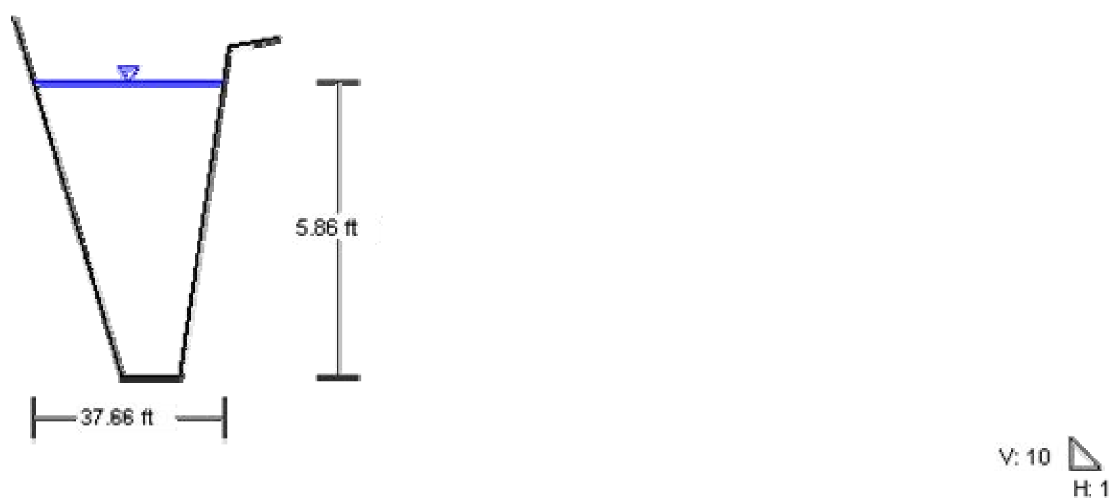
Worksheet for 37+00 511 cfs

Station	Elevation
0+21.72	4668.15
0+33.06	4668.15
0+35.21	4669.60
0+42.86	4674.71
0+52.89	4674.89

Cross Section for 37+00 511 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.035	
Channel Slope:	0.00130	ft/ft
Normal Depth:	5.86	ft
Elevation Range:	4668.15 to 4675.26 ft	
Discharge:	511.00	ft³/s



Worksheet for 38+00 406 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.00130	ft/ft
Discharge:	406.00	ft³/s

Options		
Current Roughness Weighted Methc	ImprovedLotters	
Open Channel Weighted Roughness	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	4673.06	ft
Elevation Range:	4667.68 to 4674.91 ft	
Flow Area:	121.49	ft²
Wetted Perimeter:	37.66	ft
Top Width:	34.50	ft
Normal Depth:	5.38	ft
Critical Depth:	2.88	ft
Critical Slope:	0.01535	ft/ft
Velocity:	3.34	ft/s
Velocity Head:	0.17	ft
Specific Energy:	5.56	ft
Froude Number:	0.31	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00.00, 4674.76)	(0+52.88, 4674.91)	0.035

Section Geometry

Station	Elevation
0+00.00	4674.76
0+00.38	4674.76

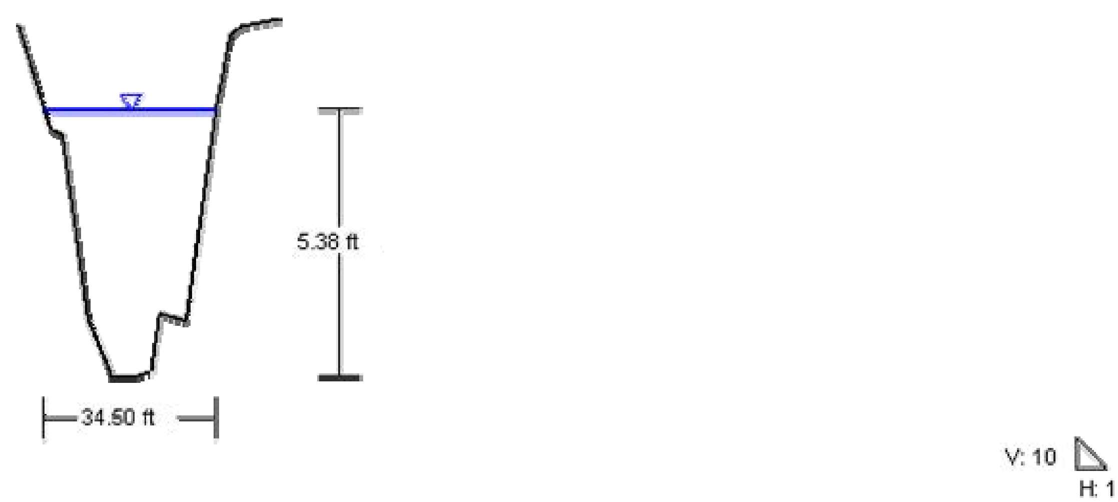
Worksheet for 38+00 406 cfs

Station	Elevation
0+06.63	4672.68
0+09.04	4672.58
0+14.18	4668.87
0+18.57	4667.82
0+18.65	4667.68
0+23.19	4667.68
0+26.86	4667.81
0+28.62	4668.98
0+33.89	4668.82
0+40.27	4673.27
0+42.81	4674.56
0+43.71	4674.68
0+44.01	4674.68
0+44.88	4674.75
0+52.88	4674.91

Cross Section for 38+00 406 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.035	
Channel Slope:	0.00130	ft/ft
Normal Depth:	5.38	ft
Elevation Range:	4667.68 to 4674.91 ft	
Discharge:	406.00	ft³/s



Worksheet for 38+00 511 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.00130	ft/ft
Discharge:	511.00	ft³/s

Options		
Current Roughness Weighted Methc	ImprovedLotters	
Open Channel Weighted Roughness	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	4673.70	ft
Elevation Range:	4667.68 to 4674.91 ft	
Flow Area:	144.24	ft²
Wetted Perimeter:	40.97	ft
Top Width:	37.54	ft
Normal Depth:	6.02	ft
Critical Depth:	3.24	ft
Critical Slope:	0.01484	ft/ft
Velocity:	3.54	ft/s
Velocity Head:	0.20	ft
Specific Energy:	6.21	ft
Froude Number:	0.32	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00.00, 4674.76)	(0+52.88, 4674.91)	0.035

Section Geometry

Station	Elevation
0+00.00	4674.76
0+00.38	4674.76

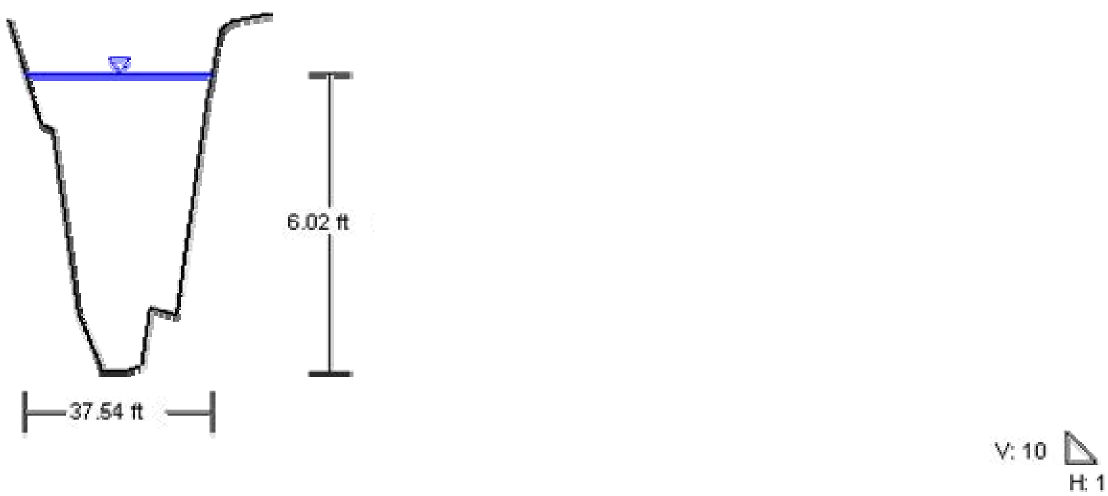
Worksheet for 38+00 511 cfs

Station	Elevation
0+06.63	4672.68
0+09.04	4672.58
0+14.18	4668.87
0+18.57	4667.82
0+18.65	4667.68
0+23.19	4667.68
0+26.86	4667.81
0+28.62	4668.98
0+33.89	4668.82
0+40.27	4673.27
0+42.81	4674.56
0+43.71	4674.68
0+44.01	4674.68
0+44.88	4674.75
0+52.88	4674.91

Cross Section for 38+00 511 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.035	
Channel Slope:	0.00130	ft/ft
Normal Depth:	6.02	ft
Elevation Range:	4667.68 to 4674.91 ft	
Discharge:	511.00	ft³/s



Worksheet for 39+00 406 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.00130	ft/ft
Discharge:	406.00	ft³/s

Options		
Current Roughness Weighted Methc	ImprovedLotters	
Open Channel Weighted Roughness	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	4673.41	ft
Elevation Range:	4667.75 to 4675.02 ft	
Flow Area:	122.41	ft²
Wetted Perimeter:	38.38	ft
Top Width:	35.29	ft
Normal Depth:	5.66	ft
Critical Depth:	3.04	ft
Critical Slope:	0.01531	ft/ft
Velocity:	3.32	ft/s
Velocity Head:	0.17	ft
Specific Energy:	5.83	ft
Froude Number:	0.31	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00.00, 4675.02)	(0+52.88, 4674.91)	0.035

Section Geometry

Station	Elevation
0+00.00	4675.02
0+00.38	4675.02

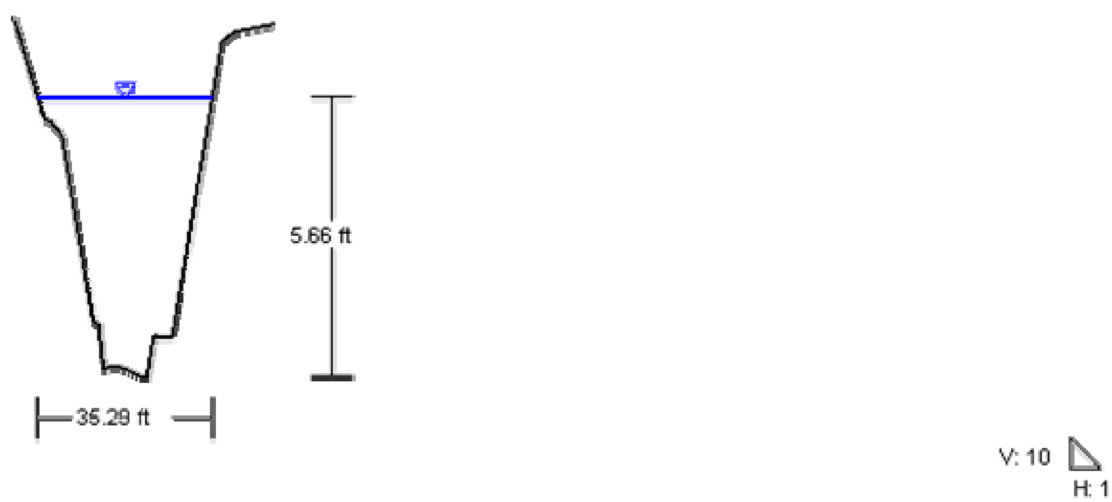
Worksheet for 39+00 406 cfs

Station	Elevation
0+06.24	4673.06
0+06.81	4672.97
0+07.73	4672.94
0+10.01	4672.66
0+16.40	4668.85
0+17.42	4668.84
0+18.38	4667.90
0+19.09	4667.98
0+22.45	4667.95
0+26.52	4667.75
0+27.11	4667.75
0+28.63	4668.63
0+29.36	4668.58
0+32.34	4668.57
0+42.41	4674.56
0+44.88	4674.75
0+52.88	4674.91

Cross Section for 39+00 406 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.035	
Channel Slope:	0.00130	ft/ft
Normal Depth:	5.66	ft
Elevation Range:	4667.75 to 4675.02 ft	
Discharge:	406.00	ft³/s



Worksheet for 39+00 511 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.00130	ft/ft
Discharge:	511.00	ft³/s

Options		
Current Roughness Weighted Methc	ImprovedLotters	
Open Channel Weighted Roughness	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	4674.03	ft
Elevation Range:	4667.75 to 4675.02 ft	
Flow Area:	145.03	ft²
Wetted Perimeter:	41.53	ft
Top Width:	38.17	ft
Normal Depth:	6.28	ft
Critical Depth:	3.43	ft
Critical Slope:	0.01481	ft/ft
Velocity:	3.52	ft/s
Velocity Head:	0.19	ft
Specific Energy:	6.47	ft
Froude Number:	0.32	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00.00, 4675.02)	(0+52.88, 4674.91)	0.035

Section Geometry

Station	Elevation
0+00.00	4675.02
0+00.38	4675.02

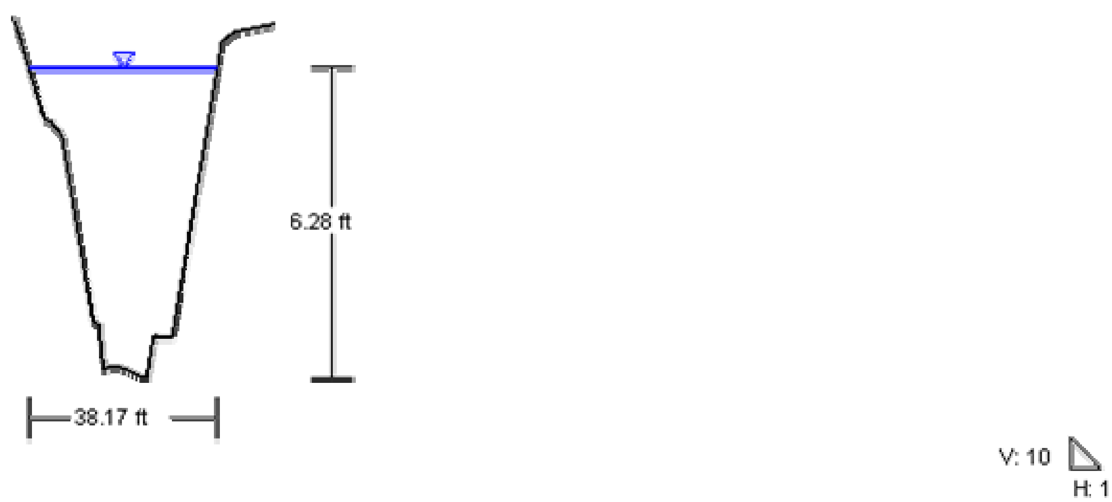
Worksheet for 39+00 511 cfs

Station	Elevation
0+06.24	4673.06
0+06.81	4672.97
0+07.73	4672.94
0+10.01	4672.66
0+16.40	4668.85
0+17.42	4668.84
0+18.38	4667.90
0+19.09	4667.98
0+22.45	4667.95
0+26.52	4667.75
0+27.11	4667.75
0+28.63	4668.63
0+29.36	4668.58
0+32.34	4668.57
0+42.41	4674.56
0+44.88	4674.75
0+52.88	4674.91

Cross Section for 39+00 511 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.035	
Channel Slope:	0.00130	ft/ft
Normal Depth:	6.28	ft
Elevation Range:	4667.75 to 4675.02 ft	
Discharge:	511.00	ft³/s



Worksheet for 40+00 406 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.00130	ft/ft
Discharge:	406.00	ft³/s

Options		
Current Roughness Weighted Methc	ImprovedLotters	
Open Channel Weighted Roughness	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	4673.37	ft
Elevation Range:	4667.57 to 4675.25 ft	
Flow Area:	120.23	ft²
Wetted Perimeter:	36.69	ft
Top Width:	33.43	ft
Normal Depth:	5.80	ft
Critical Depth:	3.08	ft
Critical Slope:	0.01518	ft/ft
Velocity:	3.38	ft/s
Velocity Head:	0.18	ft
Specific Energy:	5.98	ft
Froude Number:	0.31	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00.00, 4675.25)	(0+52.89, 4674.91)	0.035

Section Geometry

Station	Elevation
0+00.00	4675.25
0+00.37	4675.25

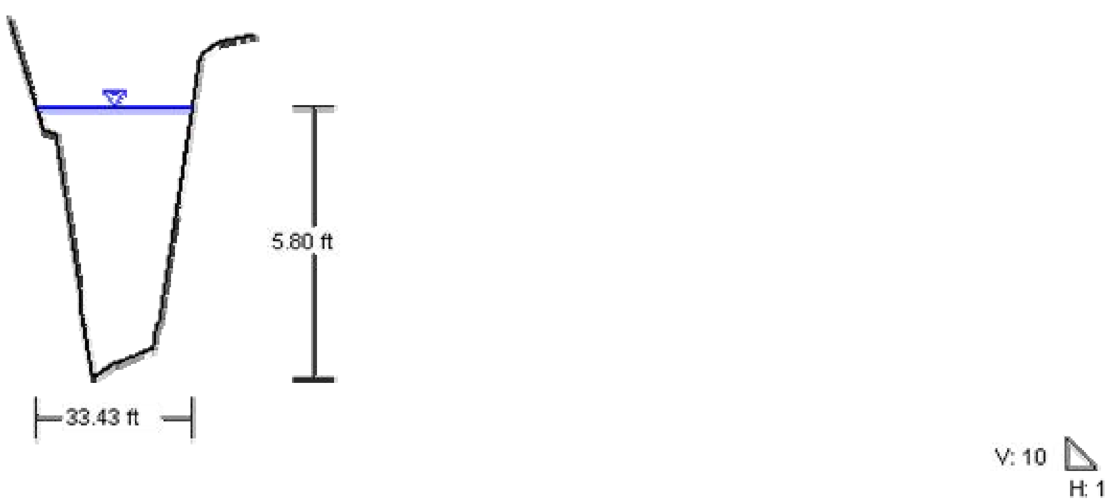
Worksheet for 40+00 406 cfs

Station	Elevation
0+07.57	4672.86
0+10.28	4672.78
0+15.32	4669.49
0+15.73	4668.90
0+18.13	4667.57
0+22.99	4667.91
0+23.33	4667.89
0+31.04	4668.21
0+31.79	4668.72
0+31.94	4668.72
0+32.39	4668.76
0+41.14	4674.47
0+44.87	4674.75
0+52.89	4674.91

Cross Section for 40+00 406 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.035	
Channel Slope:	0.00130	ft/ft
Normal Depth:	5.80	ft
Elevation Range:	4667.57 to 4675.25 ft	
Discharge:	406.00	ft³/s



Worksheet for 40+00 511 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.00130	ft/ft
Discharge:	511.00	ft³/s

Options		
Current Roughness Weighted Methc	ImprovedLotters	
Open Channel Weighted Roughness	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	4674.02	ft
Elevation Range:	4667.57 to 4675.25 ft	
Flow Area:	142.76	ft²
Wetted Perimeter:	39.93	ft
Top Width:	36.36	ft
Normal Depth:	6.45	ft
Critical Depth:	3.49	ft
Critical Slope:	0.01471	ft/ft
Velocity:	3.58	ft/s
Velocity Head:	0.20	ft
Specific Energy:	6.65	ft
Froude Number:	0.32	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00.00, 4675.25)	(0+52.89, 4674.91)	0.035

Section Geometry

Station	Elevation
0+00.00	4675.25
0+00.37	4675.25

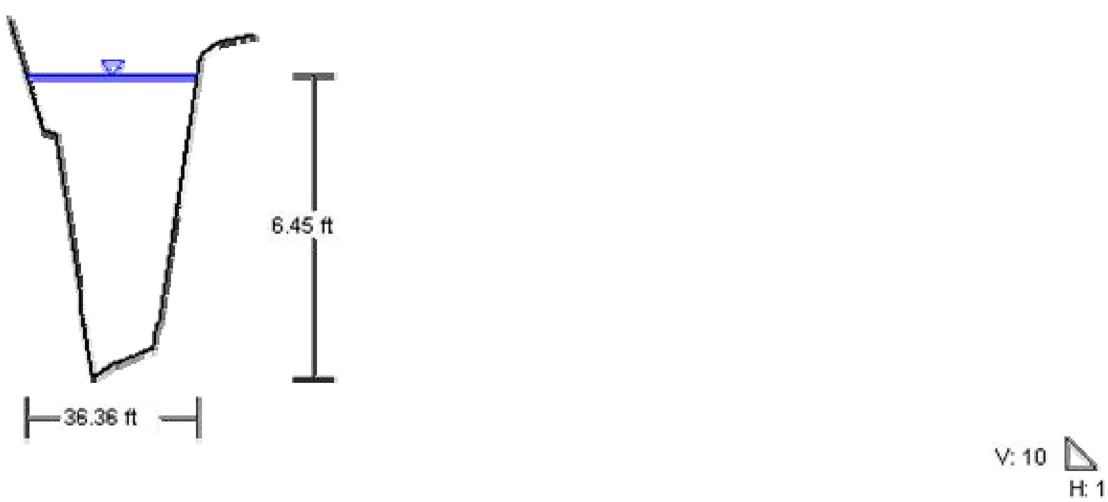
Worksheet for 40+00 511 cfs

Station	Elevation
0+07.57	4672.86
0+10.28	4672.78
0+15.32	4669.49
0+15.73	4668.90
0+18.13	4667.57
0+22.99	4667.91
0+23.33	4667.89
0+31.04	4668.21
0+31.79	4668.72
0+31.94	4668.72
0+32.39	4668.76
0+41.14	4674.47
0+44.87	4674.75
0+52.89	4674.91

Cross Section for 40+00 511 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.035	
Channel Slope:	0.00130	ft/ft
Normal Depth:	6.45	ft
Elevation Range:	4667.57 to 4675.25 ft	
Discharge:	511.00	ft³/s



Worksheet for 41+00 406 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.00130	ft/ft
Discharge:	406.00	ft³/s

Options		
Current Roughness Weighted Metho	ImprovedLotters	
Open Channel Weighted Roughness	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	4673.19	ft
Elevation Range:	4667.64 to 4674.91 ft	
Flow Area:	116.03	ft²
Wetted Perimeter:	33.58	ft
Top Width:	29.97	ft
Normal Depth:	5.55	ft
Critical Depth:	2.90	ft
Critical Slope:	0.01540	ft/ft
Velocity:	3.50	ft/s
Velocity Head:	0.19	ft
Specific Energy:	5.74	ft
Froude Number:	0.31	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00.00, 4674.75)	(0+52.91, 4674.91)	0.035

Section Geometry

Station	Elevation
0+00.00	4674.75
0+00.38	4674.75

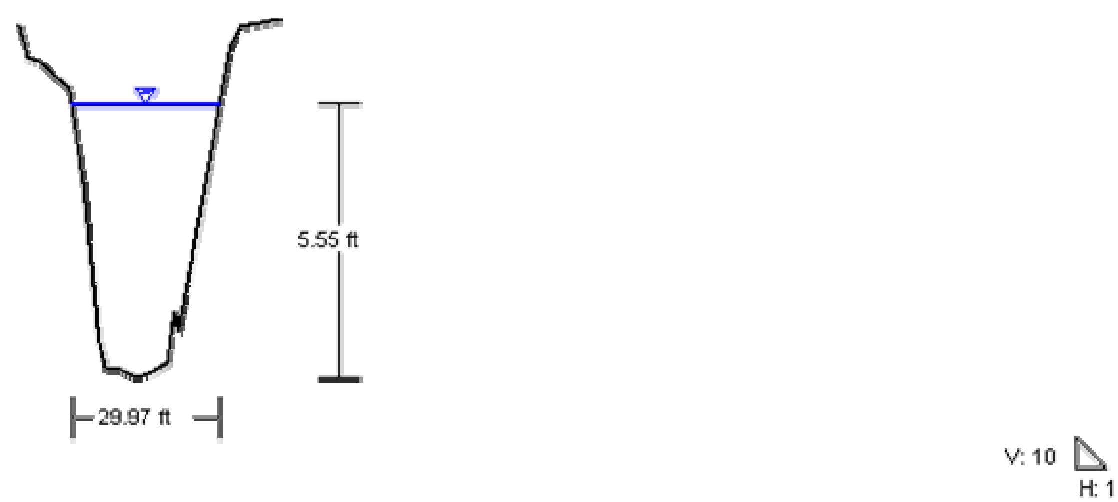
Worksheet for 41+00 406 cfs

Station	Elevation
0+02.03	4674.12
0+04.01	4674.08
0+10.40	4673.51
0+13.36	4671.57
0+16.35	4668.44
0+17.78	4667.83
0+20.59	4667.81
0+24.13	4667.64
0+27.06	4667.75
0+30.33	4667.96
0+31.78	4668.99
0+32.49	4668.56
0+42.99	4674.36
0+44.88	4674.75
0+52.91	4674.91

Cross Section for 41+00 406 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.035	
Channel Slope:	0.00130	ft/ft
Normal Depth:	5.55	ft
Elevation Range:	4667.64 to 4674.91 ft	
Discharge:	406.00	ft³/s



Worksheet for 41+00 511 cfs

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.00130	ft/ft
Discharge:	511.00	ft³/s

Options		
Current Roughness Weighted Methc	ImprovedLotters	
Open Channel Weighted Roughness	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.035	
Water Surface Elevation:	4674.17	ft
Elevation Range:	4667.64 to 4674.91 ft	
Flow Area:	149.42	ft²
Wetted Perimeter:	44.75	ft
Top Width:	40.76	ft
Normal Depth:	6.53	ft
Critical Depth:	3.30	ft
Critical Slope:	0.01493	ft/ft
Velocity:	3.42	ft/s
Velocity Head:	0.18	ft
Specific Energy:	6.71	ft
Froude Number:	0.31	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00.00, 4674.75)	(0+52.91, 4674.91)	0.035

Section Geometry

Station	Elevation
0+00.00	4674.75
0+00.38	4674.75

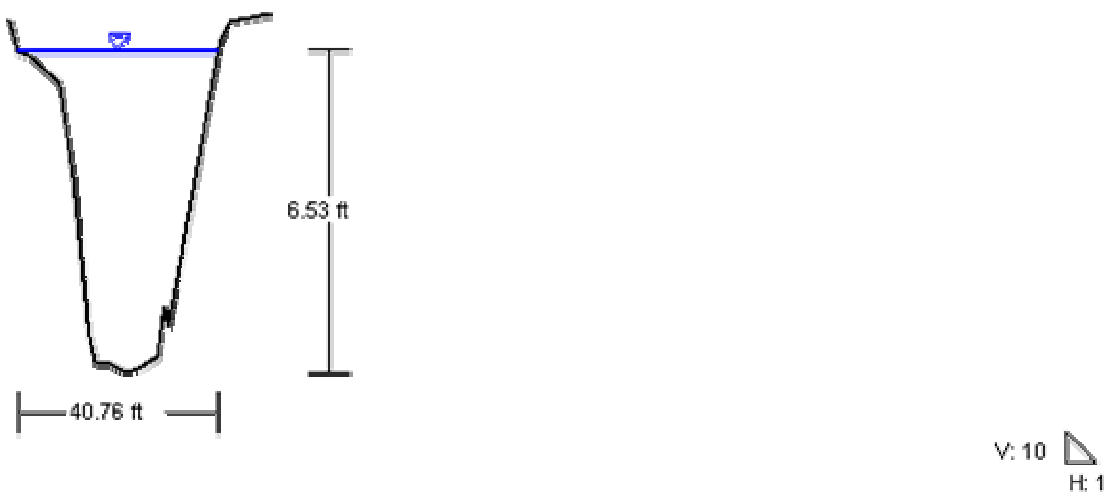
Worksheet for 41+00 511 cfs

Station	Elevation
0+02.03	4674.12
0+04.01	4674.08
0+10.40	4673.51
0+13.36	4671.57
0+16.35	4668.44
0+17.78	4667.83
0+20.59	4667.81
0+24.13	4667.64
0+27.06	4667.75
0+30.33	4667.96
0+31.78	4668.99
0+32.49	4668.56
0+42.99	4674.36
0+44.88	4674.75
0+52.91	4674.91

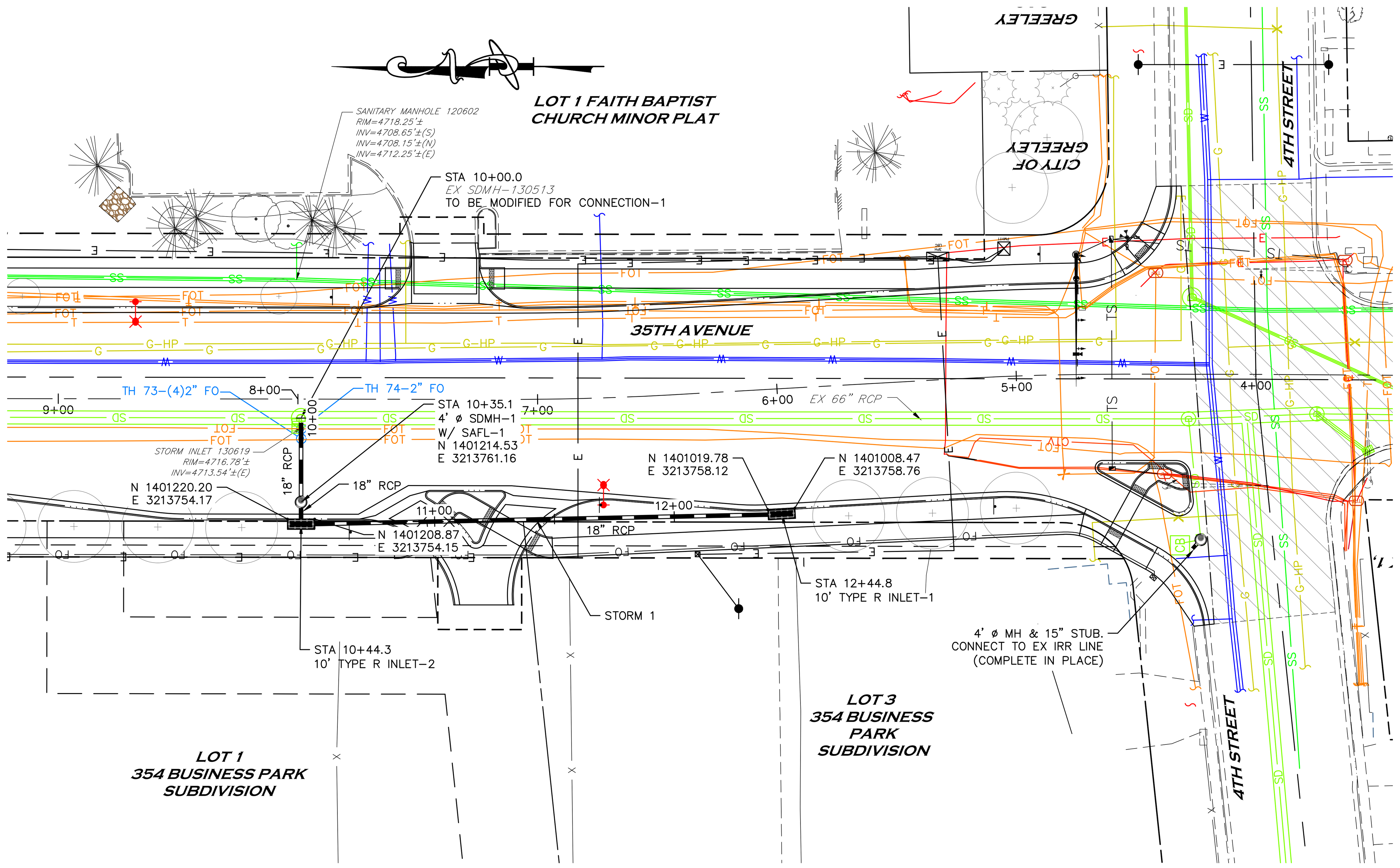
Cross Section for 41+00 511 cfs

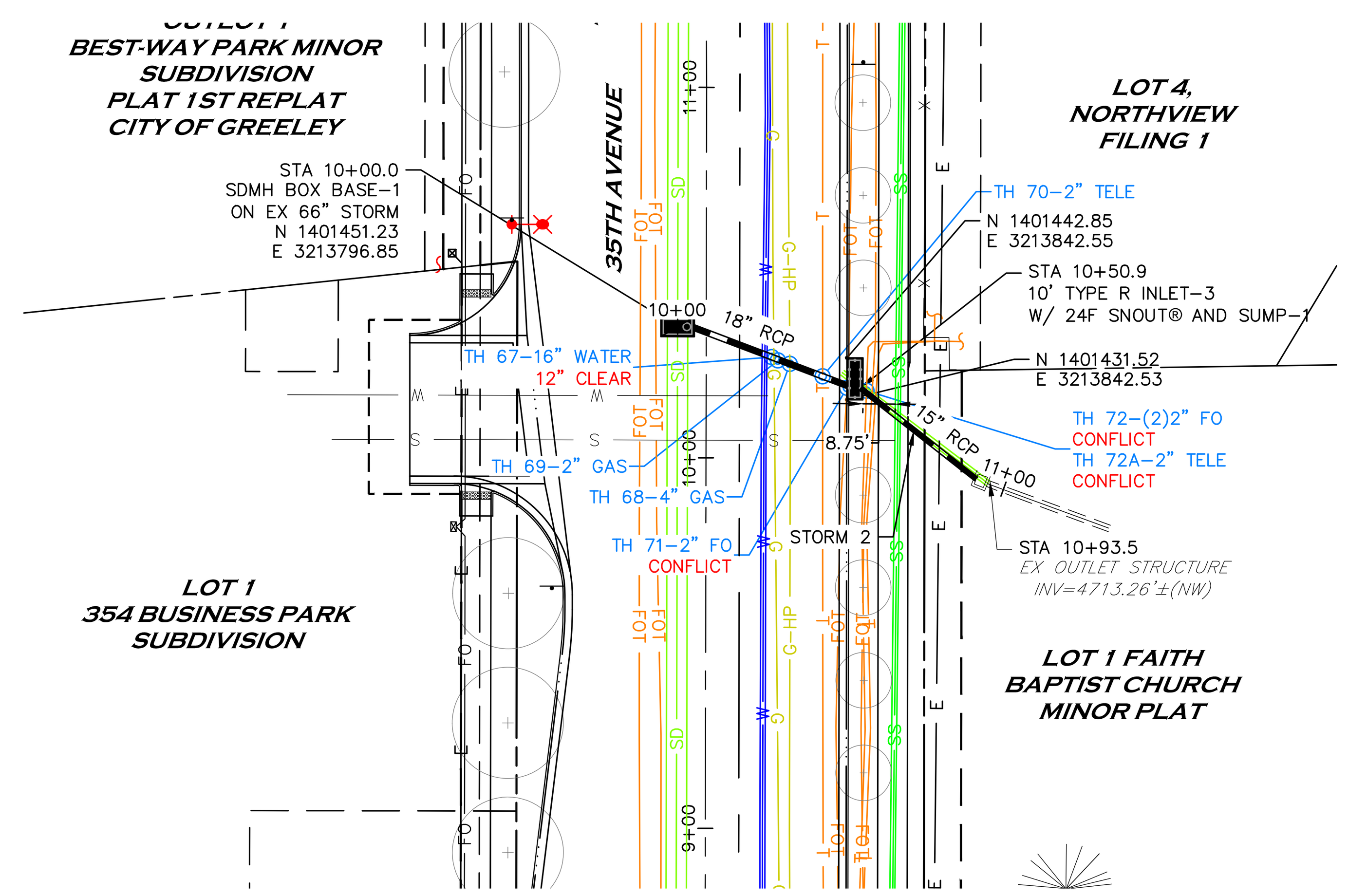
Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.035	
Channel Slope:	0.00130	ft/ft
Normal Depth:	6.53	ft
Elevation Range:	4667.64 to 4674.91 ft	
Discharge:	511.00	ft³/s



STORM SYSTEM ANALYSIS
AND
STORM PLAN AND PROFILE SHEETS





GENERAL NOTES:

1. NORTHING AND EASTINGS, STATIONING AND PIPE LENGTHS ARE FROM CENTER OF STRUCTURE TO CENTER OF STRUCTURE, TO END OF FES, TO INNER EDGE OF BOX WALL OR OUTER EDGE OF HEADWALL UNLESS OTHERWISE SPECIFIED.
2. CONTRACTOR TO VERIFY VERTICAL AND HORIZONTAL LOCATION OF EXISTING UTILITIES AT CROSSINGS.
3. RCP SHALL BE CLASS III WITH WATER TIGHT JOINTS (ASTMC443).

40 20 0 40 80

HORIZONTAL
SCALE: 1" = 40'

VERTICAL
SCALE: 1" = 4'

LEGEND

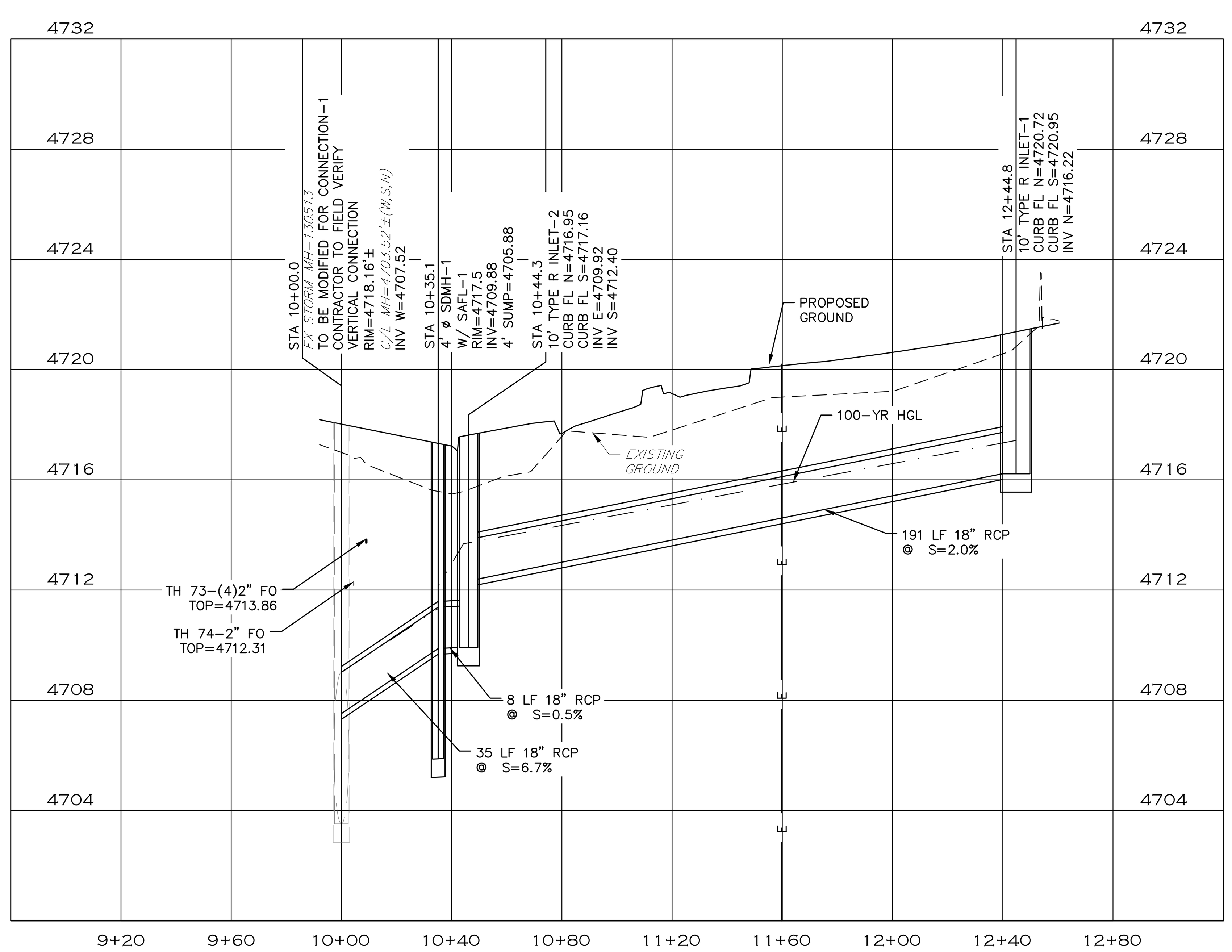
PROPOSED STORM PIPE

PROPOSED INLET

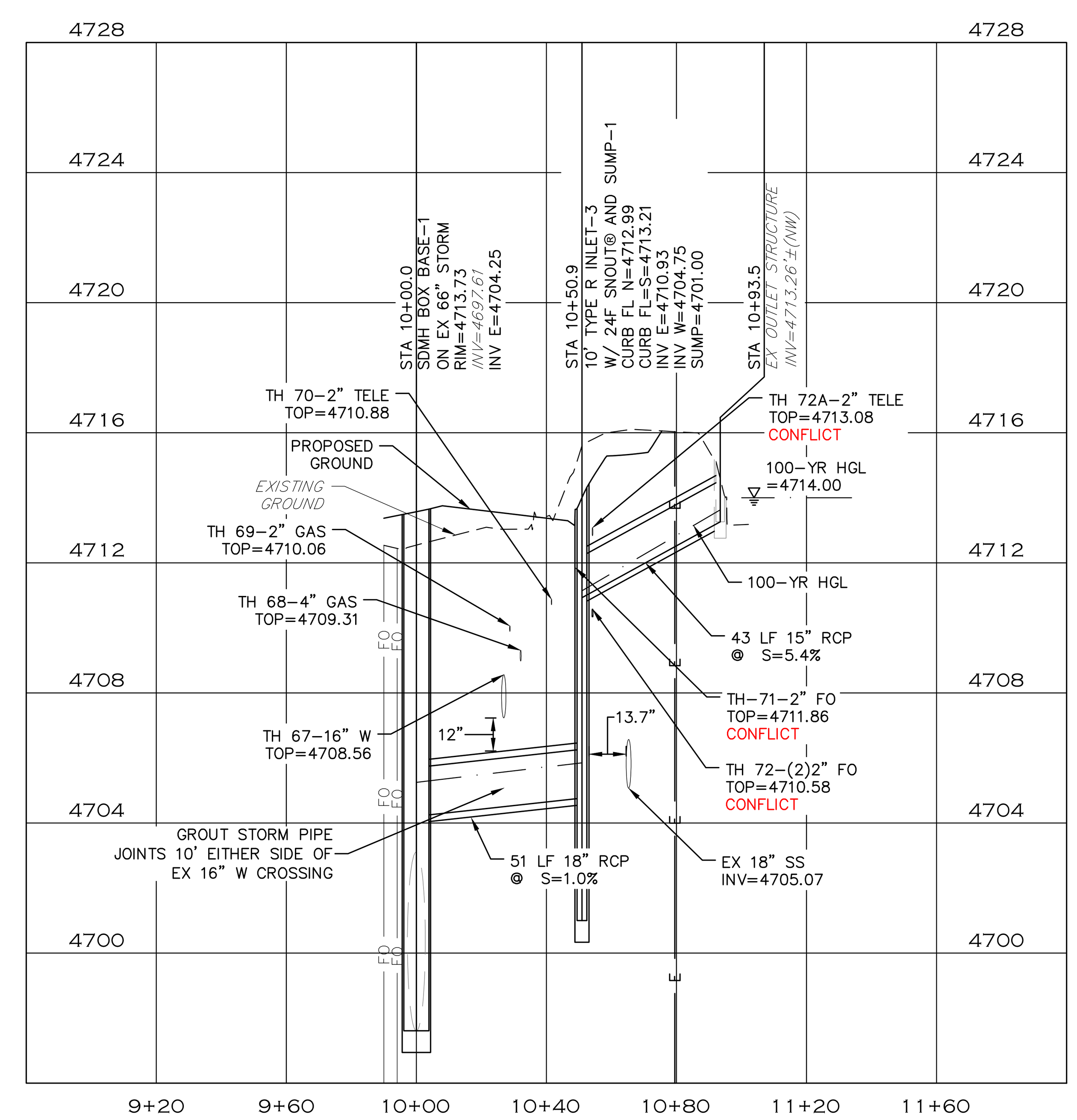
TESTHOLE # - DIA. AND TYPE OF EX UTIL.
TOP OF EX UTIL.
INVERT OF EX UTIL.
INVERT OR TOP OF STORM PIPE
CLEARANCE DEPTH OR CONFLICT — UTILITY CROSSING WITH PROPOSED STORM PIPE

FO — PROPOSED FIBER OPTIC UTILITY

E — PROPOSED ELECTRIC UTILITY



STORM 1



STORM 2

STRUCTURAL WQ INSPECTION AND MAINTENANCE NOTES:

1. SNOUT® WITH SUMPS
INSPECT AFTER EACH RAIN EVENT OF 0.5 INCHES OR MORE OR MONTHLY. SUMPS SHALL BE CLEANED WITH A VACUUM TRUCK WHEN THE SUMP IS HALF FULL AND HOODS SHALL BE FLUSHED ANNUALLY.

2. INLET FILTERS
INSPECT AFTER EACH RAIN EVENT OF 0.5 INCHES OR MORE OR THREE TIMES PER YEAR. FILTERS SHALL BE EMPTIED IF MORE THAN HALF FULL.

3. SAFL BAFFLE WITH SUMPS
INSPECT AFTER EACH RAIN EVENT OF 0.5 INCHES OR TWO TIMES PER YEAR. SUMPS SHALL BE CLEANED WITH A VACUUM TRUCK WHEN THE TOP OF THE SEDIMENT IS 12 INCHES BELOW THE BOTTOM OF THE SAFL BAFFLE OR TWICE PER YEAR. FLUSH BAFFLE WITH HIGH-PRESSURE WASHER AT THE SAME TIME.

4. BIOSWALES
INSPECT TWICE ANNUALLY FOR CLOGGING, EROSION AND REPAIR. REMOVE DEBRIS AND LITTER FROM THE SURFACE AND PROVIDE MAINTENANCE ACTIVITIES TO RESTORE INFILTRATION CAPACITY.

CALL UTILITY NOTIFICATION CENTER OF COLORADO
811
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BID SET
NOT FOR CONSTRUCTION

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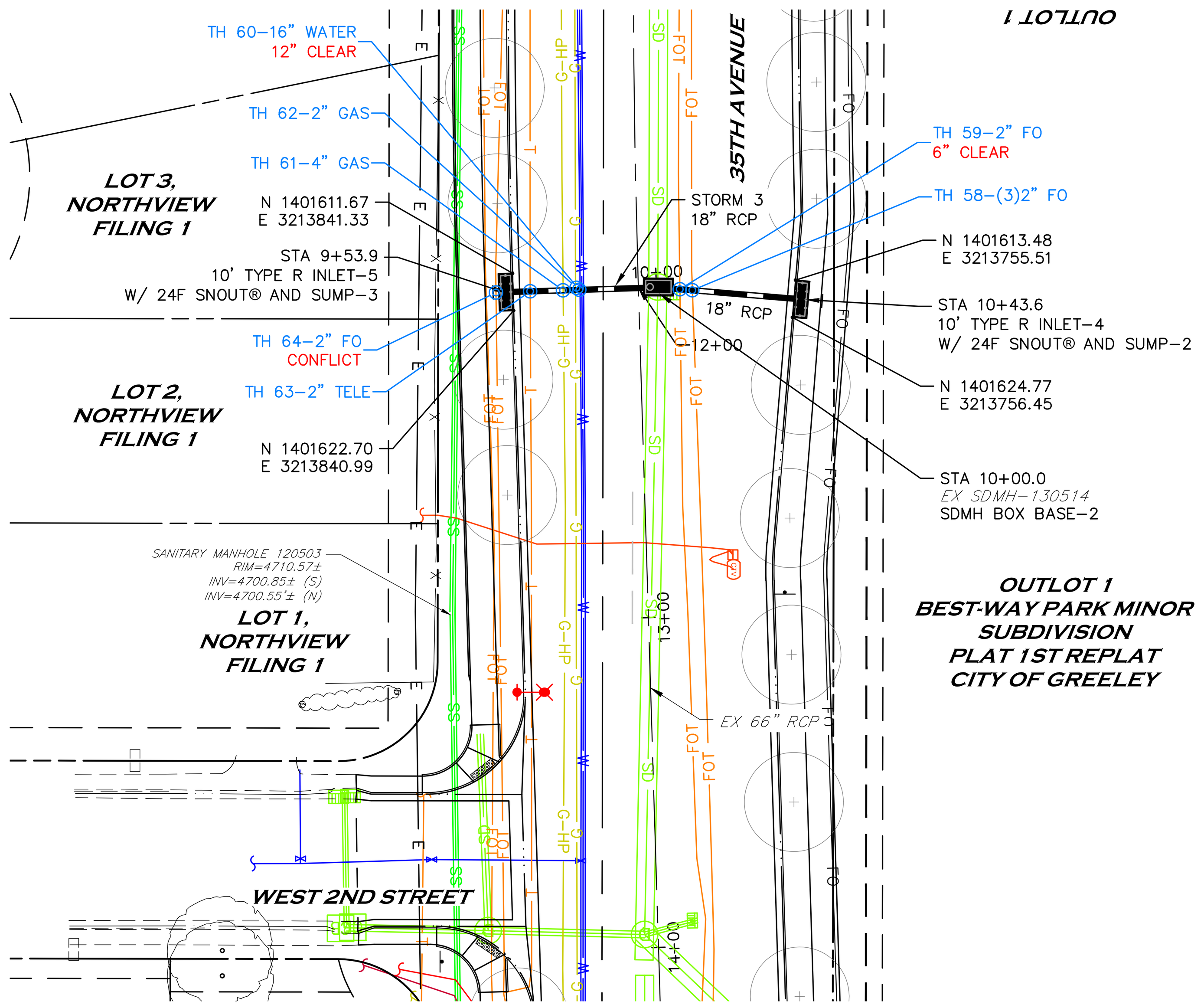
Windsor, Colorado 80550
Phone: (970) 674-3300
Fax: (970) 674-3303

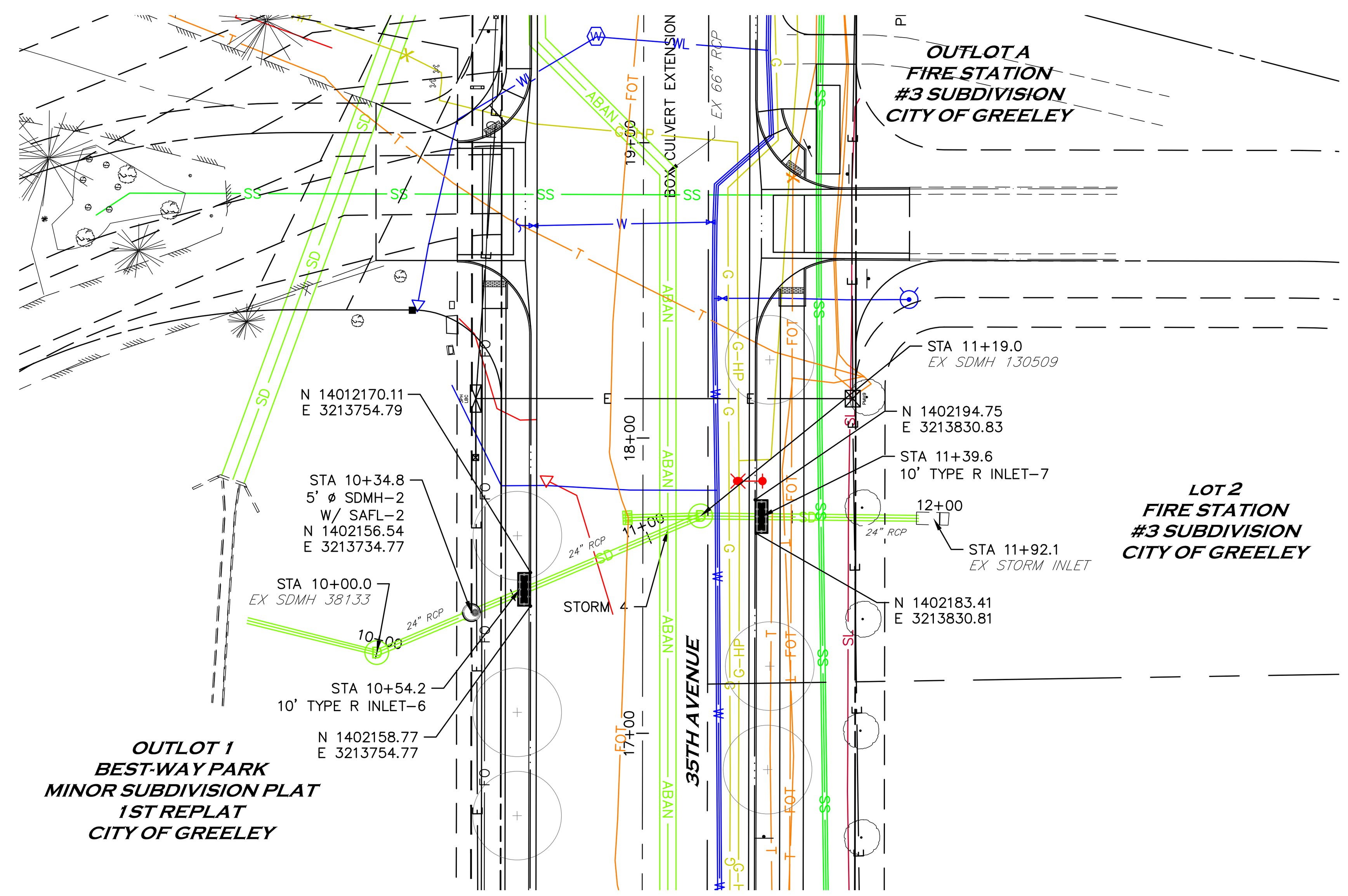
City of Greeley Colorado

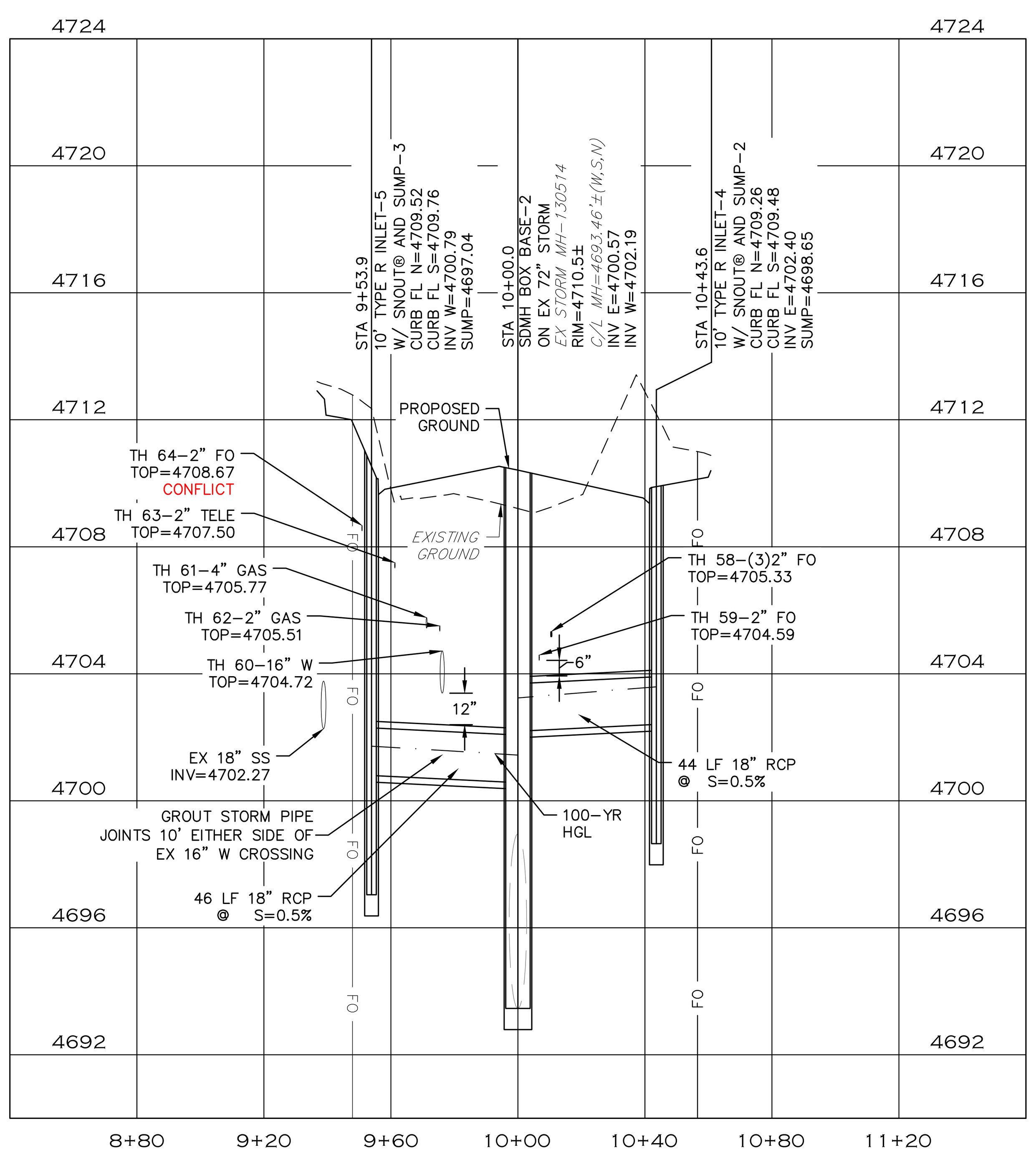
35TH AVENUE WIDENING
STORM SEWER PLAN & PROFILE

DATE: 10/30/20
SCALE (H): 1"=40'
SCALE (V): 1"=4'
DESIGNED BY: ES
CHECKED BY: MPO

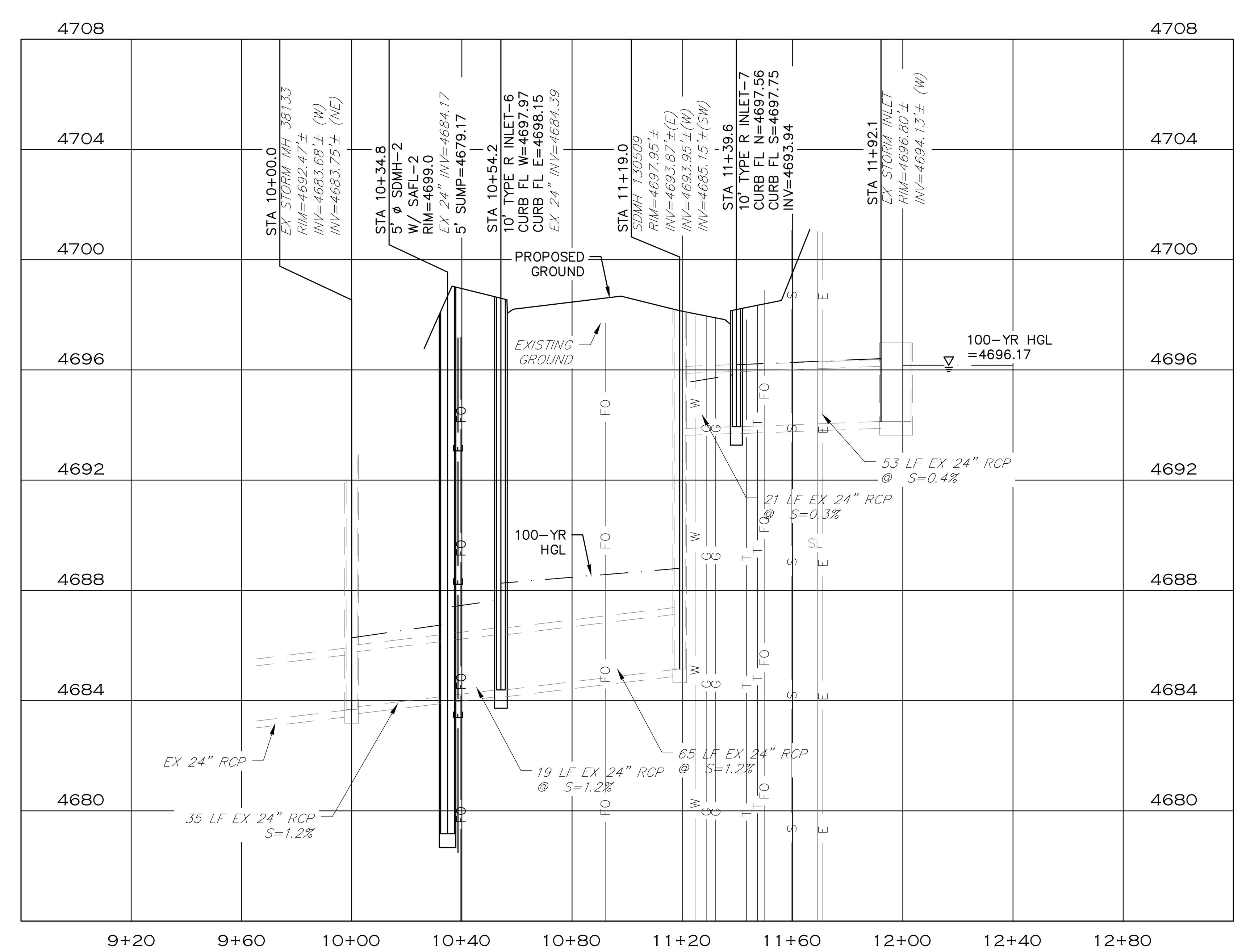
PROJ. NO. 1397-083-00







STORM 3



STORM 4

GENERAL NOTES:

1. NORTHING AND EASTINGS, STATIONING AND PIPE LENGTHS ARE FROM CENTER OF STRUCTURE TO CENTER OF STRUCTURE, TO END OF FES, TO INNER EDGE OF BOX WALL OR OUTER EDGE OF HEADWALL UNLESS OTHERWISE SPECIFIED.
2. CONTRACTOR TO VERIFY VERTICAL AND HORIZONTAL LOCATION OF EXISTING UTILITIES AT CROSSINGS.
3. RCP SHALL BE CLASS III WITH WATER TIGHT JOINTS (ASTMC443).

40 20 0 40 80

HORIZONTAL
SCALE: 1" = 40'

VERTICAL
SCALE: 1" = 4'

LEGEND

	PROPOSED STORM PIPE
	PROPOSED INLET
TESTHOLE # – DIA. AND TYPE OF EX UTIL. TOP OF EX UTIL. INVERT OF EX UTIL. INVERT OR TOP OF STORM PIPE CLEARANCE DEPTH OR CONFLICT	UTILITY CROSSING WITH PROPOSED STORM PIPE
FO	PROPOSED FIBER OPTIC UTILITY
E	PROPOSED ELECTRIC UTILITY

STRUCTURAL WQ INSPECTION AND MAINTENANCE NOTES:

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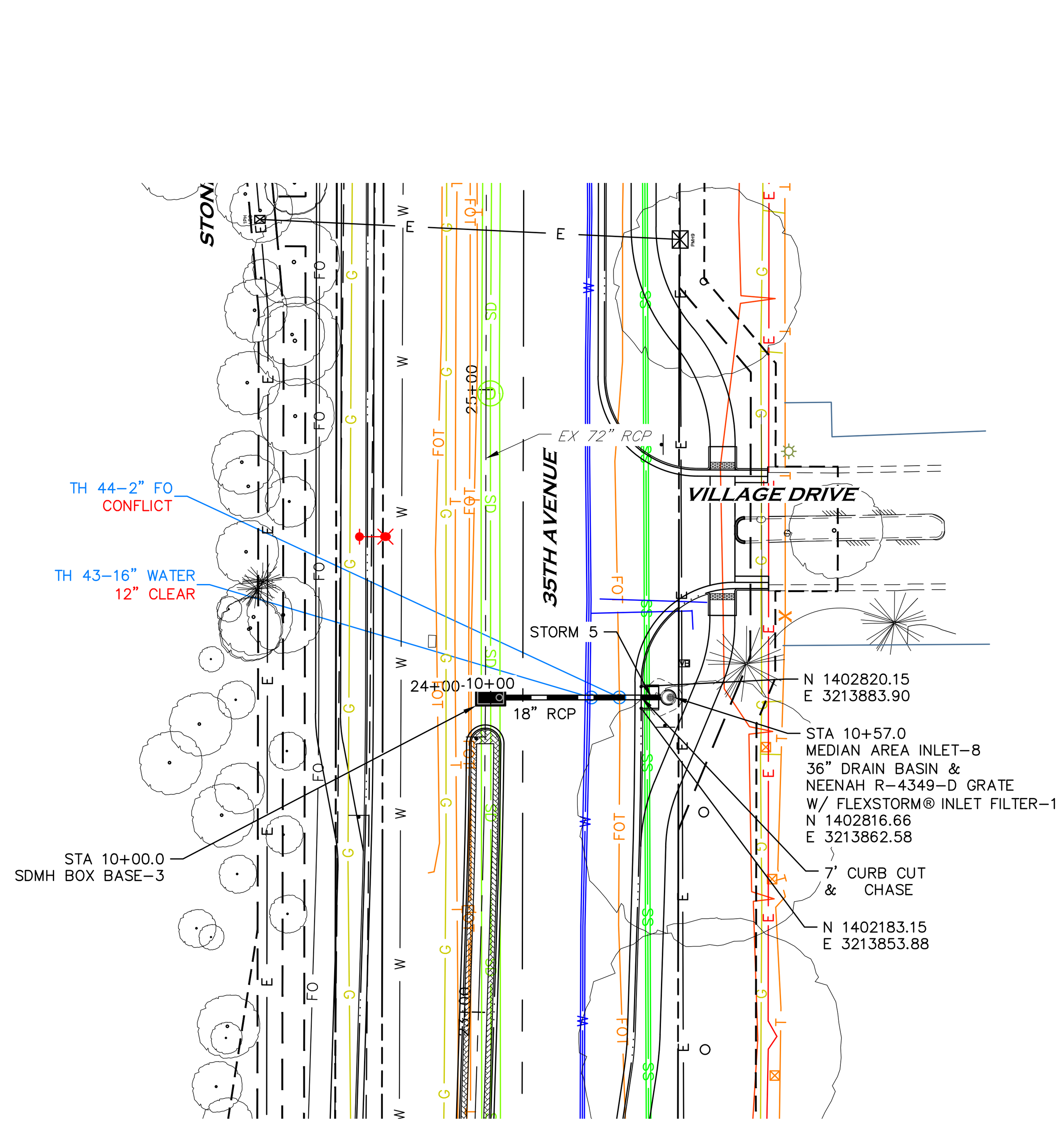

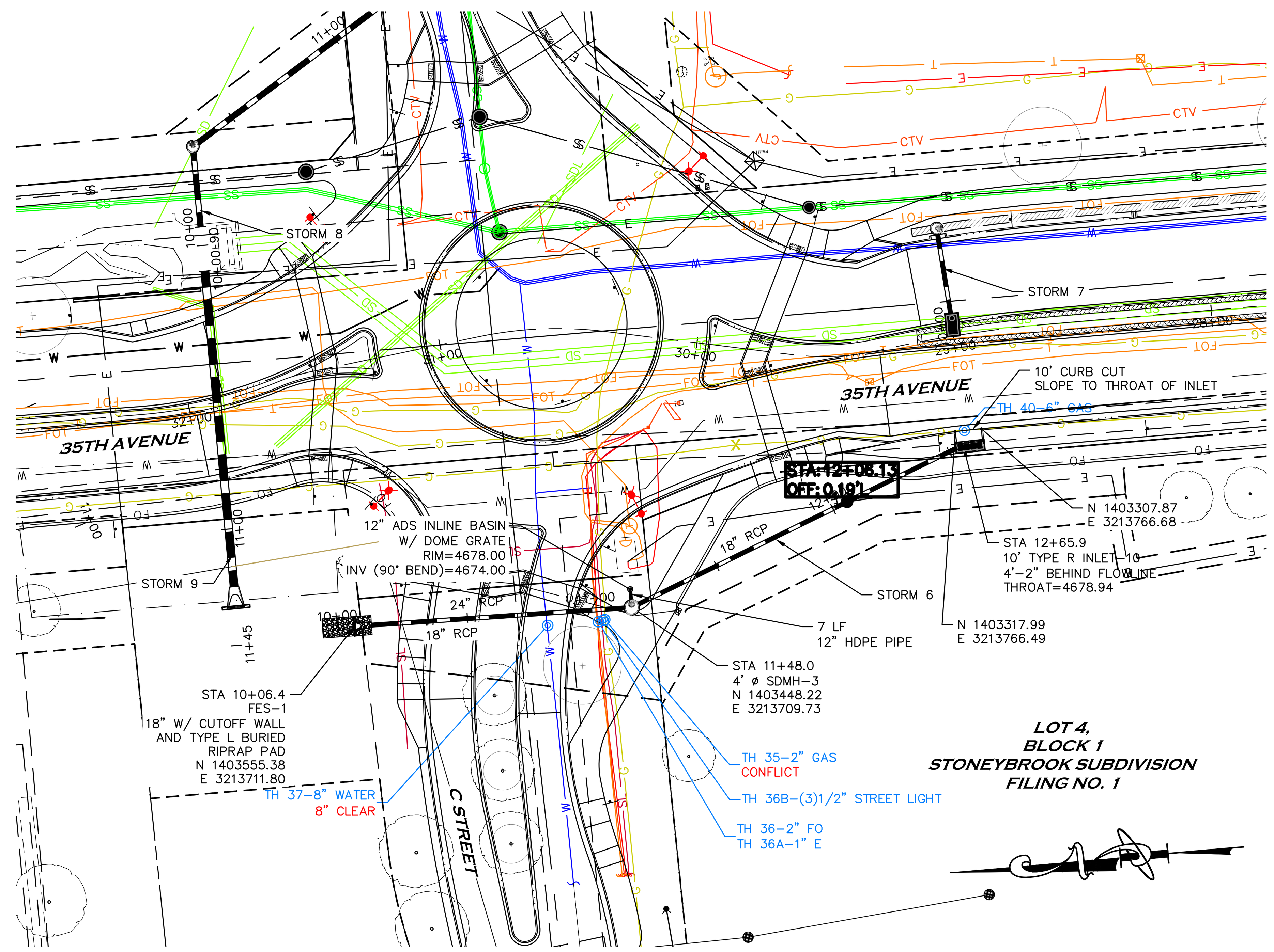

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HORIZONTAL
SCALE: 1" = 40'

VERTICAL
SCALE: 1" = 4'

LEGEND

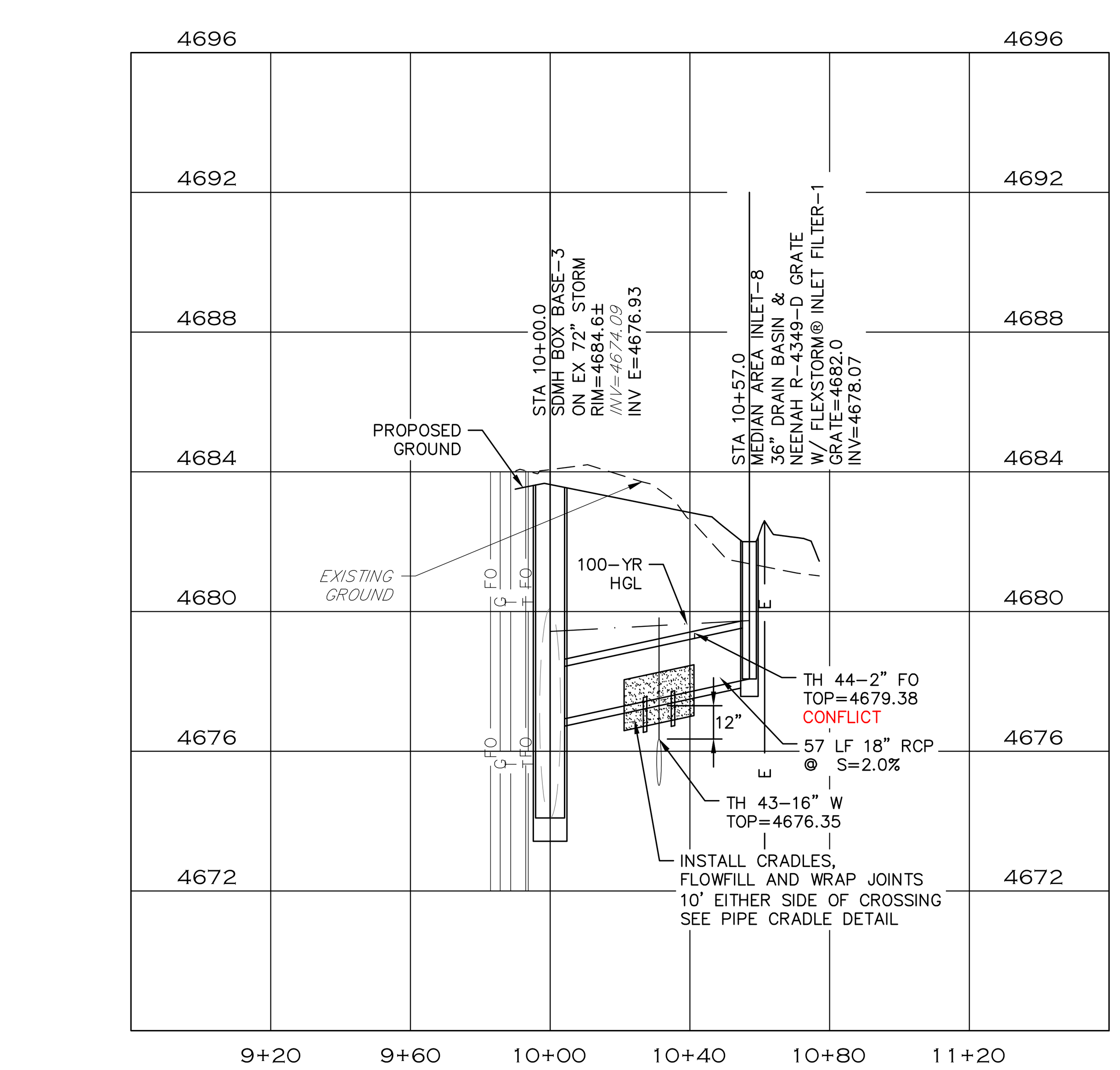
PROPOSED STORM PIPE

PROPOSED INLET

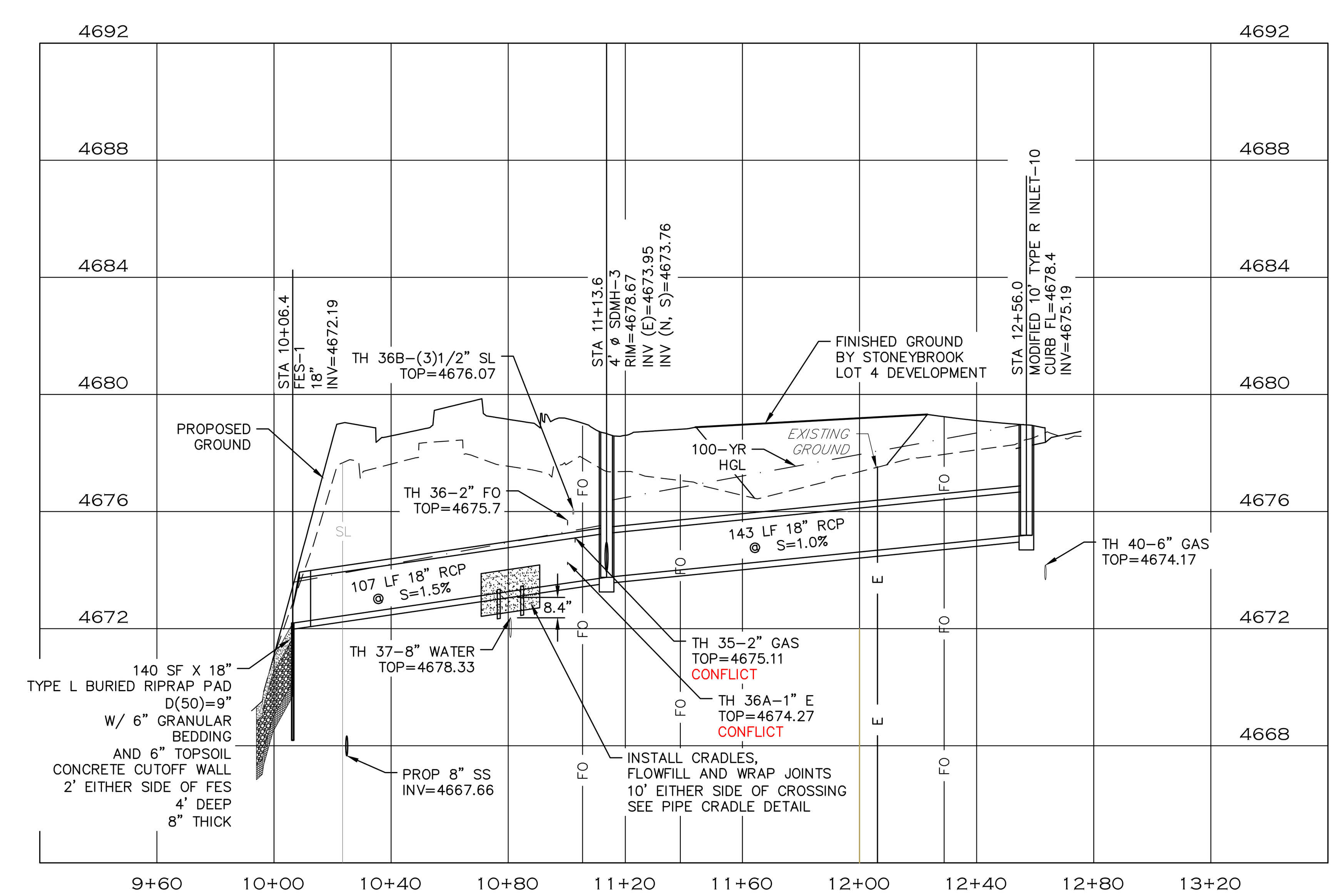
TESTHOLE # - DIA. AND TYPE OF EX UTIL.
TOP OF EX UTIL.
INVERT OF EX UTIL.
INVERT OR TOP OF STORM PIPE
CLEARANCE DEPTH OR CONFLICT
— UTILITY CROSSING WITH PROPOSED STORM PIPE

FO — PROPOSED FIBER OPTIC UTILITY

E — PROPOSED ELECTRIC UTILITY



STORM 5



STORM 6

STRUCTURAL WQ INSPECTION AND MAINTENANCE NOTES:

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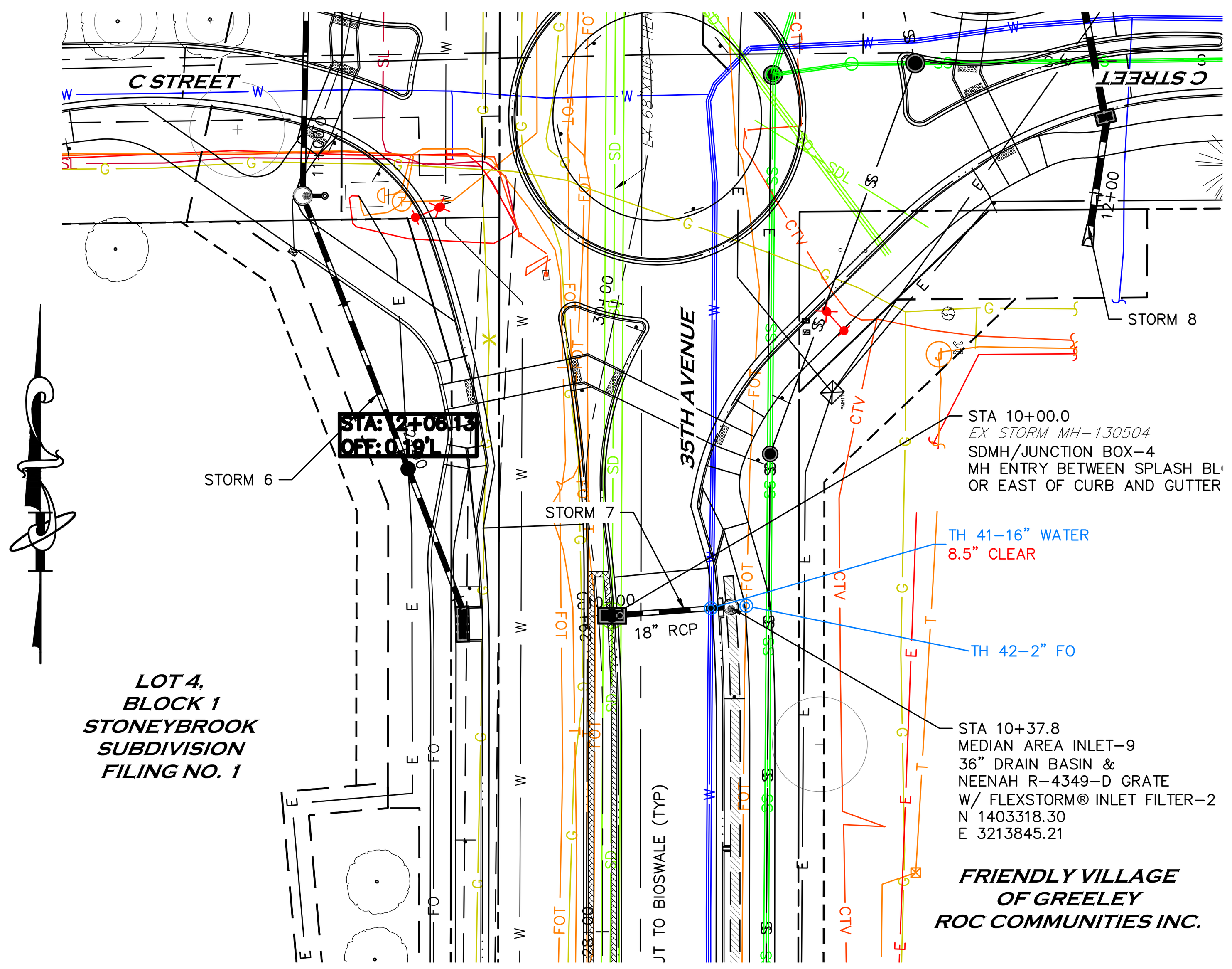

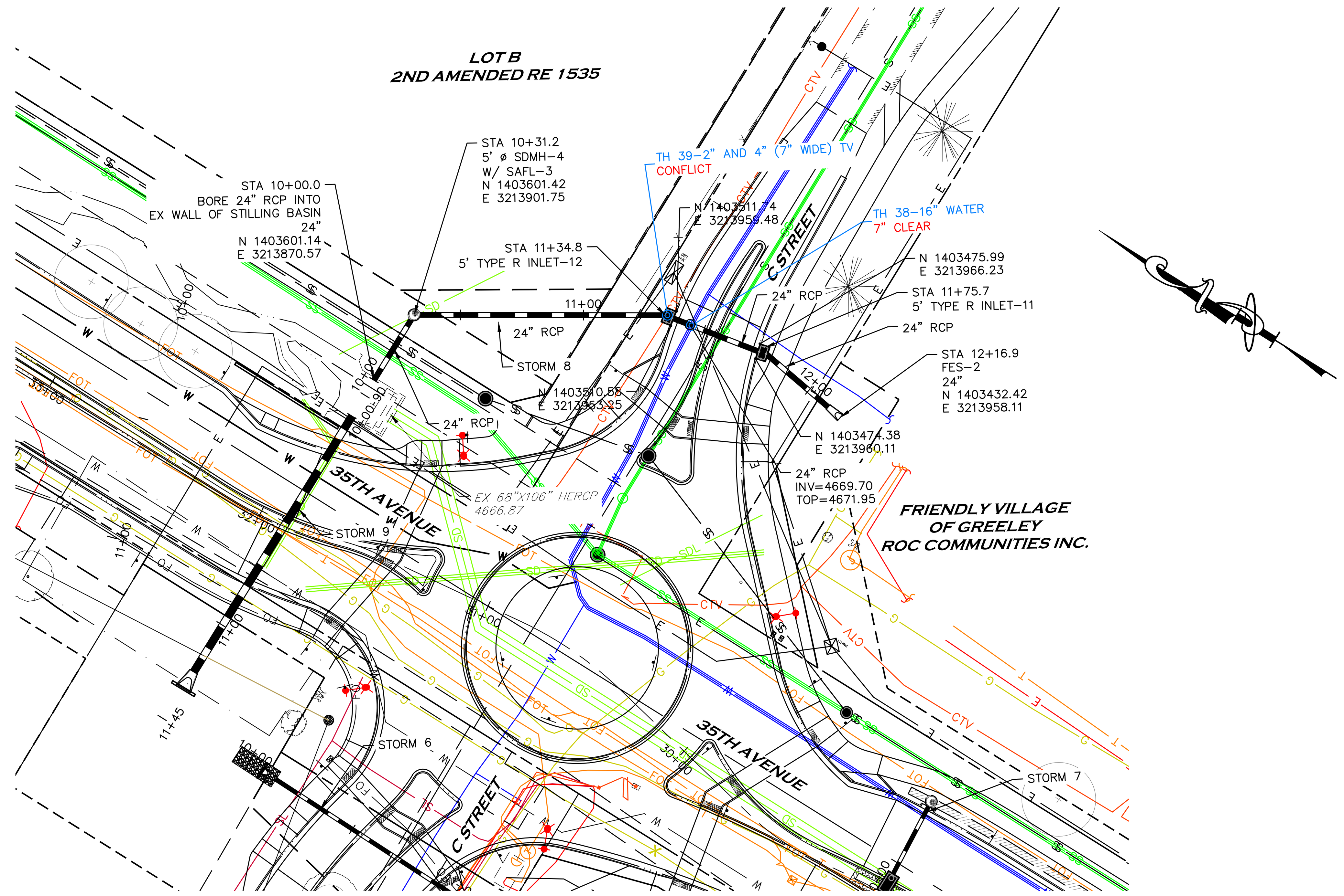

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HORIZONTAL
SCALE: 1" = 40'

VERTICAL
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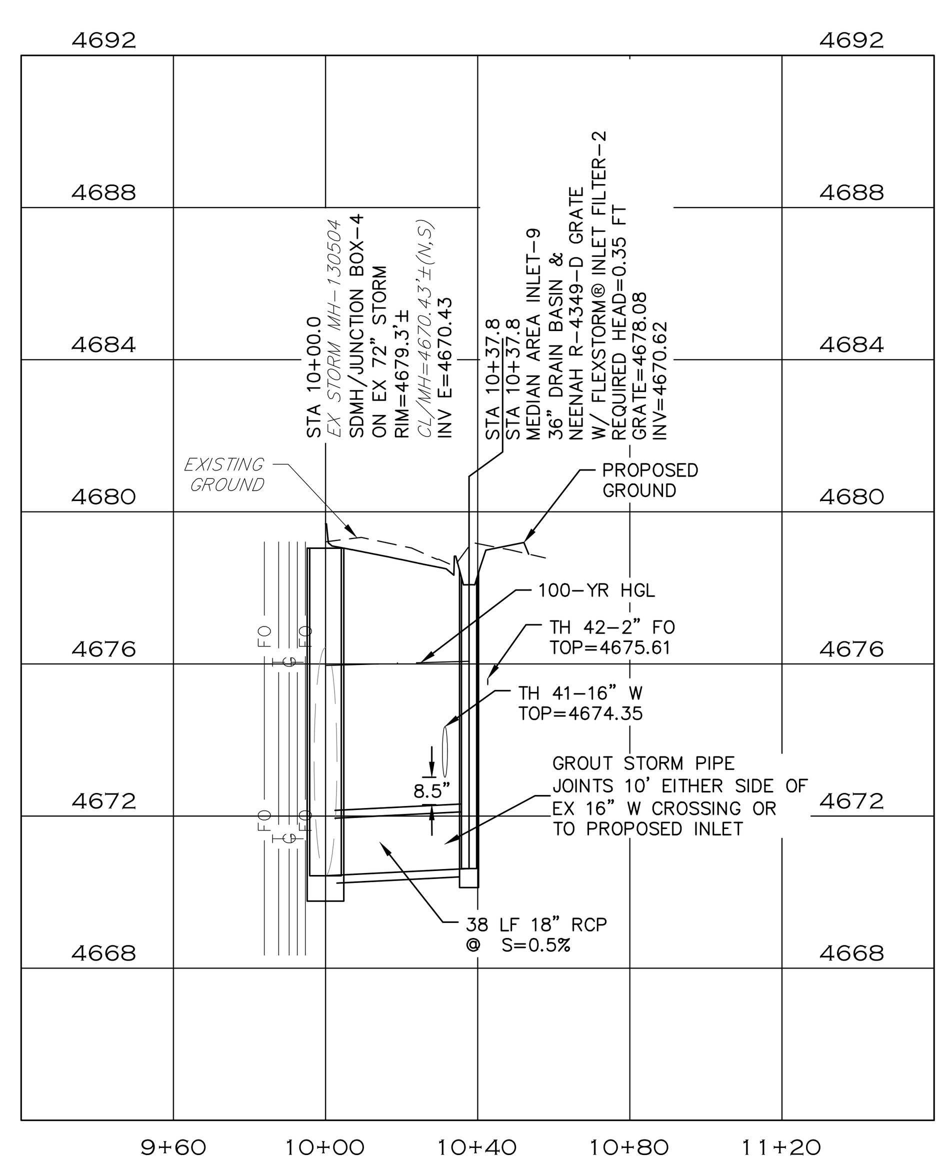
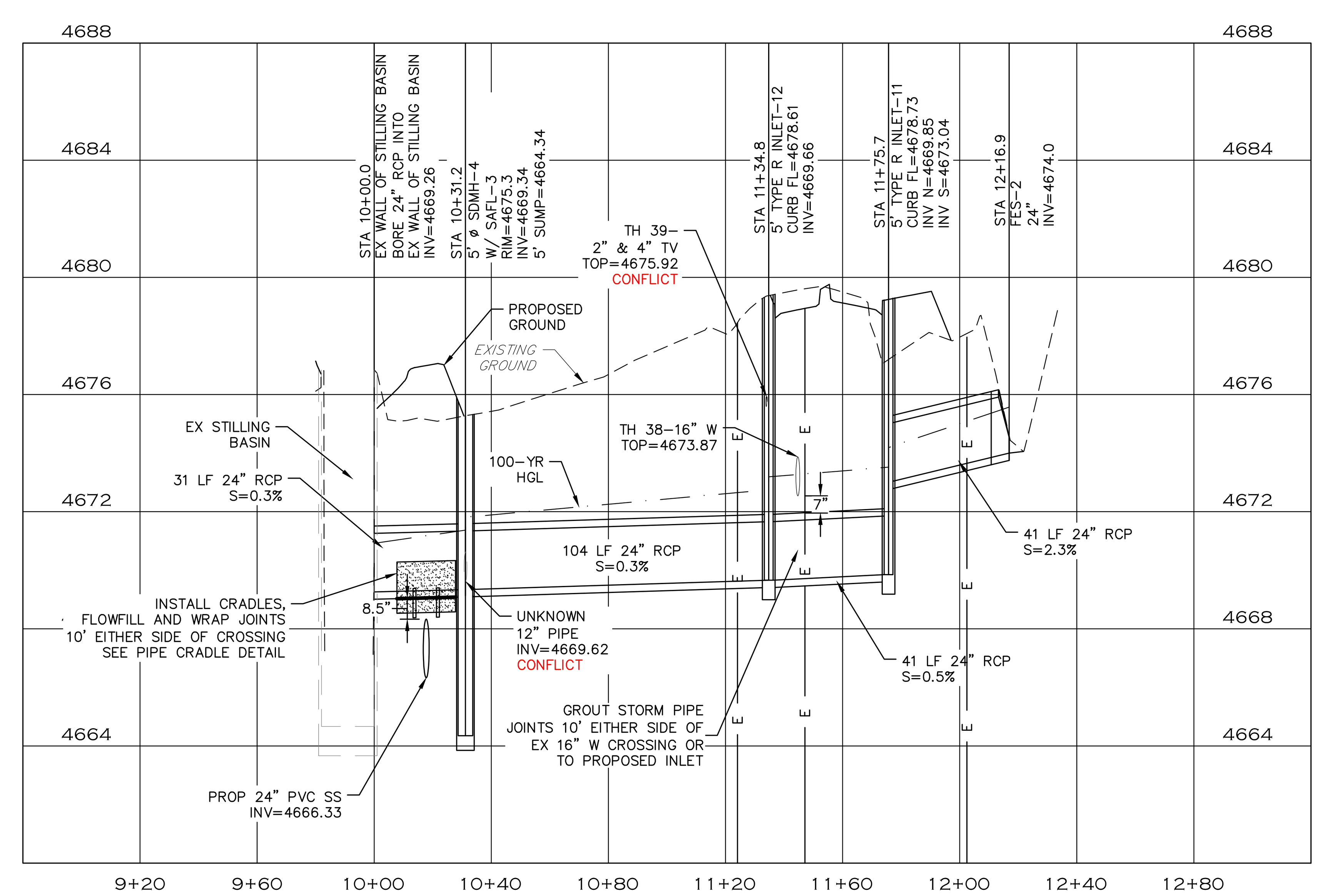
LEGEND

	PROPOSED STORM PIPE
	PROPOSED INLET
TESTHOLE # - DIA. AND TYPE OF EX UTIL. TOP OF EX UTIL. INVERT OF EX UTIL. INVERT OR TOP OF STORM PIPE CLEARANCE DEPTH OR CONFLICT	UTILITY CROSSING WITH PROPOSED STORM PIPE
—— FO ——	PROPOSED FIBER OPTIC UTILITY
—— E ——	PROPOSED ELECTRIC UTILITY



STORM 7



STORM 8

STRUCTURAL WQ INSPECTION AND MAINTENANCE NOTES:

1. SNOUT® WITH SUMPS
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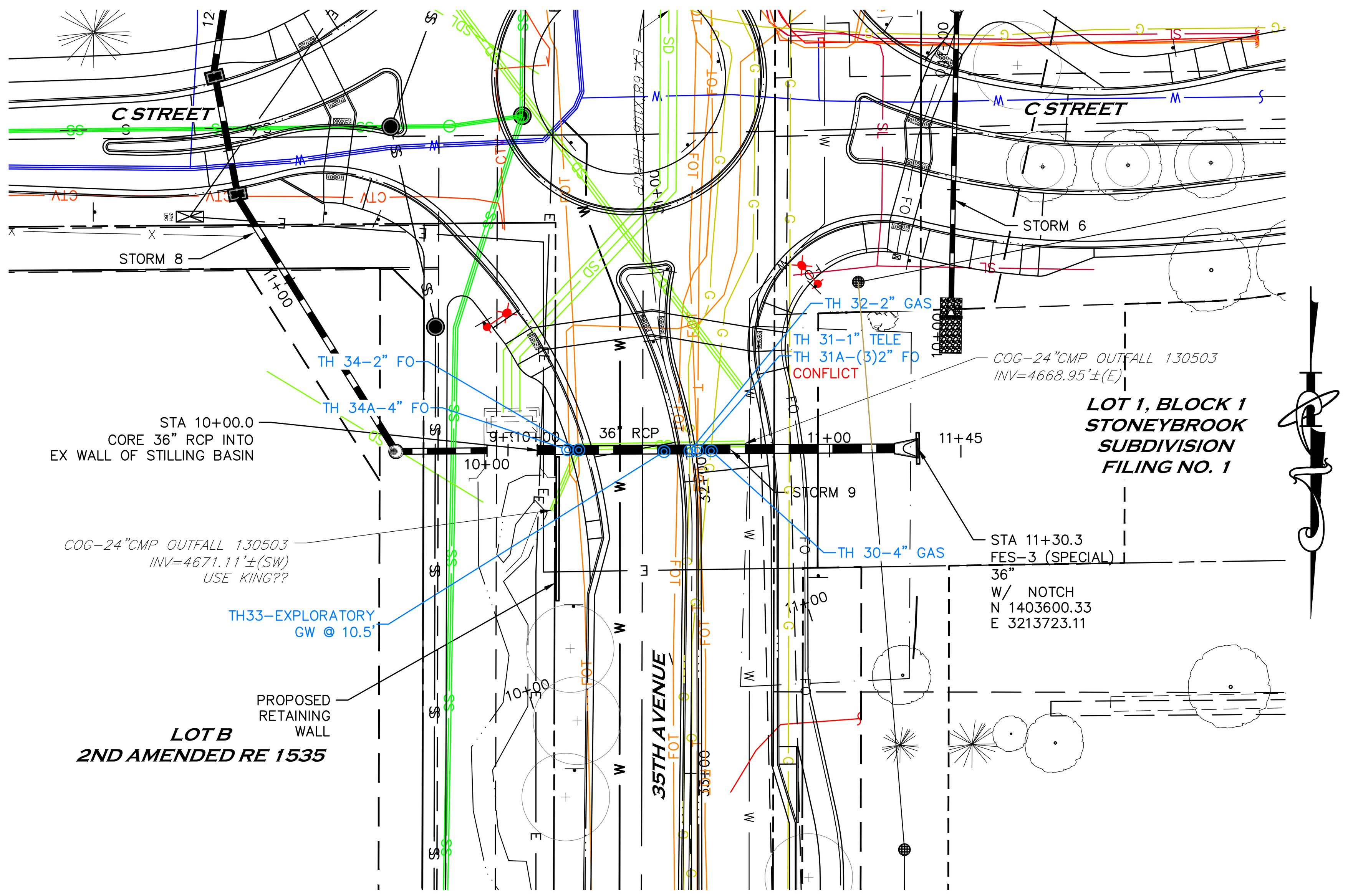
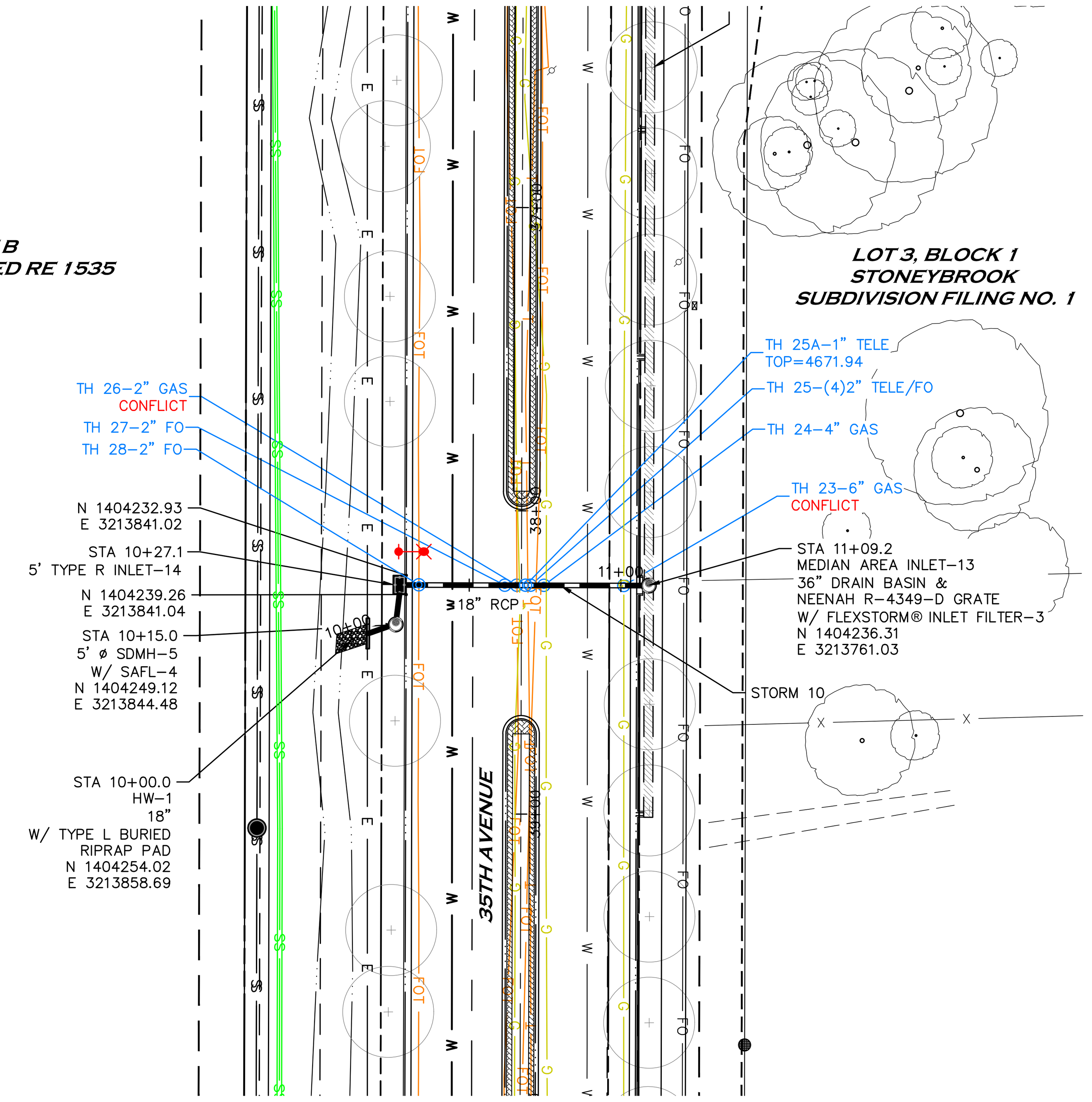
PROJ. NO. 1397-083-00

33 OF 74





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40 20 0 40 80

HORIZONTAL
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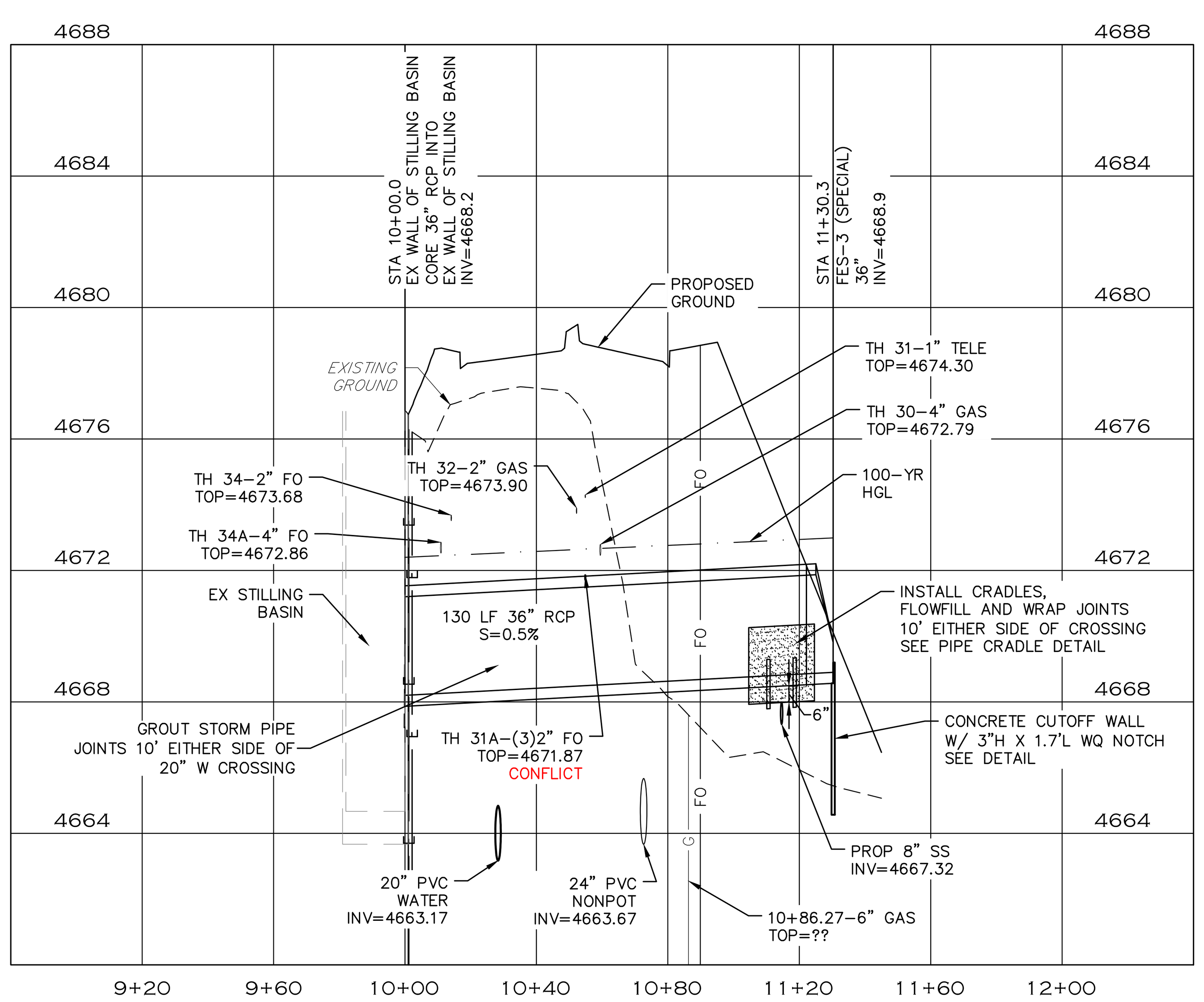
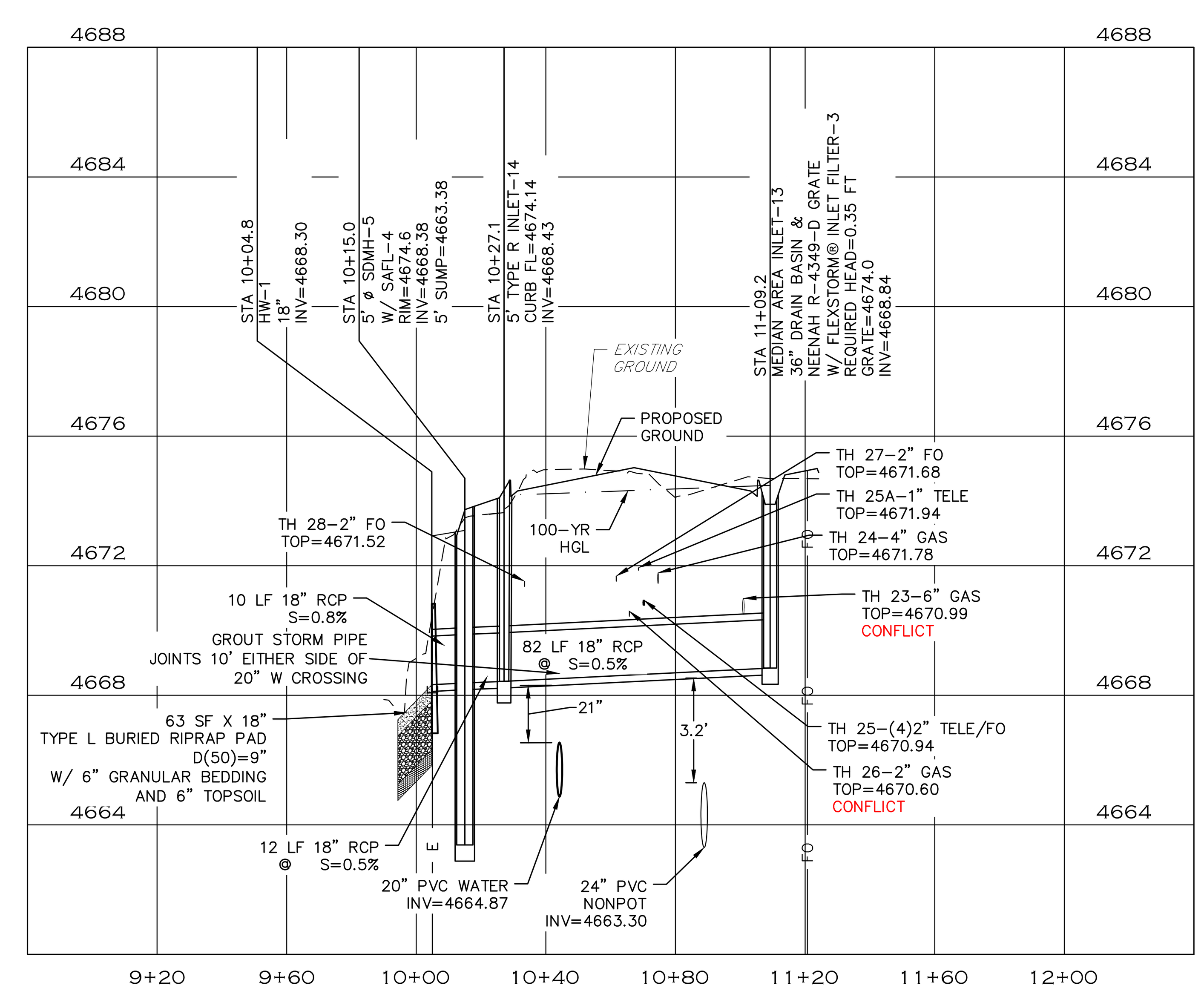
VERTICAL
SCALE: 1" = 4'

LEGEND

	PROPOSED STORM PIPE
	PROPOSED INLET
TESTHOLE # – DIA. AND TYPE OF EX UTIL. TOP OF EX UTIL. INVERT OF EX UTIL. INVERT OR TOP OF STORM PIPE CLEARANCE DEPTH OR CONFLICT	UTILITY CROSSING WITH PROPOSED STORM PIPE
—— FO ——	PROPOSED FIBER OPTIC UTILITY
—— E ——	PROPOSED ELECTRIC UTILITY



STORM 9



STORM 10

STRUCTURAL WQ INSPECTION AND MAINTENANCE NOTES:

1. SNOUT® WITH SUMPS
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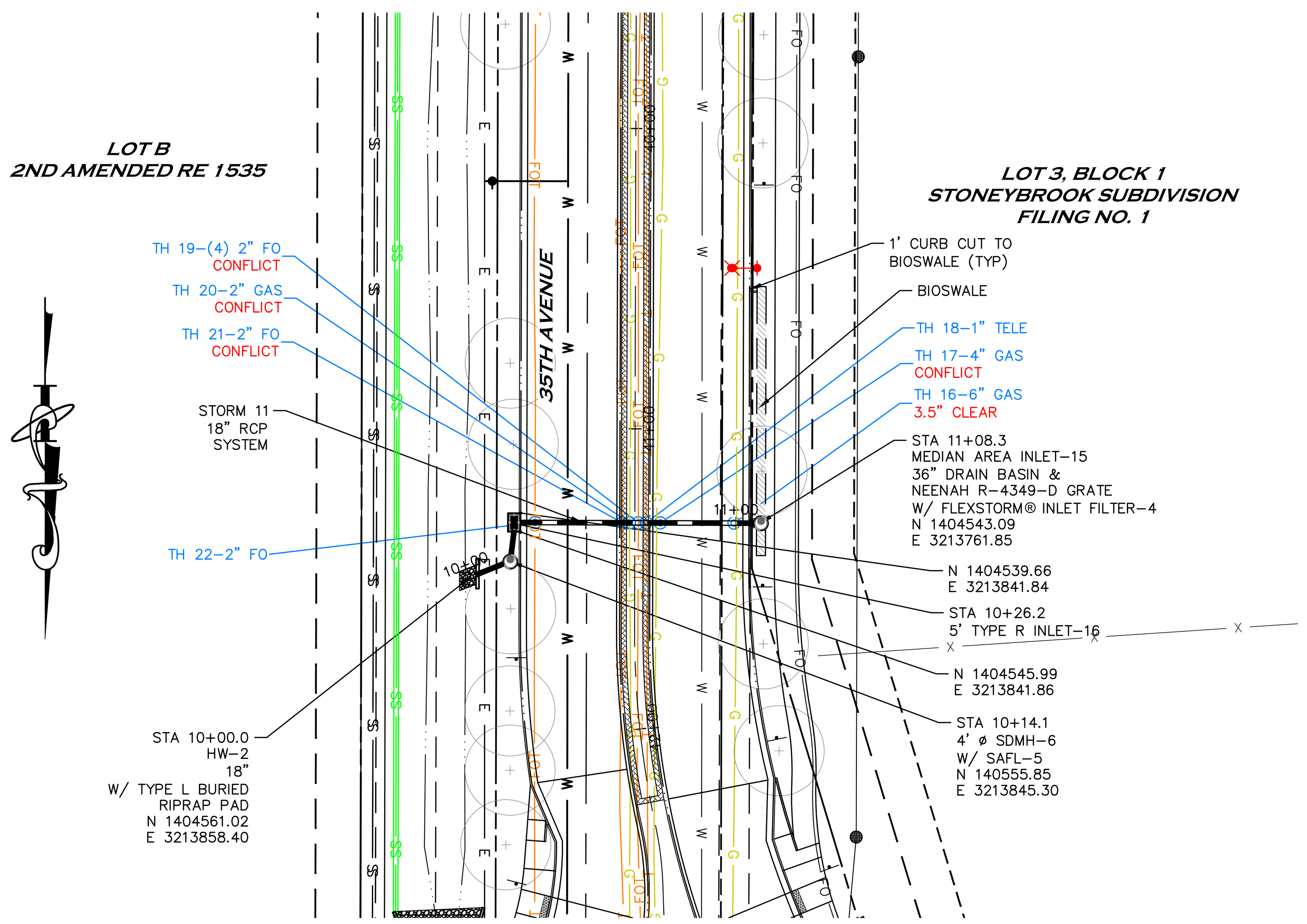

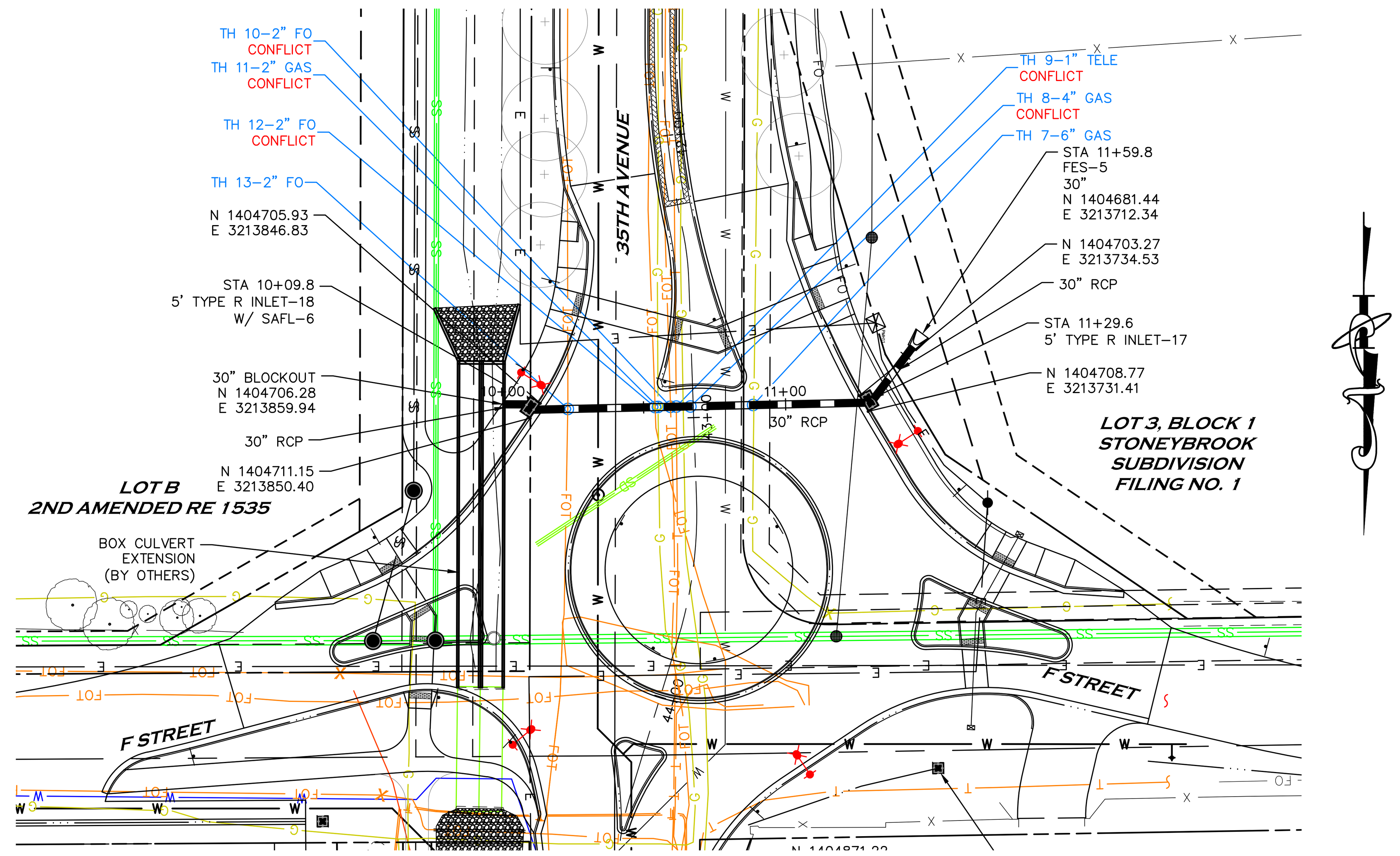

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HORIZONTAL
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LEGEND

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FO	PROPOSED FIBER OPTIC UTILITY
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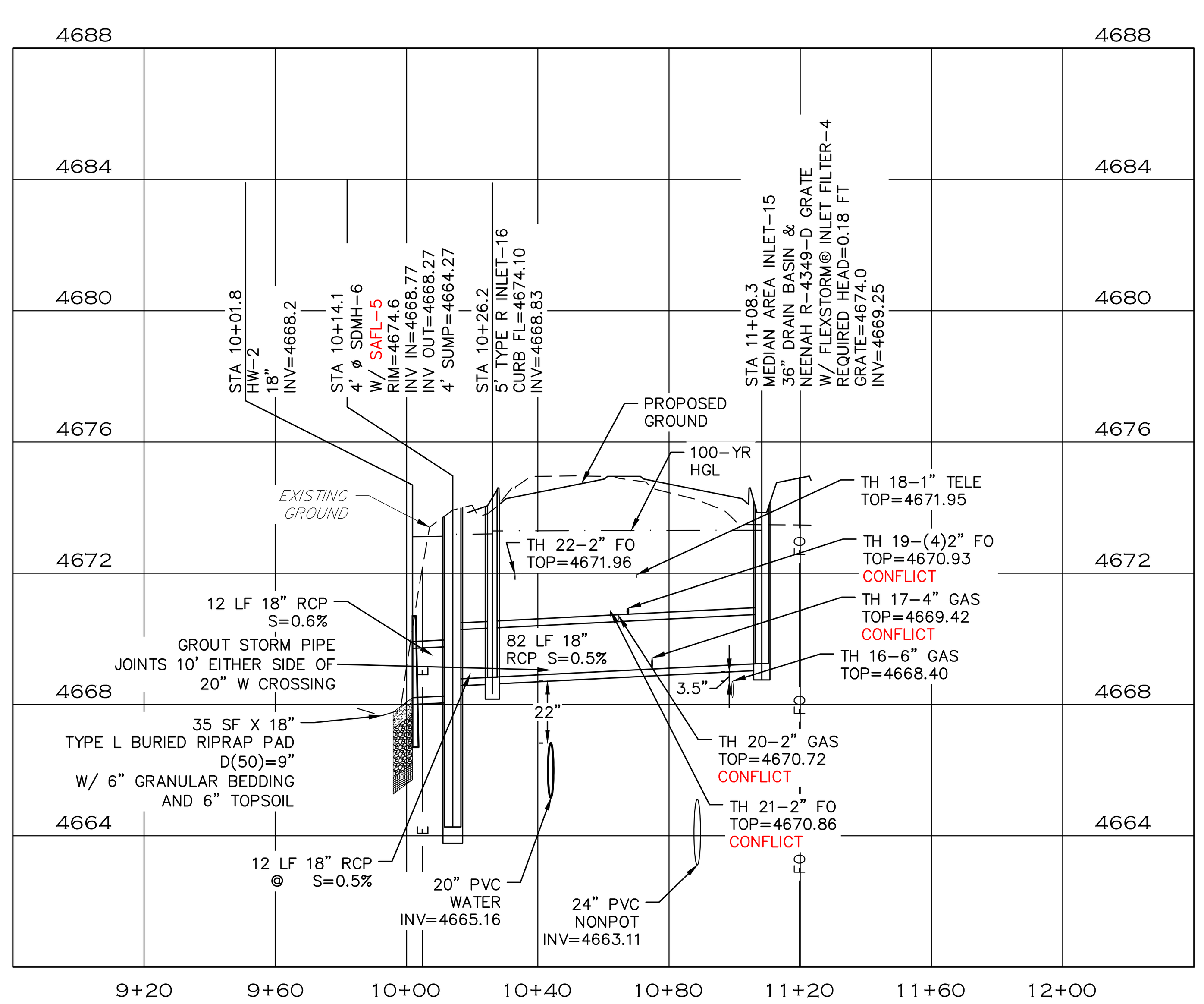
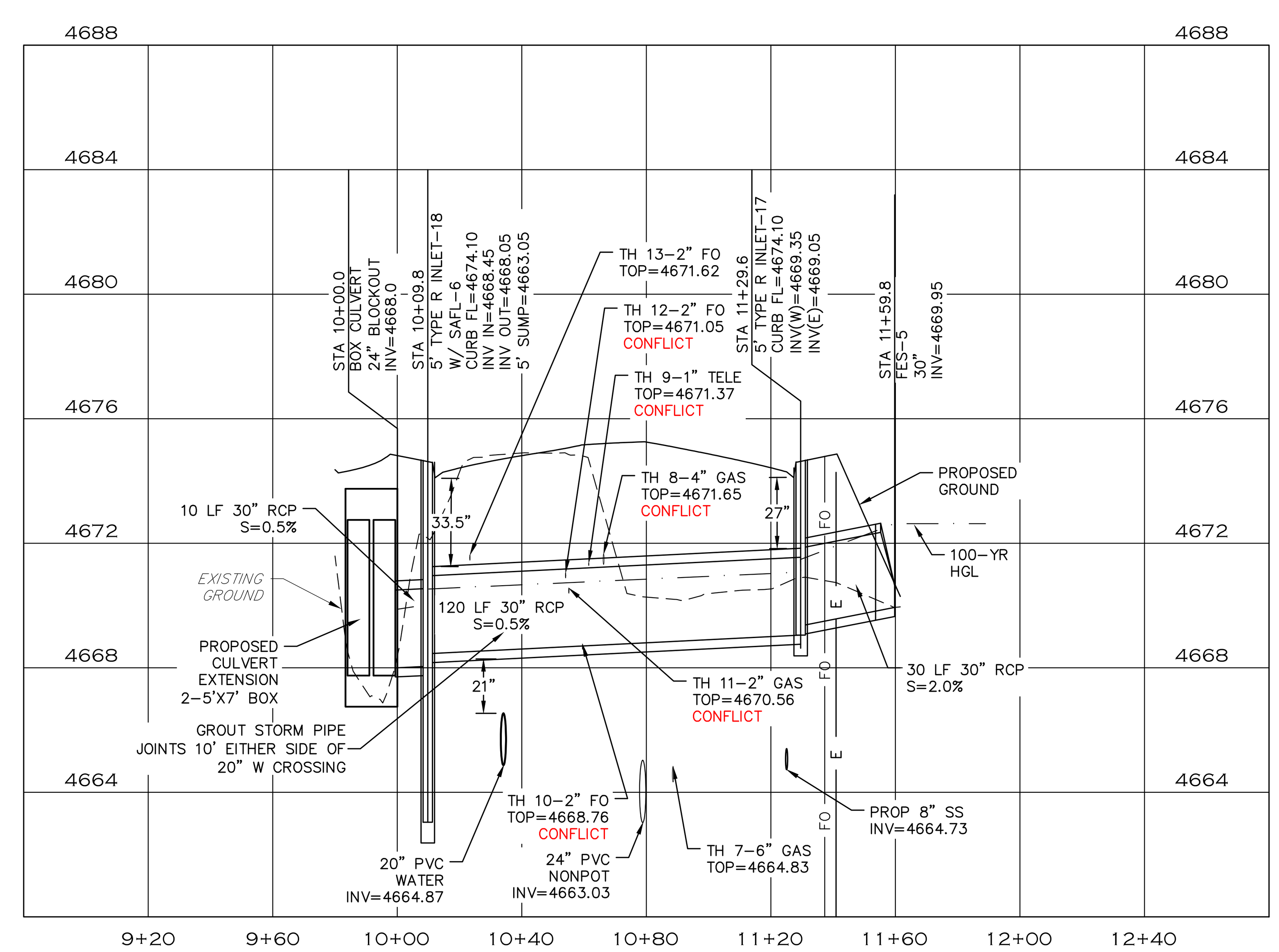


STORM 11



STORM 12

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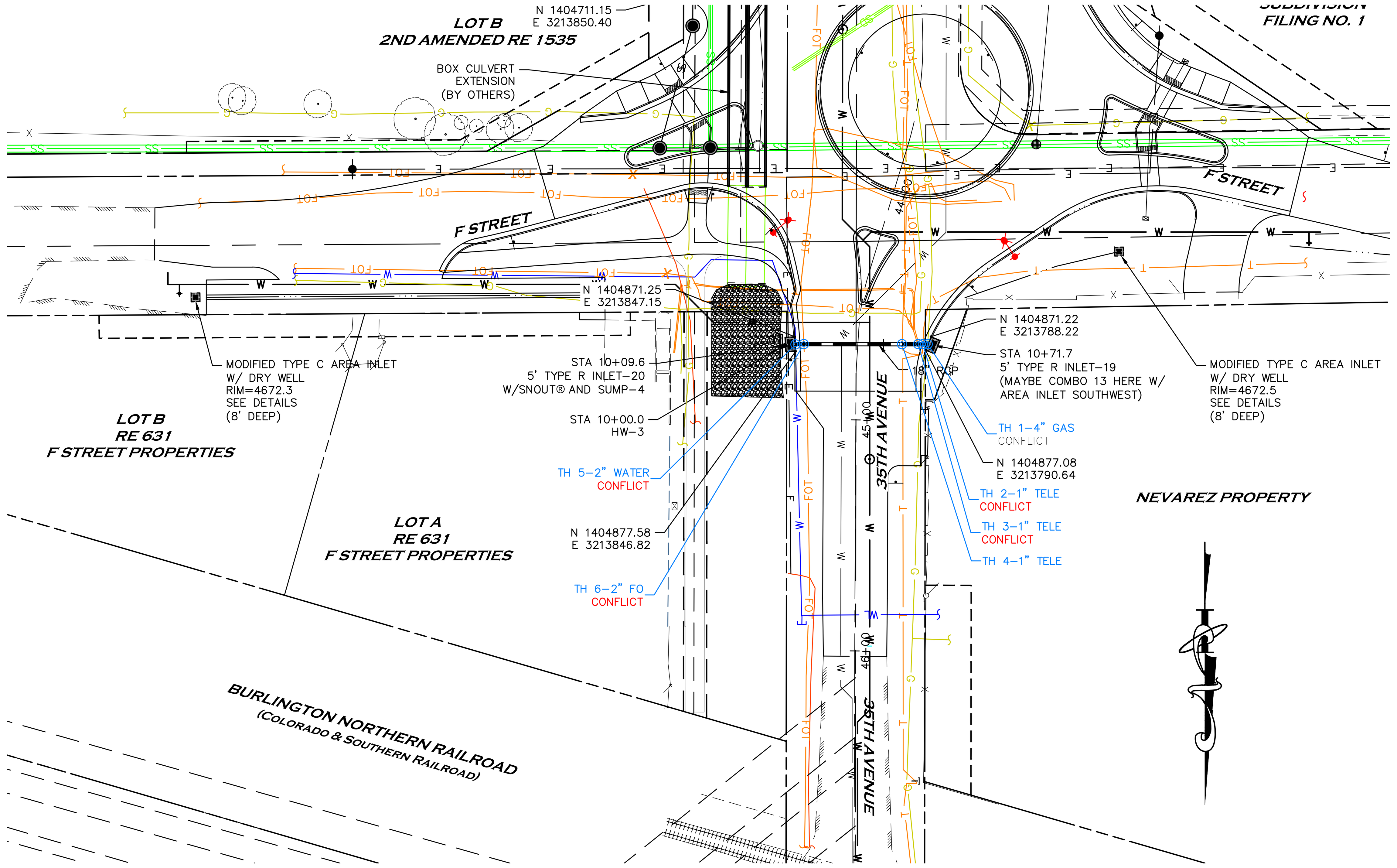

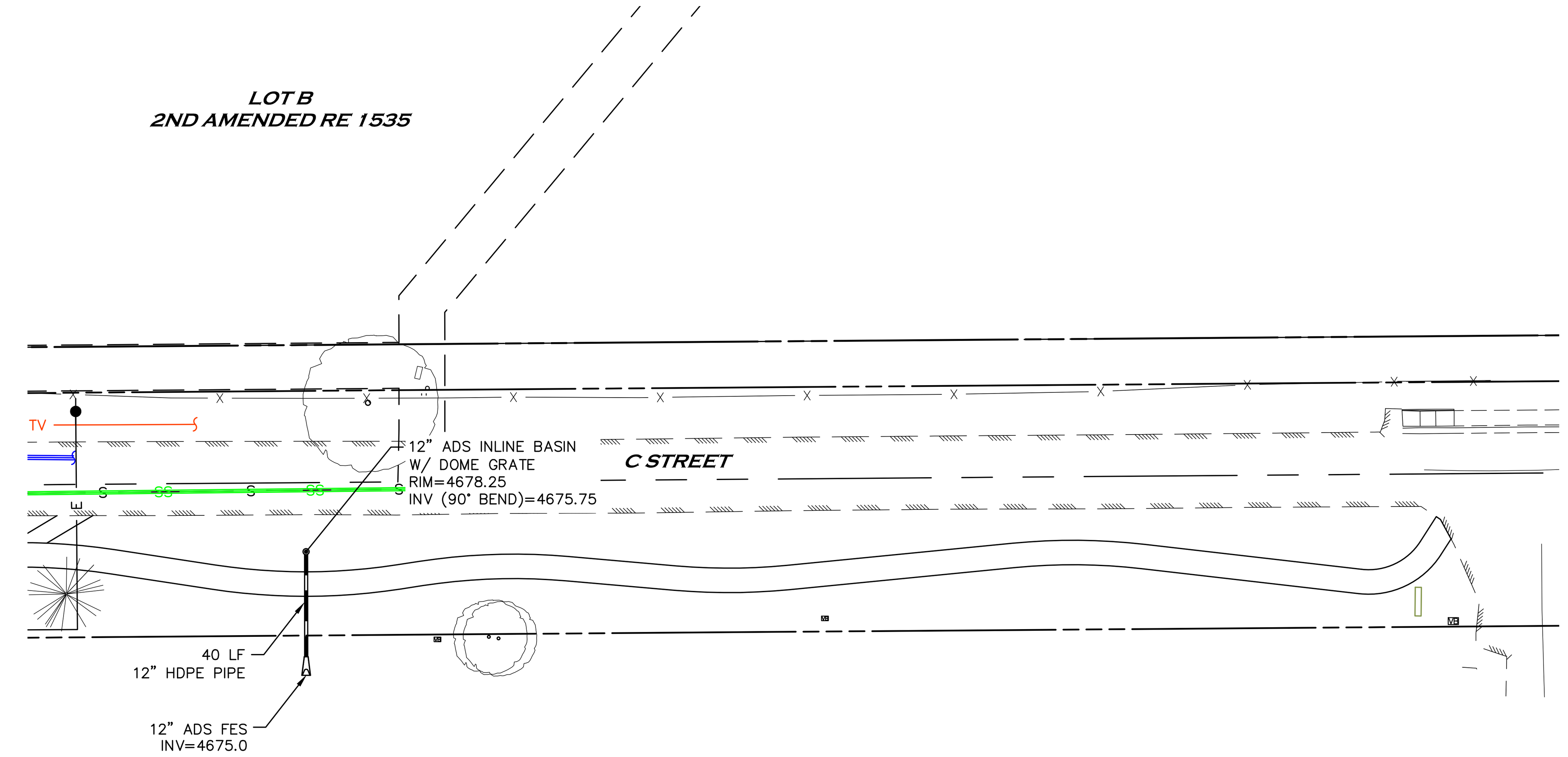

C STREET STORM SYSTEMS

GENERAL NOTES:

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SCALE: 1" = 4'

LEGEND

PROPOSED STORM PIPE

PROPOSED INLET

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INVERT OF EX UTIL.
INVERT OR TOP OF STORM PIPE
CLEARANCE DEPTH OR CONFLICT
UTILITY CROSSING WITH PROPOSED STORM PIPE

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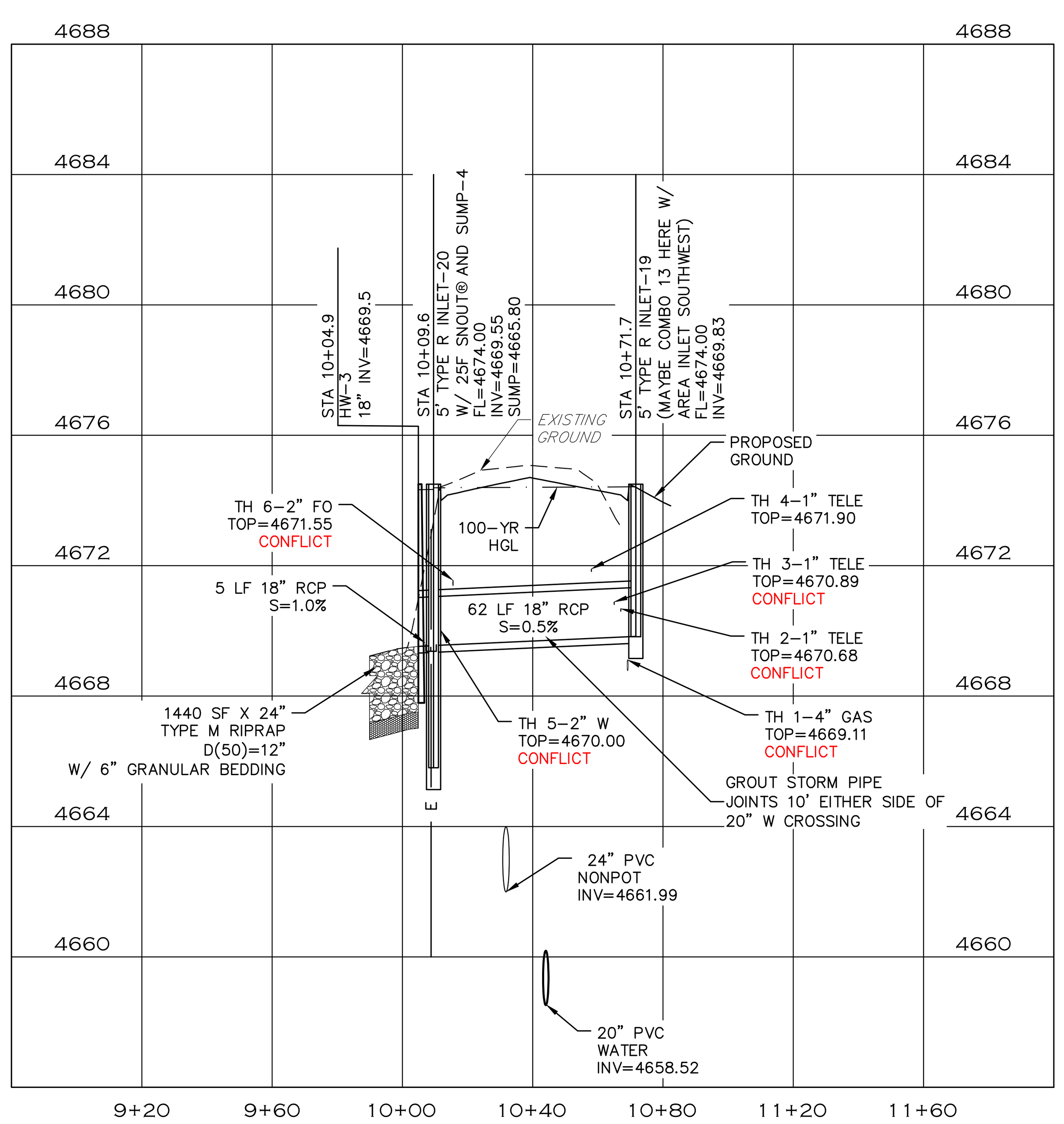
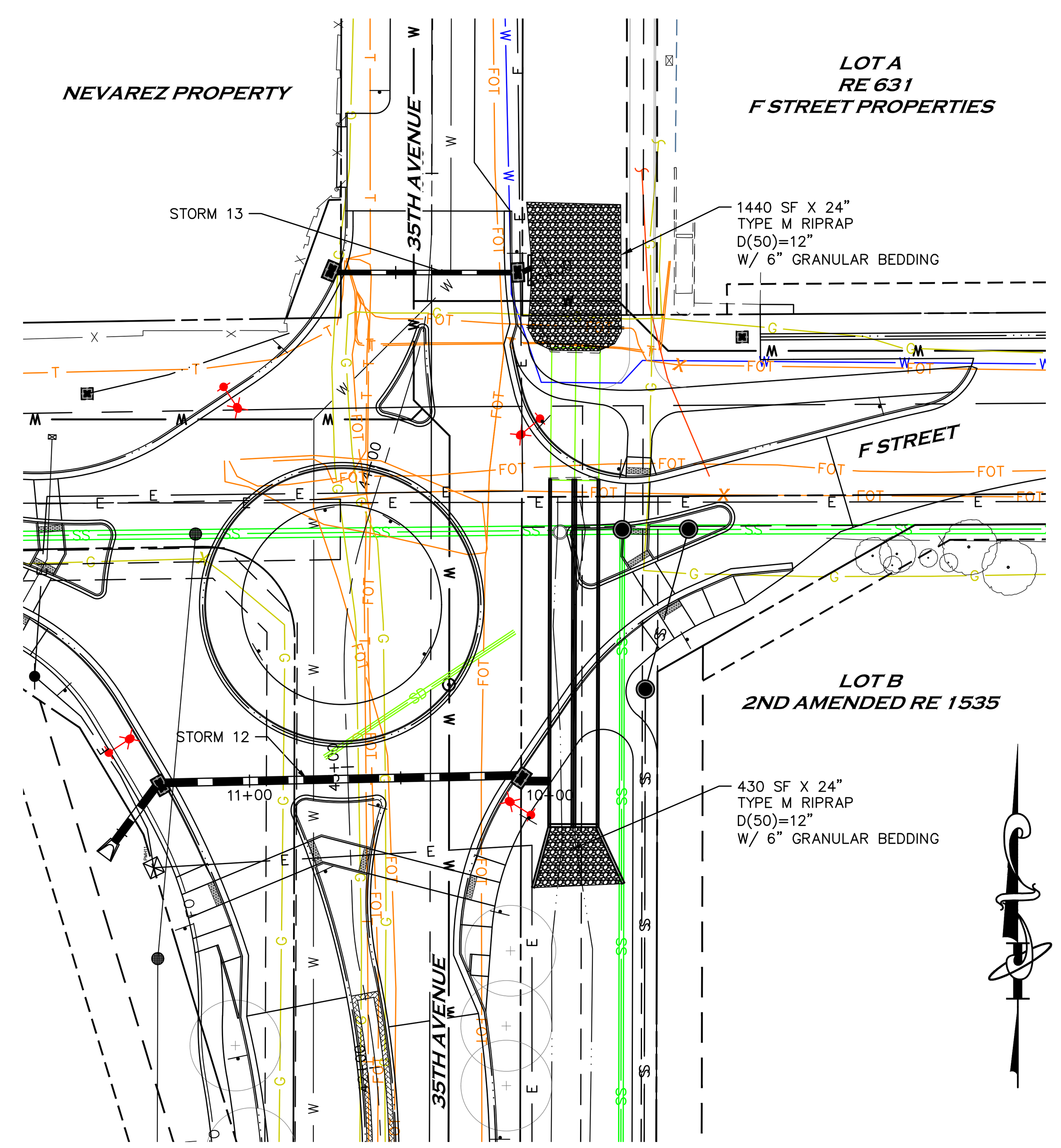


STORM 13



BOX CULVERT EXTENSION (BY OTHERS) RIPRAP

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BID SET
NOT FOR CONSTRUCTION

INTERWEST CONSULTING GROUP
1218 W. Ash, Suite A
Windsor, Colorado 80550
Phone: (970) 674-3300
Fax: (970) 674-3303

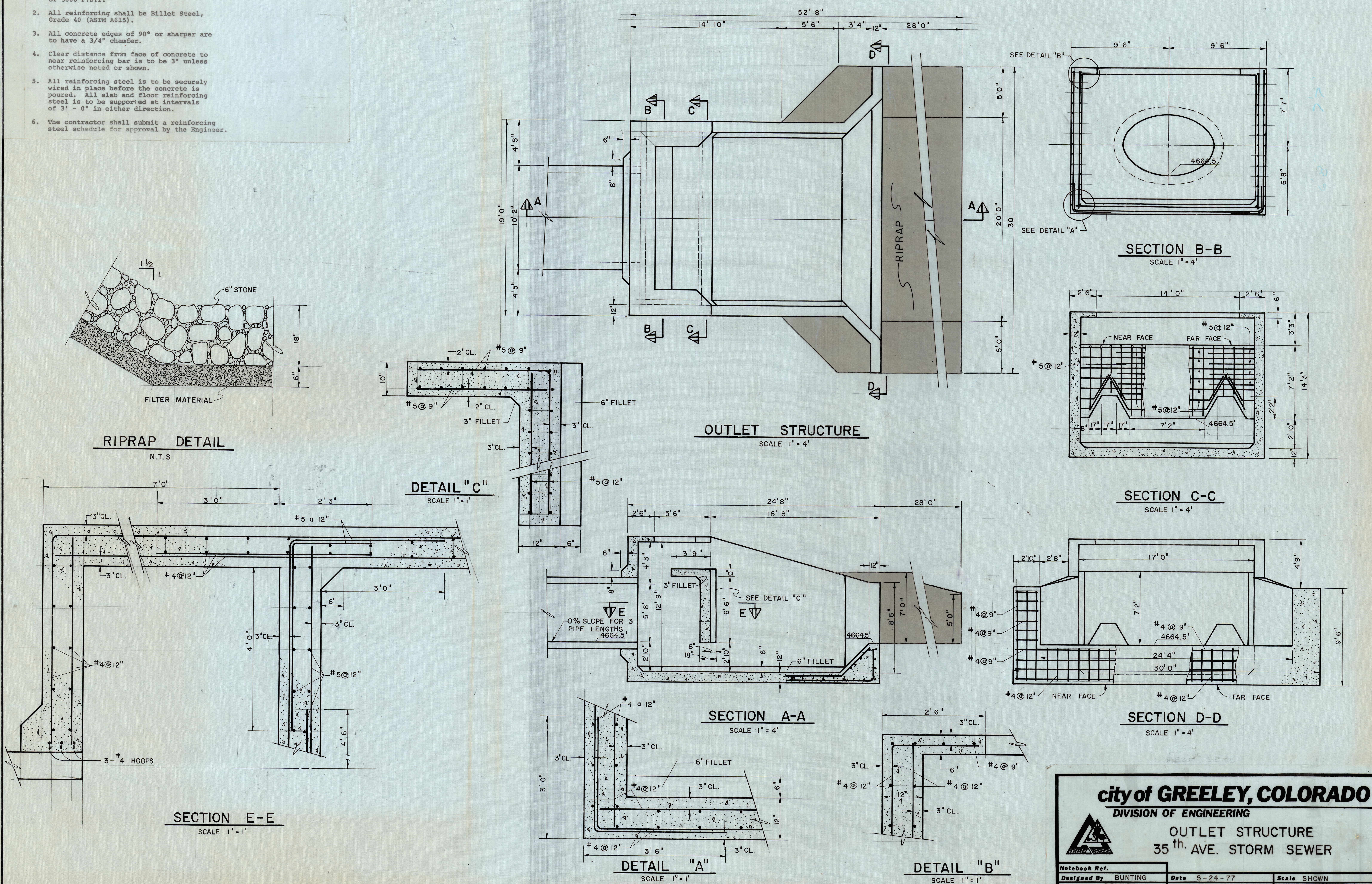
City of Greeley Colorado

35TH AVENUE WIDENING
STORM SEWER PLAN & PROFILE

DATE: 10/30/20
SCALE (H): 1"=40'
SCALE (V): 1"=4'
DESIGNED BY: ES
CHECKED BY: MPO

PROJ. NO. 1397-083-00

1. Concrete shall have a strength at 28 days of 3000 P.S.I.
2. All reinforcing shall be Billet Steel, Grade 40 (ASTM A615).
3. All concrete edges of 90° or sharper are to have a 3/4" chamfer.
4. Clear distance from face of concrete to near reinforcing bar is to be 3" unless otherwise noted or shown.
5. All reinforcing steel is to be securely wired in place before the concrete is poured. All slab and floor reinforcing steel is to be supported at intervals of 3' - 0" in either direction.
6. The contractor shall submit a reinforcing steel schedule for approval by the Engineer.



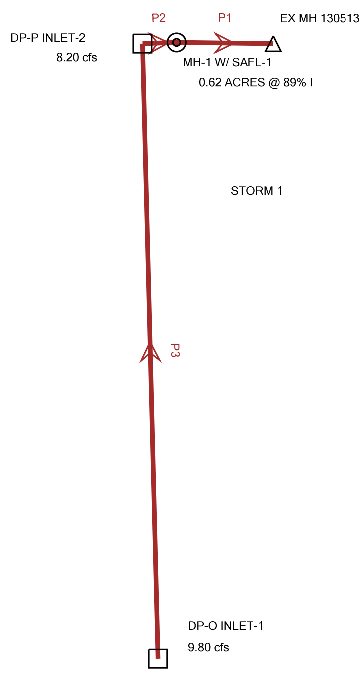
city of GREELEY, COLORADO
DIVISION OF ENGINEERING

OUTLET STRUCTURE
35 th. AVE. STORM SEWER

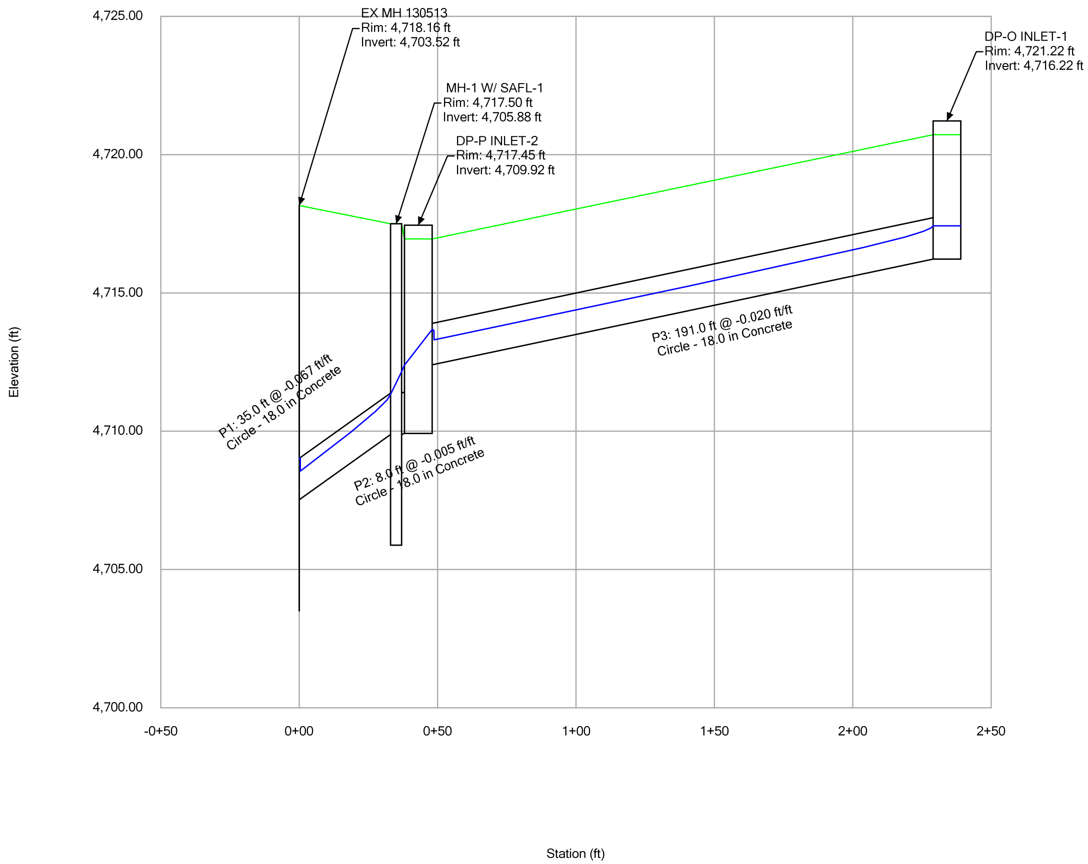
Notebook Ref.		
Designed By BUNTING	Date 5-24-77	Scale SHOWN
Drawn By BENNIER	Checked By M.A.K.	No. 17 Sheet 17 of 22

CHARTPAK LEEDS, MASS. SPH 10290

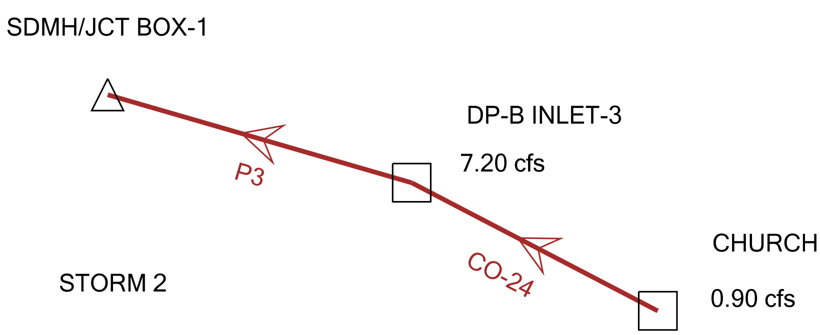
Scenario: 100-yr



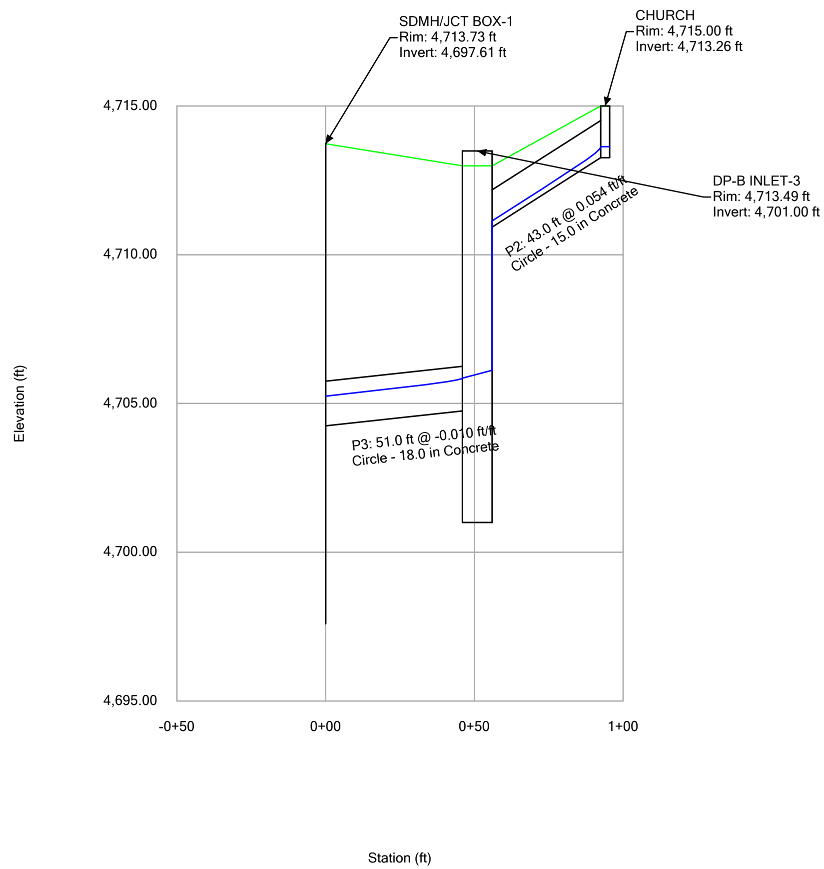
Profile Report
Engineering Profile - STORM 1 (10-15-20 SAFL Storm.stsw)



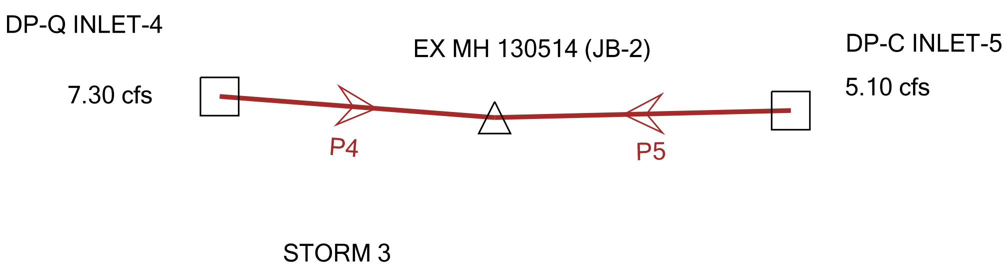
Scenario: 100-yr



Profile Report
Engineering Profile - STORM 2 (10-15-20 35th Storm.stsw)

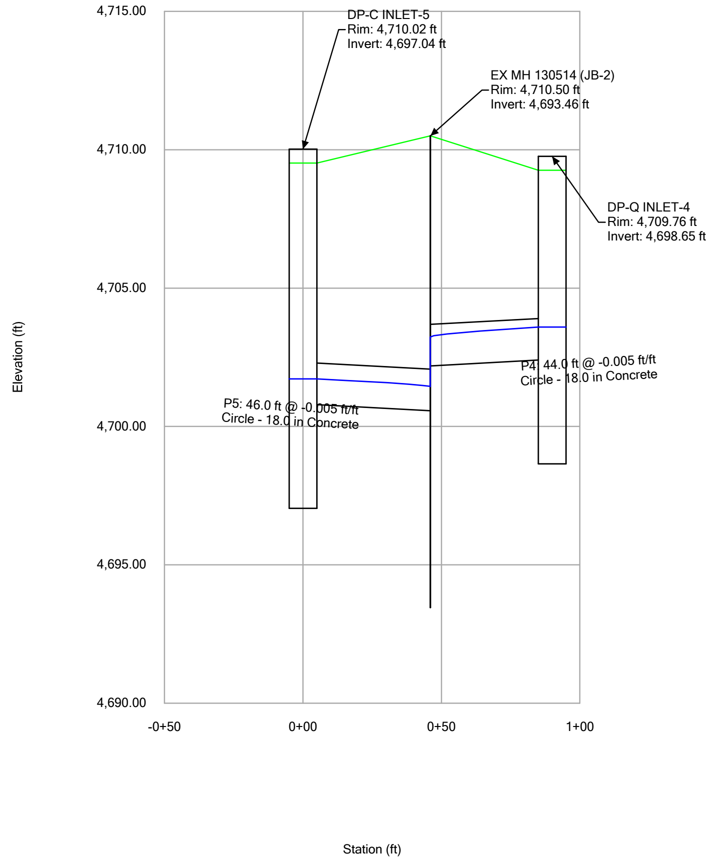


Scenario: 100-yr

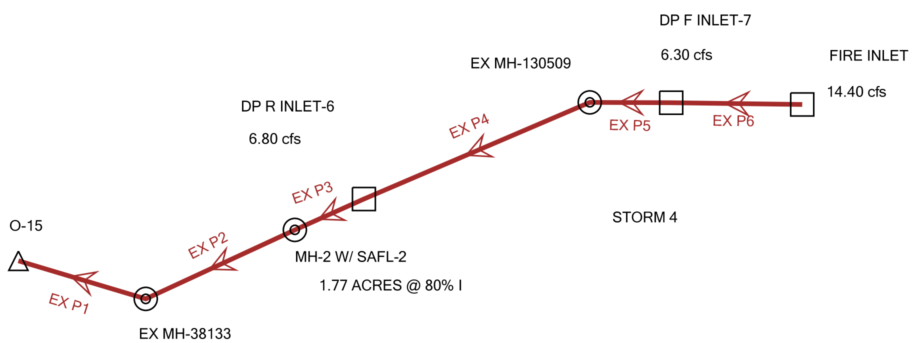


Profile Report

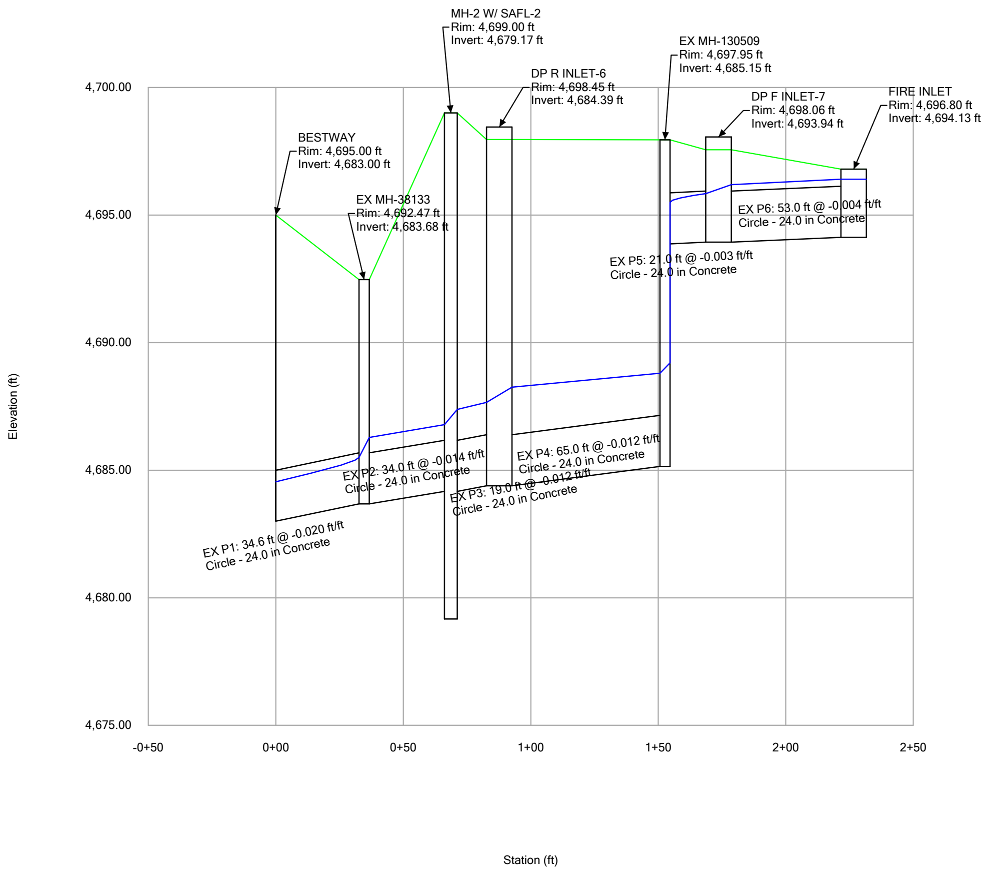
Engineering Profile - STORM 3 (10-15-20 35th Storm.stsw)



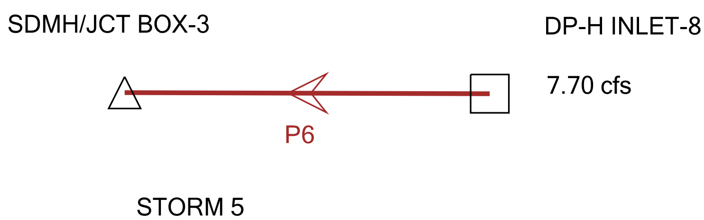
Scenario: 100-yr



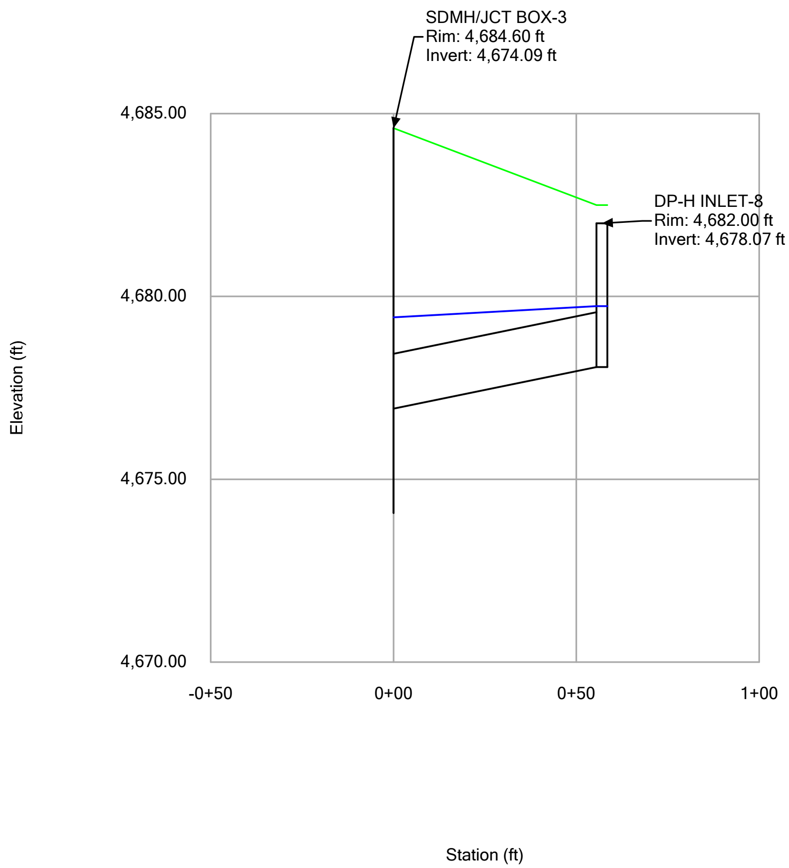
Profile Report
Engineering Profile - STORM 4 (10-15-20 SAFL Storm.stsw)



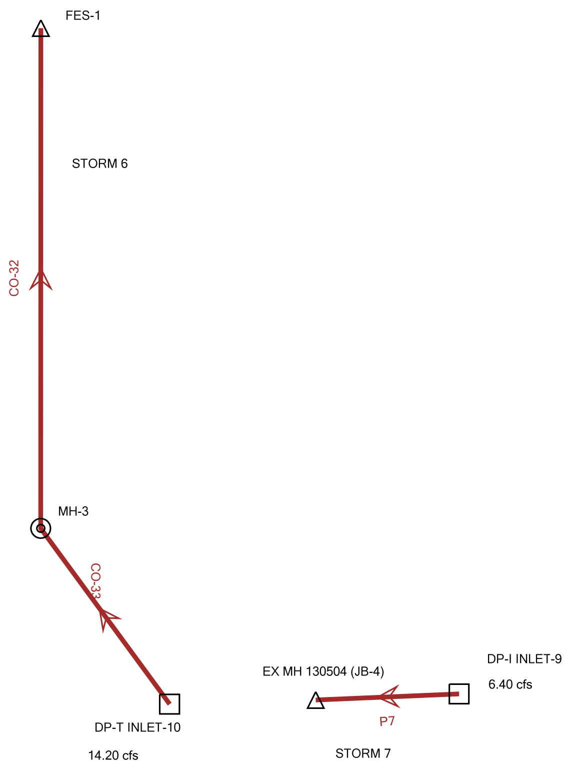
Scenario: 100-yr



Profile Report
Engineering Profile - STORM 5 (10-15-20 35th Storm.stsw)

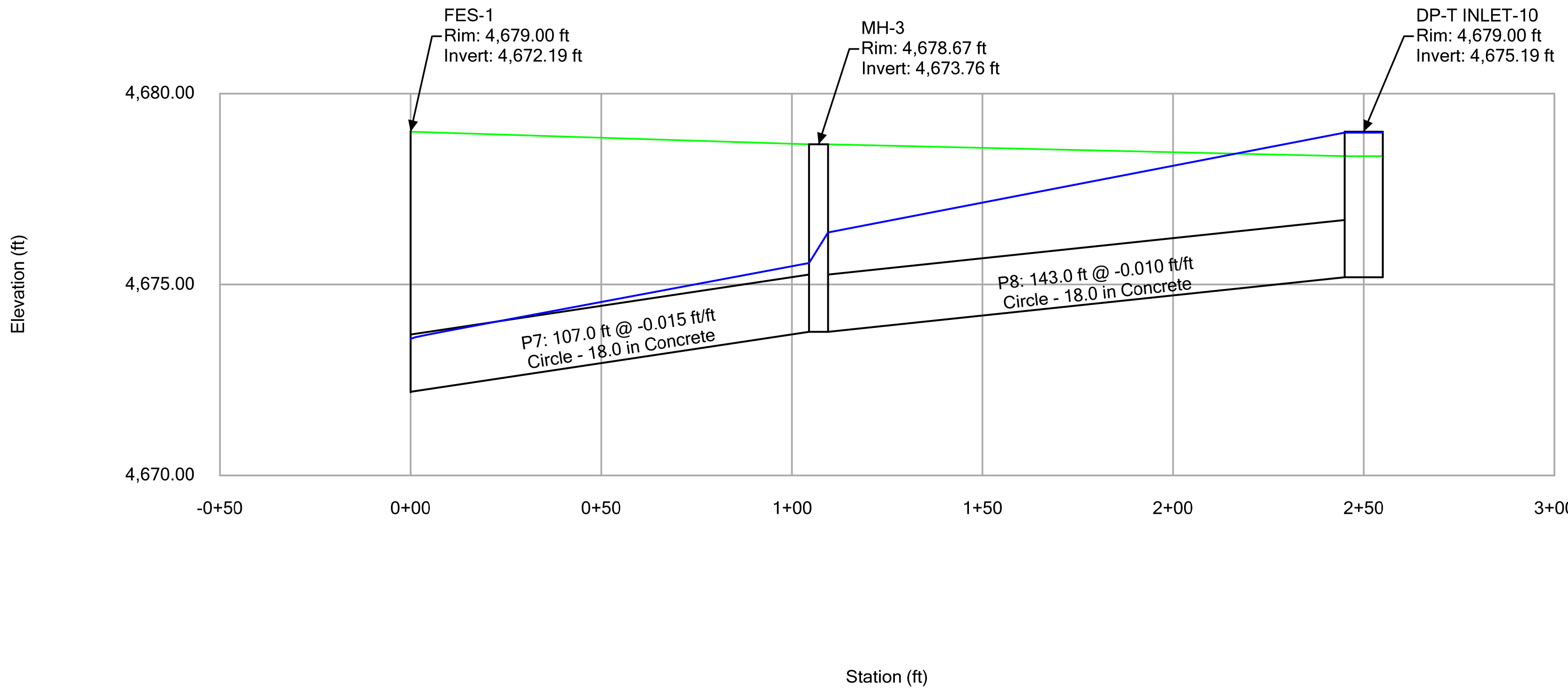


Scenario: 100-yr

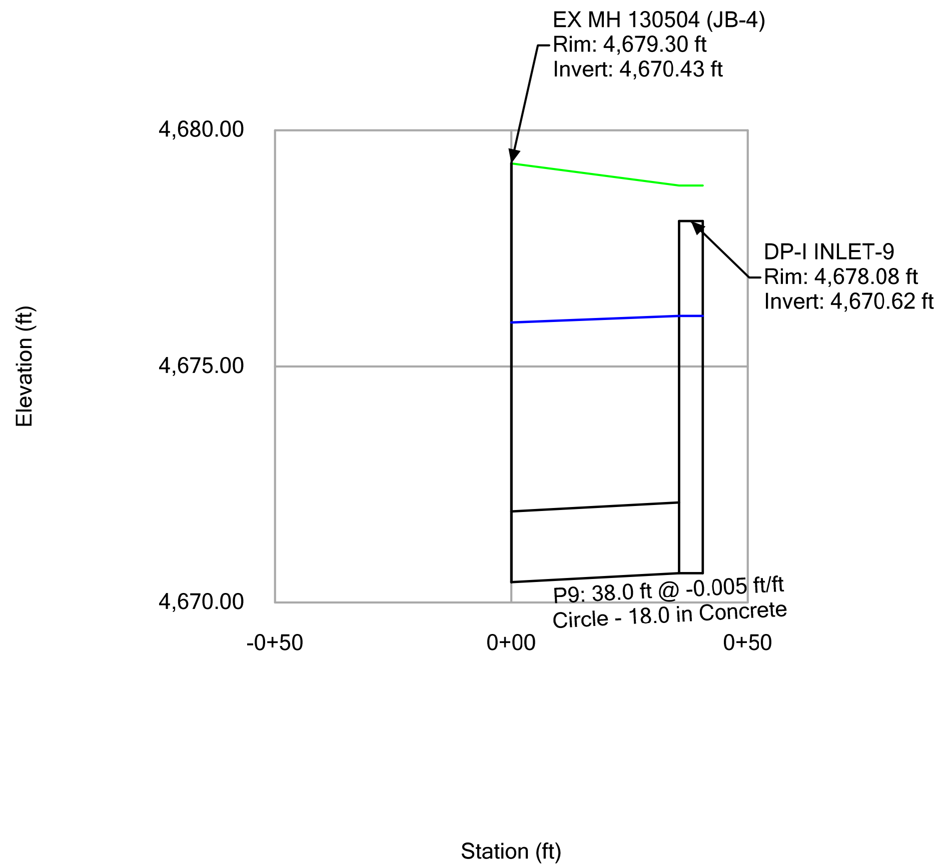


Profile Report

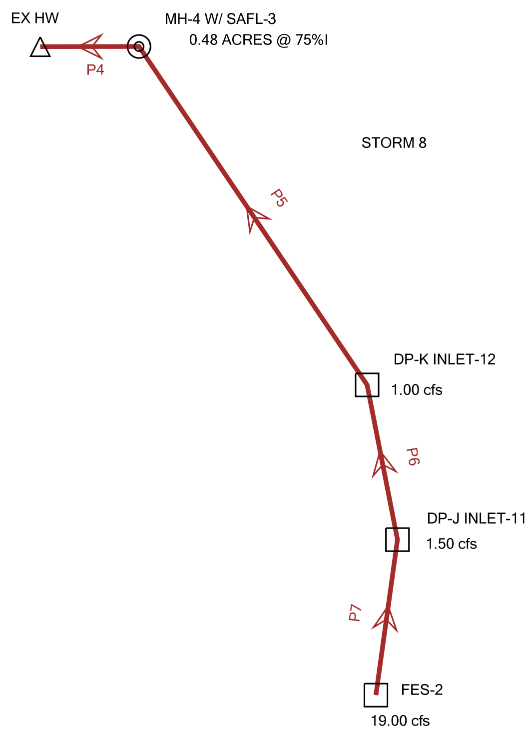
Engineering Profile - STORM 6 (10-15-20 35th Storm.stsw)



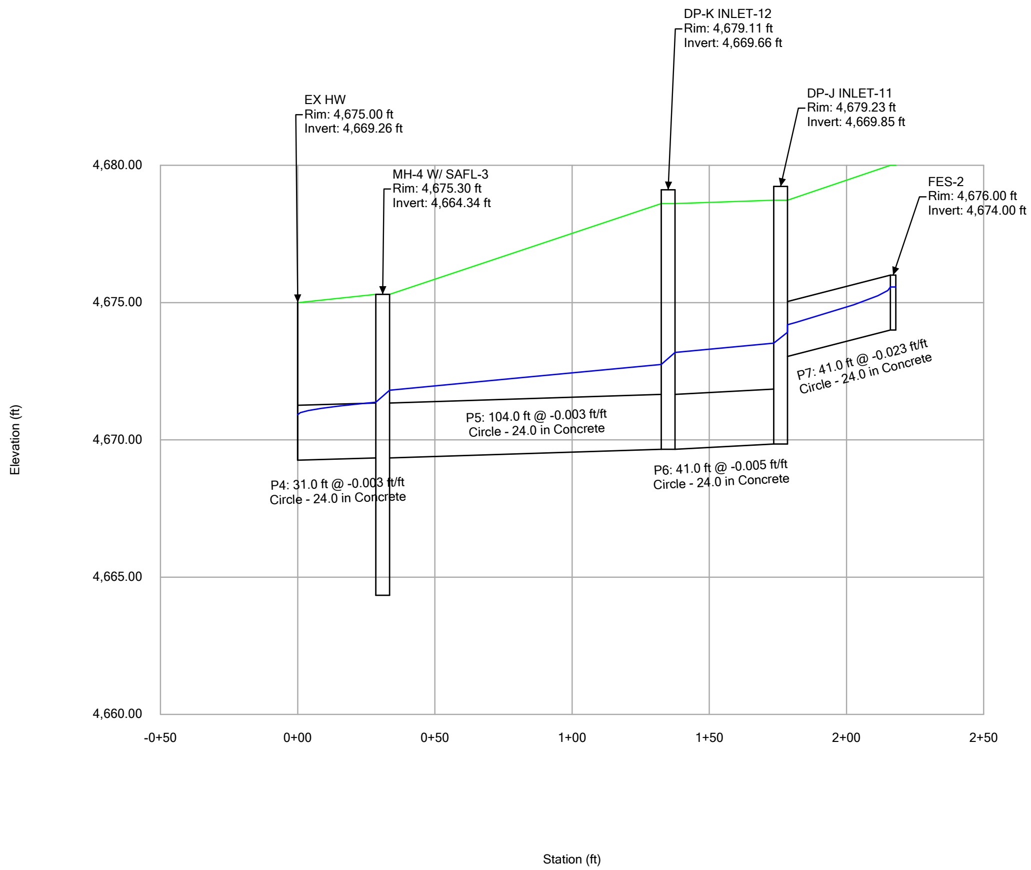
Profile Report
Engineering Profile - STORM 7 (10-15-20 35th Storm.stsw)



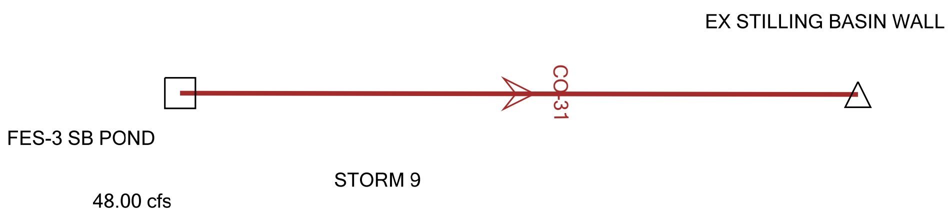
Scenario: 100-yr



Profile Report
Engineering Profile - STORM 8 (10-15-20 SAFL Storm.stsw)

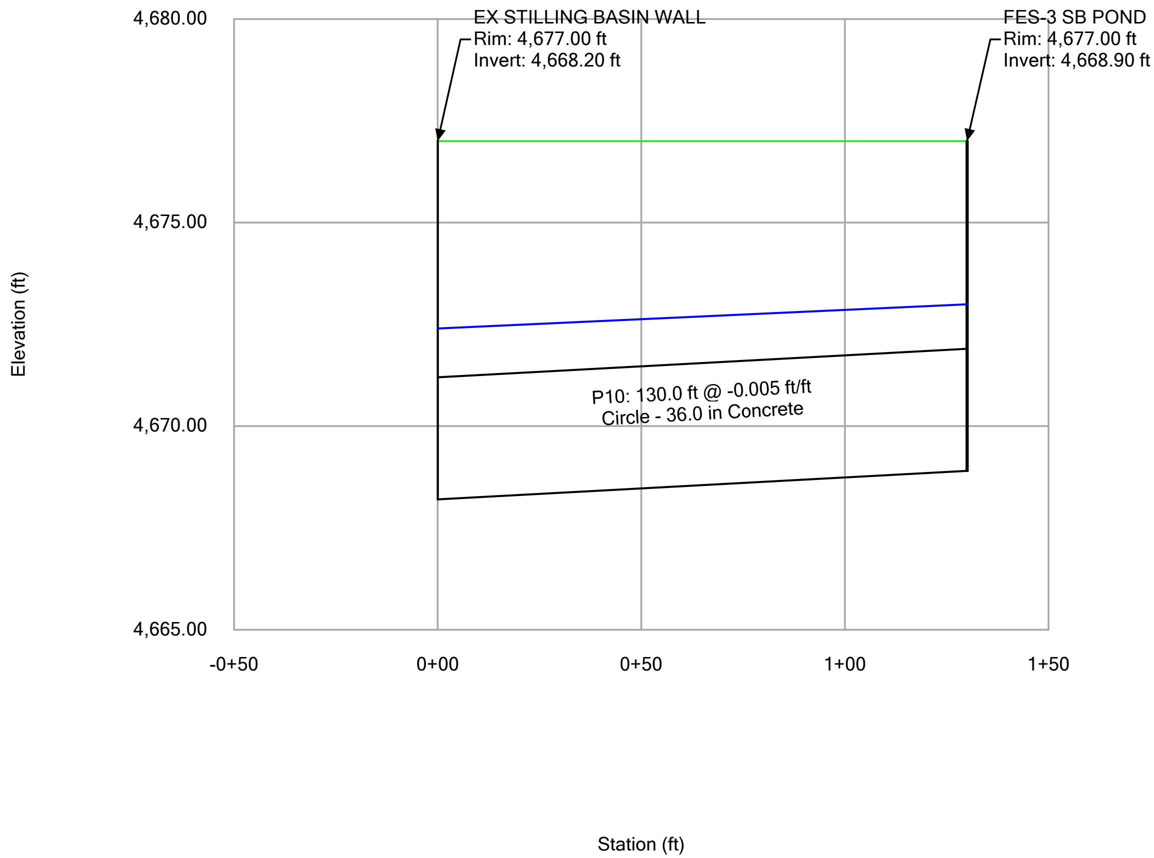


Scenario: 100-yr

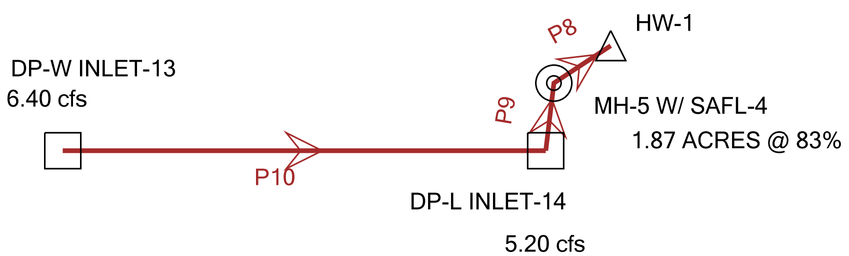


Profile Report

Engineering Profile - STORM 9 (10-15-20 35th Storm.stsw)



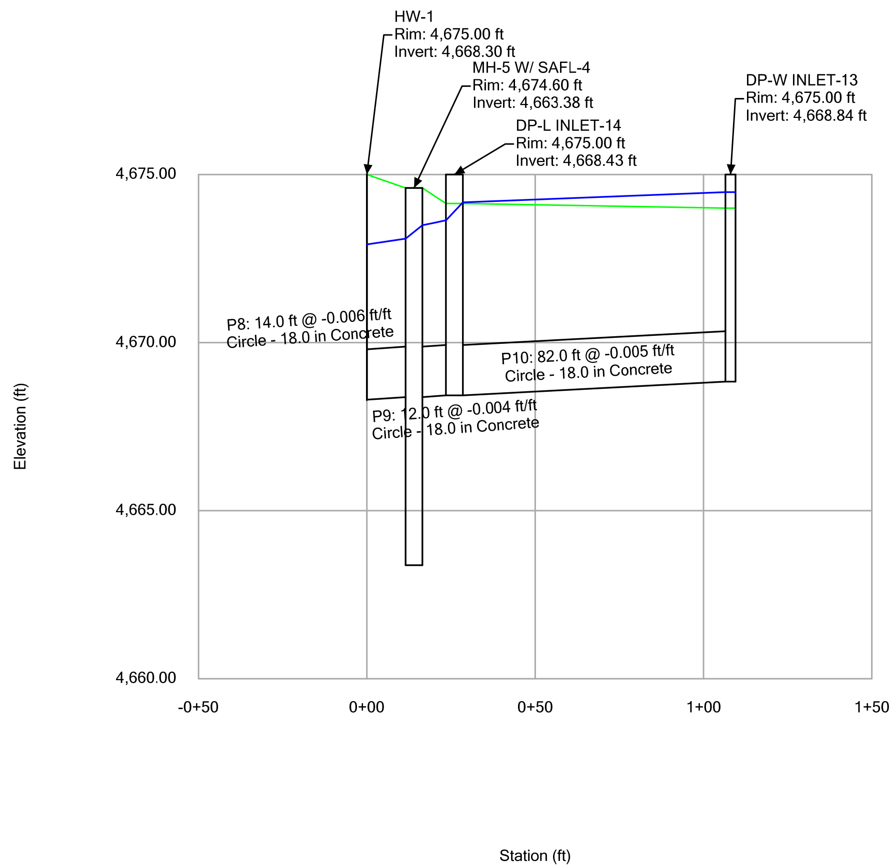
Scenario: 100-yr



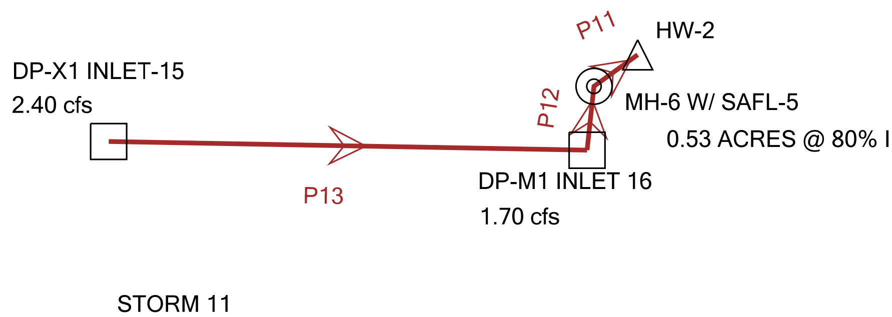
STORM 10

Profile Report

Engineering Profile - STORM 10 (10-15-20 SAFL Storm.stsw)

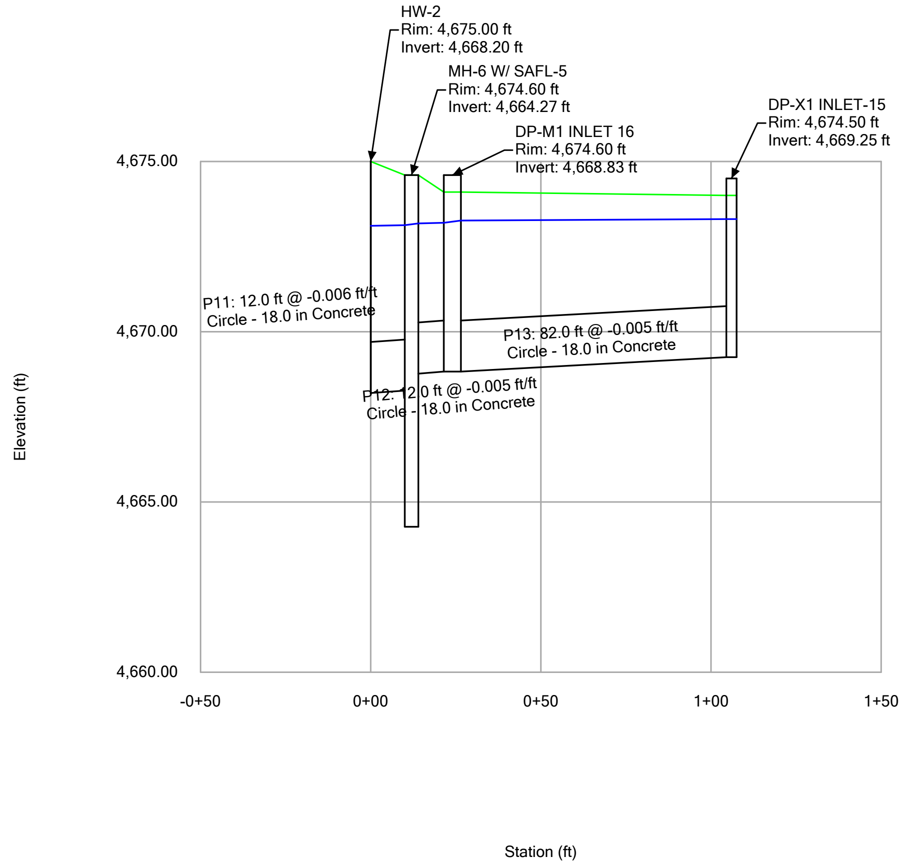


Scenario: 100-yr

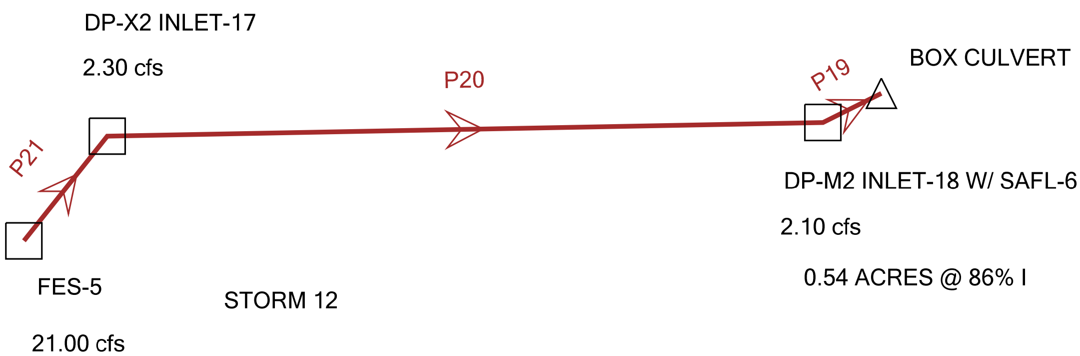


Profile Report

Engineering Profile - STORM 11 (10-15-20 SAFL Storm.stsw)

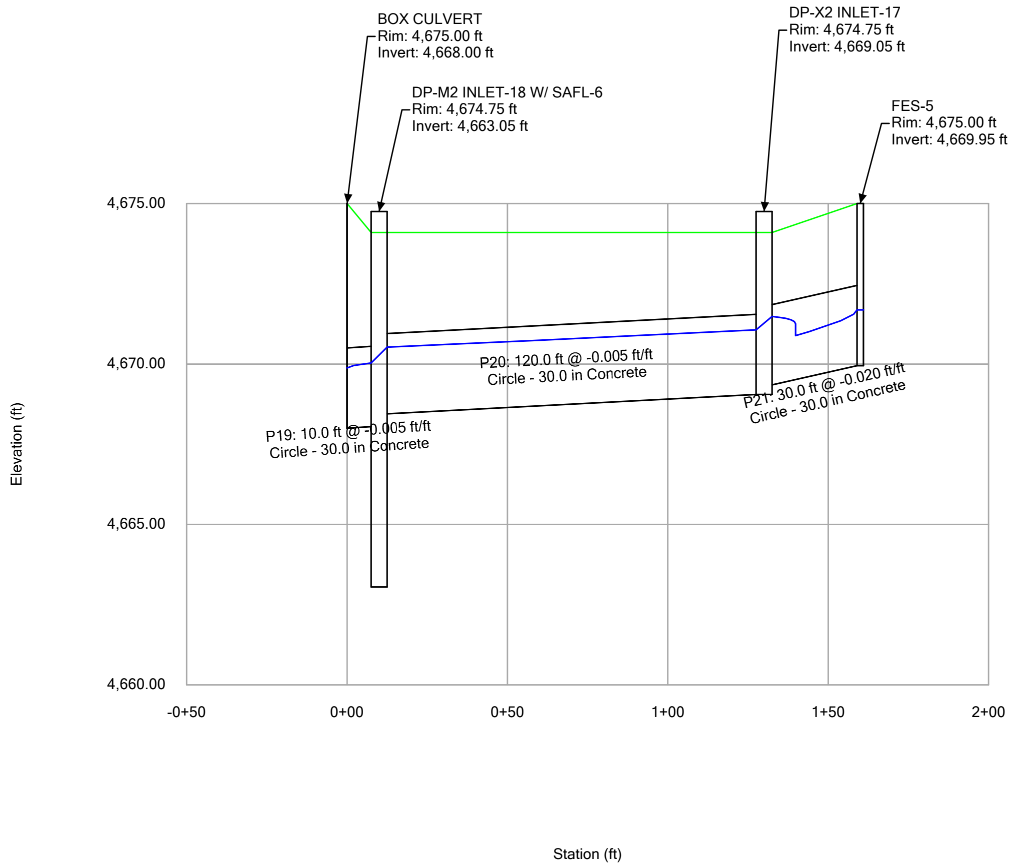


Scenario: 100-yr

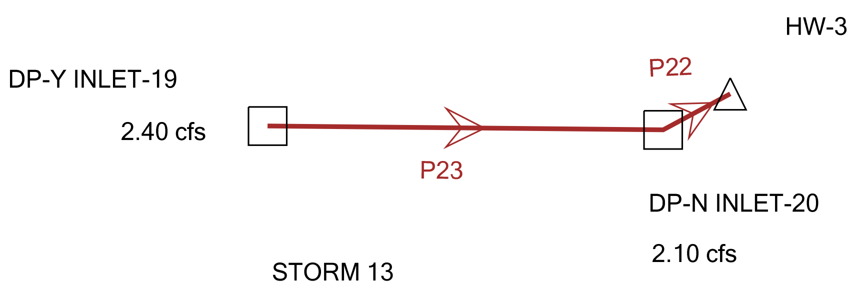


Profile Report

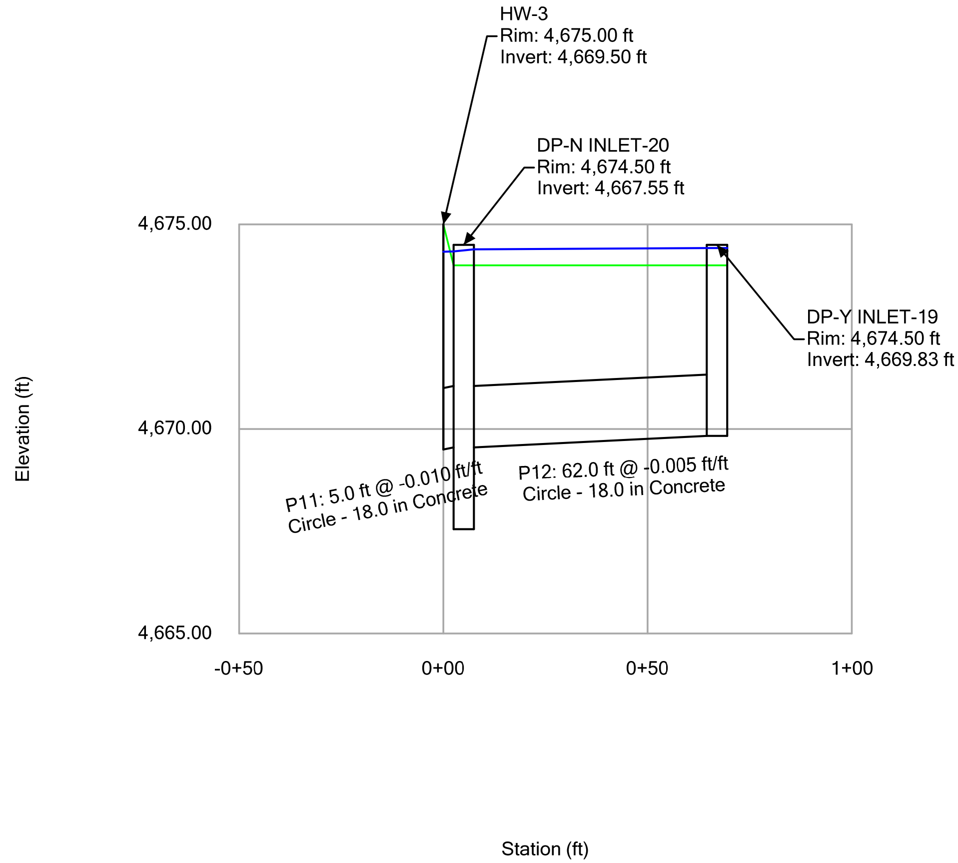
Engineering Profile - STORM 12 (10-15-20 SAFL Storm.stsw)



Scenario: 100-yr



Profile Report
Engineering Profile - STORM 13 (10-15-20 35th Storm.stsw)



FlexTable: Catch Basin Table

ID	Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Flow (Additional Carryover) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
33	DP-B INLET-3	4,712.99	4,713.49	4,701.00	7.20	4,706.12	4,705.85	4,706.82	4,706.38
36	DP-Q INLET-4	4,709.26	4,709.76	4,698.65	7.30	4,703.59	4,703.59	4,703.96	4,703.96
37	DP-C INLET-5	4,709.52	4,710.02	4,697.04	5.10	4,701.72	4,701.72	4,702.02	4,702.02
41	DP-H INLET-8	4,682.50	4,682.00	4,678.07	7.70	4,679.74	4,679.74	4,680.03	4,680.03
44	DP-I INLET-9	4,678.83	4,678.08	4,670.62	6.40	4,676.07	4,676.07	4,676.28	4,676.28
48	DP-T INLET-10	4,678.36	4,679.00	4,675.19	14.20	4,678.98	4,678.98	4,679.98	4,679.98
81	DP-N INLET-20	4,674.00	4,674.50	4,667.55	2.10	4,674.39	4,674.34	4,674.42	4,674.44
82	DP-Y INLET-19	4,674.00	4,674.50	4,669.83	2.40	4,674.42	4,674.42	4,674.45	4,674.45
98	CHURCH	4,715.00	4,715.00	4,713.26	0.90	4,713.63	4,713.63	4,713.77	4,713.77
112	FES-3 SB POND	4,677.00	4,677.00	4,668.90	45.00	4,672.99	4,672.99	4,673.62	4,673.62

Conduit FlexTable: Combined Pipe/Node Report

Label	Start Node	Stop Node	Length (Unified) (ft)	Material	Diameter (in)	Flow (cfs)	Velocity (ft/s)	Invert (Start) (ft)	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
P2	CHURCH	DP-B INLET-3	43.0	Concrete	15.0	0.90	6.74	4,713.26	4,710.93	0.054	4,713.63	4,711.14	4,713.77	4,711.84
P3	SDMH/JCT BOX-1	DP-B INLET-3	51.0	Concrete	18.0	8.10	6.51	4,704.25	4,704.75	-0.010	4,705.85	4,705.25	4,706.38	4,705.90
P4	EX MH 130514 (JB -2)	DP-Q INLET-4	44.0	Concrete	18.0	7.30	4.68	4,702.19	4,702.40	-0.005	4,703.59	4,703.24	4,703.96	4,703.71
P5	EX MH 130514 (JB -2)	DP-C INLET-5	46.0	Concrete	18.0	5.10	4.45	4,700.57	4,700.79	-0.005	4,701.72	4,701.44	4,702.02	4,701.80
P6	SDMH/JCT BOX-3	DP-H INLET-8	57.0	Concrete	18.0	7.70	4.36	4,676.93	4,678.07	-0.020	4,679.74	4,679.43	4,680.03	4,679.73
P7	FES-1	MH-3	107.0	Concrete	18.0	14.20	8.04	4,672.19	4,673.76	-0.015	4,675.56	4,673.58	4,676.57	4,674.65
P8	MH-3	DP-T INLET-10	143.0	Concrete	18.0	14.20	8.04	4,673.76	4,675.19	-0.010	4,678.98	4,676.36	4,679.98	4,677.37
P9	EX MH 130504 (JB -4)	DP-I INLET-9	38.0	Concrete	18.0	6.40	3.62	4,670.43	4,670.62	-0.005	4,676.07	4,675.93	4,676.27	4,676.13
P10	EX STILLING BASIN WALL	FES-3 SB POND	130.0	Concrete	36.0	45.00	6.37	4,668.20	4,668.90	-0.005	4,672.99	4,672.40	4,673.62	4,673.03
P11	HW-3	DP-N INLET-20	5.0	Concrete	18.0	4.50	2.55	4,669.50	4,669.55	-0.010	4,674.34	4,674.33	4,674.44	4,674.43
P12	DP-N INLET-20	DP-Y INLET-19	62.0	Concrete	18.0	2.40	1.36	4,669.55	4,669.83	-0.005	4,674.42	4,674.39	4,674.45	4,674.42

FlexTable: Manhole Table

Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
MH-3	4,678.67	4,678.67	4,673.76	14.20	4,675.56	4,676.36	4,677.37	4,676.57

FlexTable: Outfall Table

Label	Elevation (Ground) (ft)	Set Rim to Ground Elevation?	Elevation (Invert) (ft)	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)	Energy Grade Line (ft)
SDMH/JCT BOX-1	4,713.73	True	4,697.61	4,702.12	4,705.25	8.10	4,705.25
EX MH 130514 (JB-2)	4,710.50	True	4,693.46	4,698.96	4,703.24	12.40	4,703.24
SDMH/JCT BOX-3	4,684.60	True	4,674.09	4,679.43	4,679.43	7.70	4,679.43
EX MH 130504 (JB-4)	4,679.30	True	4,670.43	4,675.93	4,675.93	6.40	4,675.93
FES-1	4,679.00	True	4,672.19		4,673.58	14.20	4,673.58
HW-3	4,675.00	True	4,669.50	4,674.33	4,674.33	4.50	4,674.33
EX STILLING BASIN WALL	4,677.00	True	4,668.20	4,672.40	4,672.40	45.00	4,672.40

FlexTable: Catch Basin Table

ID	Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Flow (Additional Carryover) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
28	DP-P INLET-2	4,716.95	4,717.45	4,709.92	8.20	4,713.68	4,712.39	4,714.26	4,714.00
29	DP-O INLET-1	4,720.72	4,721.22	4,716.22	9.80	4,717.43	4,717.43	4,718.07	4,718.07
53	FES-2	4,680.00	4,676.00	4,674.00	19.00	4,675.57	4,675.57	4,676.37	4,676.37
54	DP-J INLET-11	4,678.73	4,679.23	4,669.85	1.50	4,673.92	4,673.52	4,675.52	4,674.19
64	DP-L INLET-14	4,674.14	4,675.00	4,668.43	5.20	4,674.17	4,673.64	4,674.38	4,674.31
65	DP-W INLET-13	4,674.00	4,675.00	4,668.84	6.40	4,674.48	4,674.48	4,674.68	4,674.68
69	DP-M1 INLET 16	4,674.10	4,674.60	4,668.83	1.70	4,673.26	4,673.20	4,673.29	4,673.28
70	DP-X1 INLET-15	4,674.00	4,674.50	4,669.25	2.40	4,673.31	4,673.31	4,673.34	4,673.34
74	DP-M2 INLET-18 W/ SAFL-6	4,674.10	4,674.75	4,663.05	2.10	4,670.53	4,670.03	4,671.18	4,670.86
75	DP-X2 INLET-17	4,674.10	4,674.75	4,669.05	2.30	4,671.48	4,671.07	4,672.01	4,671.76
76	FES-5	4,675.00	4,675.00	4,669.95	26.00	4,671.69	4,671.69	4,672.48	4,672.48
85	DP-K INLET-12	4,678.61	4,679.11	4,669.66	1.00	4,673.19	4,672.75	4,673.85	4,673.48
119	FIRE INLET	4,696.80	4,696.80	4,694.13	14.40	4,696.41	4,696.41	4,696.73	4,696.73
120	DP F INLET-7	4,697.56	4,698.06	4,693.94	6.30	4,696.19	4,695.84	4,696.52	4,696.54
121	DP R INLET-6	4,697.96	4,698.45	4,684.39	6.80	4,688.26	4,687.66	4,688.93	4,688.85

Conduit FlexTable: Combined Pipe/Node Report

Label	Start Node	Stop Node	Length (Unified) (ft)	Material	Diameter (in)	Flow (cfs)	Velocity (ft/s)	Invert (Start) (ft)	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
EX P1	BESTWAY	EX MH-38133	34.6	Concrete	24.0	27.50	11.36	4,683.00	4,683.68	-0.020	4,685.50	4,684.54
EX P2	EX MH-38133	MH-2 W/ SAFL-2	34.0	Concrete	24.0	27.50	8.75	4,683.68	4,684.17	-0.014	4,686.78	4,686.28
EX P3	MH-2 W/ SAFL-2	DP R INLET-6	19.0	Concrete	24.0	27.50	8.75	4,684.17	4,684.39	-0.012	4,687.66	4,687.38
EX P4	DP R INLET-6	EX MH-130509	65.0	Concrete	24.0	20.70	6.59	4,684.39	4,685.15	-0.012	4,688.80	4,688.26
EX P5	EX MH-130509	DP F INLET-7	21.0	Concrete	24.0	20.70	6.59	4,693.87	4,693.94	-0.003	4,695.84	4,695.50
EX P6	DP F INLET-7	FIRE INLET	53.0	Concrete	24.0	14.40	4.58	4,693.94	4,694.13	-0.004	4,696.41	4,696.19
P1	EX MH 130513	MH-1 W/ SAFL-1	35.0	Concrete	18.0	18.00	16.49	4,707.52	4,709.88	-0.067	4,711.33	4,709.02
P2	MH-1 W/ SAFL-1	DP-P INLET-2	8.0	Concrete	18.0	18.00	10.19	4,709.88	4,709.92	-0.005	4,712.39	4,712.15
P3	DP-P INLET-2	DP-O INLET-1	191.0	Concrete	18.0	9.80	8.98	4,712.40	4,716.22	-0.020	4,717.43	4,713.68
P4	EX HW	MH-4 W/ SAFL-3	31.0	Concrete	24.0	21.50	6.84	4,669.26	4,669.34	-0.003	4,671.37	4,670.92
P5	MH-4 W/ SAFL-3	DP-K INLET-12	104.0	Concrete	24.0	21.50	6.84	4,669.34	4,669.66	-0.003	4,672.75	4,671.81
P6	DP-K INLET-12	DP-J INLET-11	41.0	Concrete	24.0	20.50	6.53	4,669.66	4,669.85	-0.005	4,673.52	4,673.19
P7	DP-J INLET-11	FES-2	41.0	Concrete	24.0	19.00	11.28	4,673.04	4,674.00	-0.023	4,675.57	4,674.19
P8	HW-1	MH-5 W/ SAFL-4	14.0	Concrete	18.0	11.60	6.56	4,668.30	4,668.38	-0.006	4,673.09	4,672.92
P9	MH-5 W/ SAFL-4	DP-L INLET-14	12.0	Concrete	18.0	11.60	6.56	4,668.38	4,668.43	-0.004	4,673.64	4,673.49
P10	DP-L INLET-14	DP-W INLET-13	82.0	Concrete	18.0	6.40	3.62	4,668.43	4,668.84	-0.005	4,674.48	4,674.17
P11	HW-2	MH-6 W/ SAFL-5	12.0	Concrete	18.0	4.10	2.32	4,668.20	4,668.27	-0.006	4,673.13	4,673.11
P12	MH-6 W/ SAFL-5	DP-M1 INLET 16	12.0	Concrete	18.0	4.10	2.32	4,668.77	4,668.83	-0.005	4,673.20	4,673.18
P13	DP-M1 INLET 16	DP-X1 INLET-15	82.0	Concrete	18.0	2.40	1.36	4,668.83	4,669.25	-0.005	4,673.31	4,673.26
P19	BOX CULVERT	DP-M2 INLET-18 W/ SAFL-6	10.0	Concrete	30.0	30.40	6.70	4,668.00	4,668.05	-0.005	4,670.03	4,669.88
P20	DP-M2 INLET-18 W/ SAFL-6	DP-X2 INLET-17	120.0	Concrete	30.0	28.30	6.73	4,668.45	4,669.05	-0.005	4,671.07	4,670.53
P21	DP-X2 INLET-17	FES-5	30.0	Concrete	30.0	26.00	11.49	4,669.35	4,669.95	-0.020	4,671.69	4,671.48

Conduit FlexTable: Combined Pipe/Node Report

Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
4,686.80	4,686.28
4,687.98	4,687.47
4,688.85	4,688.57
4,689.48	4,688.93
4,696.54	4,696.39
4,696.73	4,696.52
4,712.98	4,710.63
4,714.00	4,713.77
4,718.07	4,714.26
4,672.10	4,671.84
4,673.48	4,672.54
4,674.19	4,673.85
4,676.37	4,675.79
4,673.76	4,673.59
4,674.31	4,674.16
4,674.68	4,674.38
4,673.21	4,673.19
4,673.28	4,673.26
4,673.33	4,673.29
4,670.86	4,670.80
4,671.76	4,671.18
4,672.48	4,672.01

FlexTable: Manhole Table

Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
MH-4 W/ SAFL-3	4,675.30	4,675.30	4,664.34	21.50	4,671.37	4,671.81	4,672.54	4,672.10
MH-1 W/ SAFL-1	4,717.50	4,717.50	4,705.88	18.00	4,711.33	4,712.15	4,713.77	4,712.98
EX MH-130509	4,697.95	4,697.95	4,685.15	20.70	4,688.80	4,689.21	4,690.09	4,689.47
MH-2 W/ SAFL-2	4,699.00	4,699.00	4,679.17	27.50	4,686.78	4,687.38	4,688.57	4,687.98
EX MH-38133	4,692.47	4,692.47	4,683.68	27.50	4,685.50	4,686.28	4,687.47	4,686.80
MH-5 W/ SAFL-4	4,674.60	4,674.60	4,663.38	11.60	4,673.09	4,673.49	4,674.16	4,673.76
MH-6 W/ SAFL-5	4,674.60	4,674.60	4,664.27	4.10	4,673.13	4,673.18	4,673.26	4,673.21

FlexTable: Outfall Table

Label	Elevation (Ground) (ft)	Set Rim to Ground Elevation?	Elevation (Invert) (ft)	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)	Energy Grade Line (ft)
EX MH 130513	4,718.16	True	4,703.52	4,709.02	4,709.02	18.00	4,709.02
EX HW	4,675.00	True	4,669.26		4,670.92	21.50	4,670.92
HW-1	4,675.00	True	4,668.30	4,672.92	4,672.92	11.60	4,672.92
HW-2	4,675.00	True	4,668.20	4,673.11	4,673.11	4.10	4,673.11
BOX CULVERT	4,675.00	True	4,668.00		4,669.88	30.40	4,669.88
BESTWAY	4,695.00	True	4,683.00		4,684.54	27.50	4,684.54

LOCATION: 35TH Avenue Greeley
ITEM: RIPRAP CALCULATIONS FOR CIRCULAR (or box) CONDUIT OUTLETS
COMPUTATIONS BY: es
SUBMITTED BY: INTERWEST CONSULTING GROUP

From Urban Strom Drainage Criterial Manual
(Referenced figures are attached at the end of this section)

Q = discharge, cfs
D = diameter of circular conduit, ft
Y_t = tailwater depth, ft

LOCATION	Type of Pipe	Design Flow Q_{tot} (cfs)	Width or Diam. D (ft)	Tailwater Depth Y_t (ft)	Velocity V (ft/s)	$\frac{Q_{tot}}{D^{2.5}}$	$\frac{Y_t}{D}$	Figure 9-38 Riprap Type	Distance Downstream 3*D (ft)	d_{50} (in)
STORM 6	*RCP*	*14.2*	*2.0*	*1.36*	*5.8*	2.51	0.68	*TYPE L*	6.0	*9.0*
STORM 10	*RCP*	*11.6*	*1.5*	*2.09*	*6.6*	4.21	1.39	*TYPE L*	4.5	*9.0*
STORM 11	*RCP*	*4.1*	*1.5*	*3.8*	*2.3*	1.49	2.53	*TYPE L*	4.5	*9.0*
STORM 13	*RCP*	*4.5*	*1.5*	*0.81*	*4.4*	1.63	0.54	*TYPE L*	4.5	*9.0*
2-5x7 Culverts	*RCP*	*511*	*14.0*	*4.85*	*7.6*	9.76	0.97	*TYPE M*	42.0	*12.0*

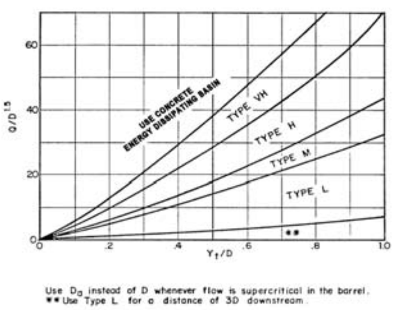


Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for $Q/D_{2.5} \le 6.0$)

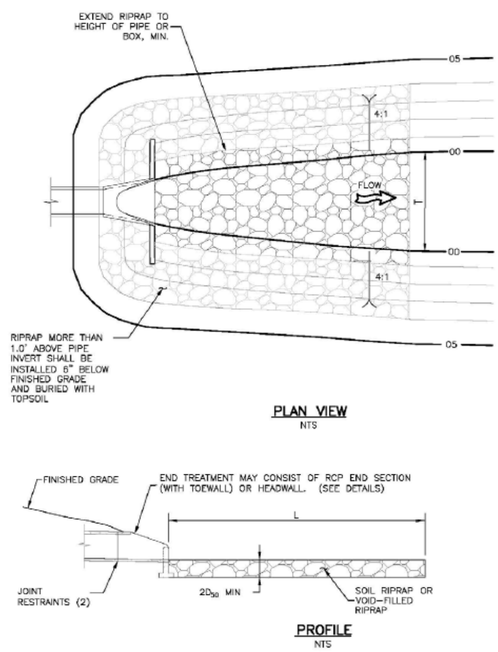


Figure 9-34. Riprap apron detail for culverts in-line with the channel

LOCATION: 35TH Avenue Greeley
ITEM: RIPRAP CALCULATIONS FOR CIRCULAR (or box) CONDUIT OUTLETS
COMPUTATIONS BY: es
SUBMITTED BY: INTERWEST CONSULTING GROUP

From Urban Strom Drainage Criterial Manual
(Referenced figures are attached at the end of this section)

Q = discharge, cfs
D = diameter of circular conduit, ft
Yt = tailwater depth, ft

LOCATION	Riprap Depth to L/2 (in) $2*d_{50}$	Riprap Depth L/2 to L (in) $1.5*d_{50}$	(MINIMUM) Width of Riprap (ft) D*3	$\frac{Q}{WH^{1.5}}$	Expansion Factor 1/(2 tan θ) Figure 9-35 (9-36)	At = Q/V (ft^2)	L = (1/(2tanq)) *(At/Yt-W) (ft)	(MINIMUM) Use L (ft)
STORM 6	18.0	13.5	6	0.8	*6.6*	2.47	-1.22	6.00
STORM 10	18.0	13.5	4.5	1.4	*6.6*	1.77	-4.32	4.50
STORM 11	18.0	13.5	4.5	0.5	*6.6*	1.77	-6.83	4.50
STORM 13	18.0	13.5	4.5	0.5	*6.6*	1.02	-1.57	4.50
2-5x7 Culverts	24.0	18	42	0.2	*6.6*	67.59	-0.42	42.00

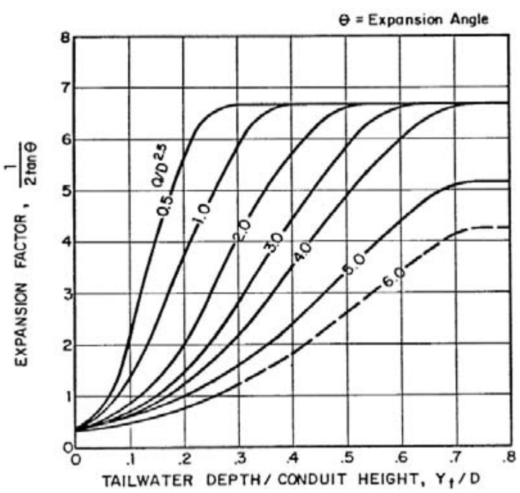


Figure 9-35. Expansion factor for circular conduits

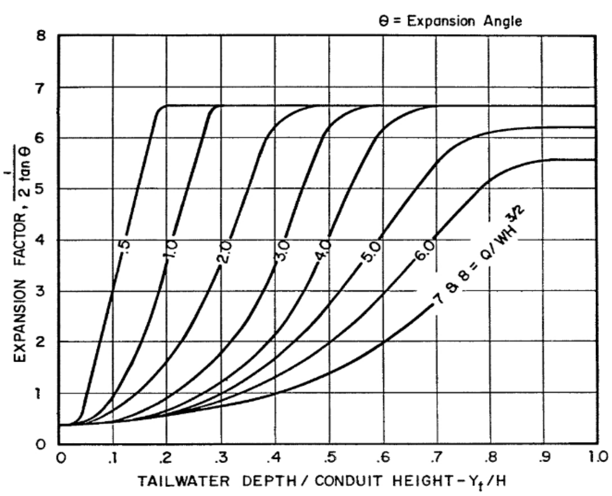
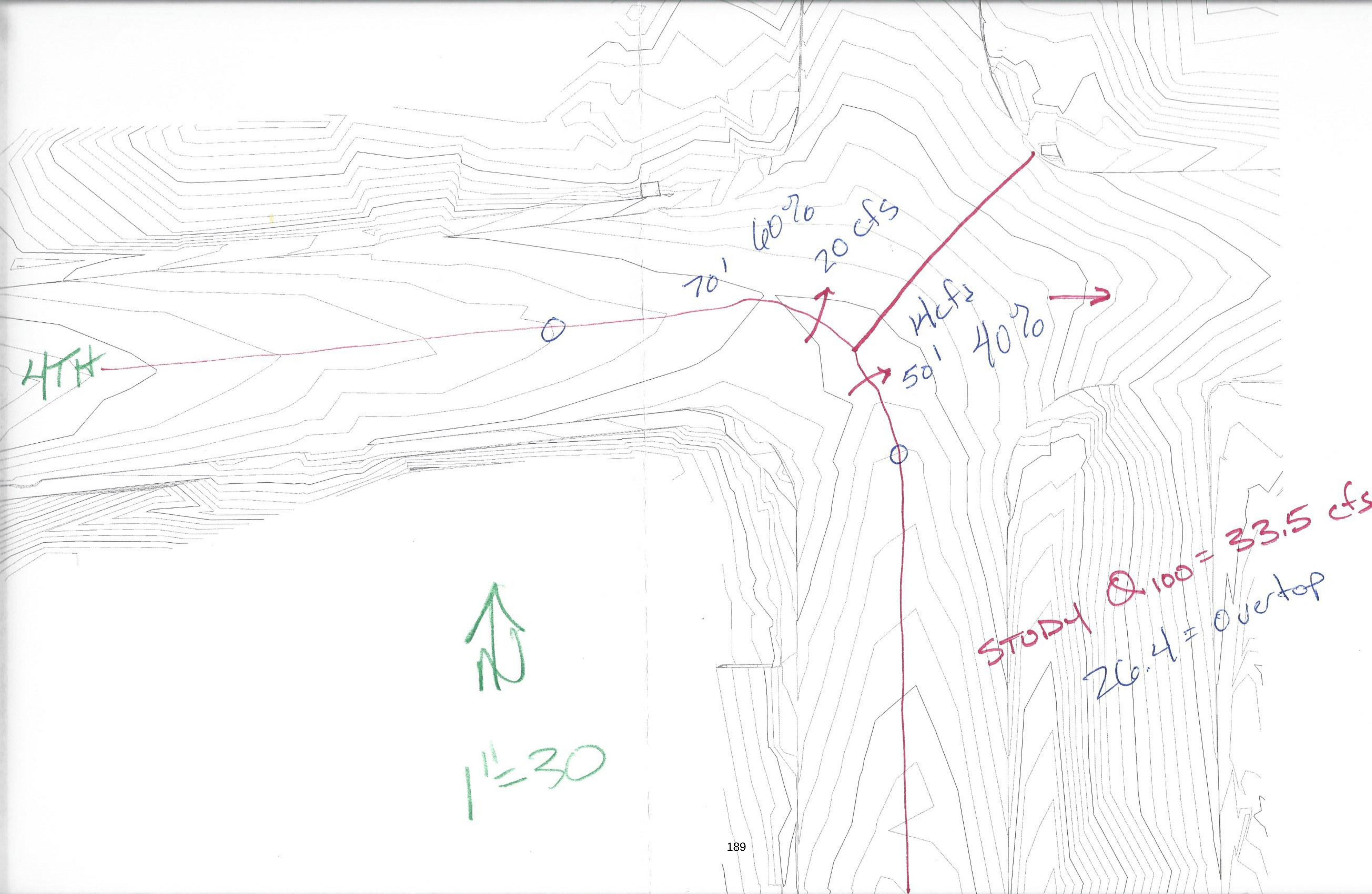


Figure 9-36. Expansion factor for rectangular conduits

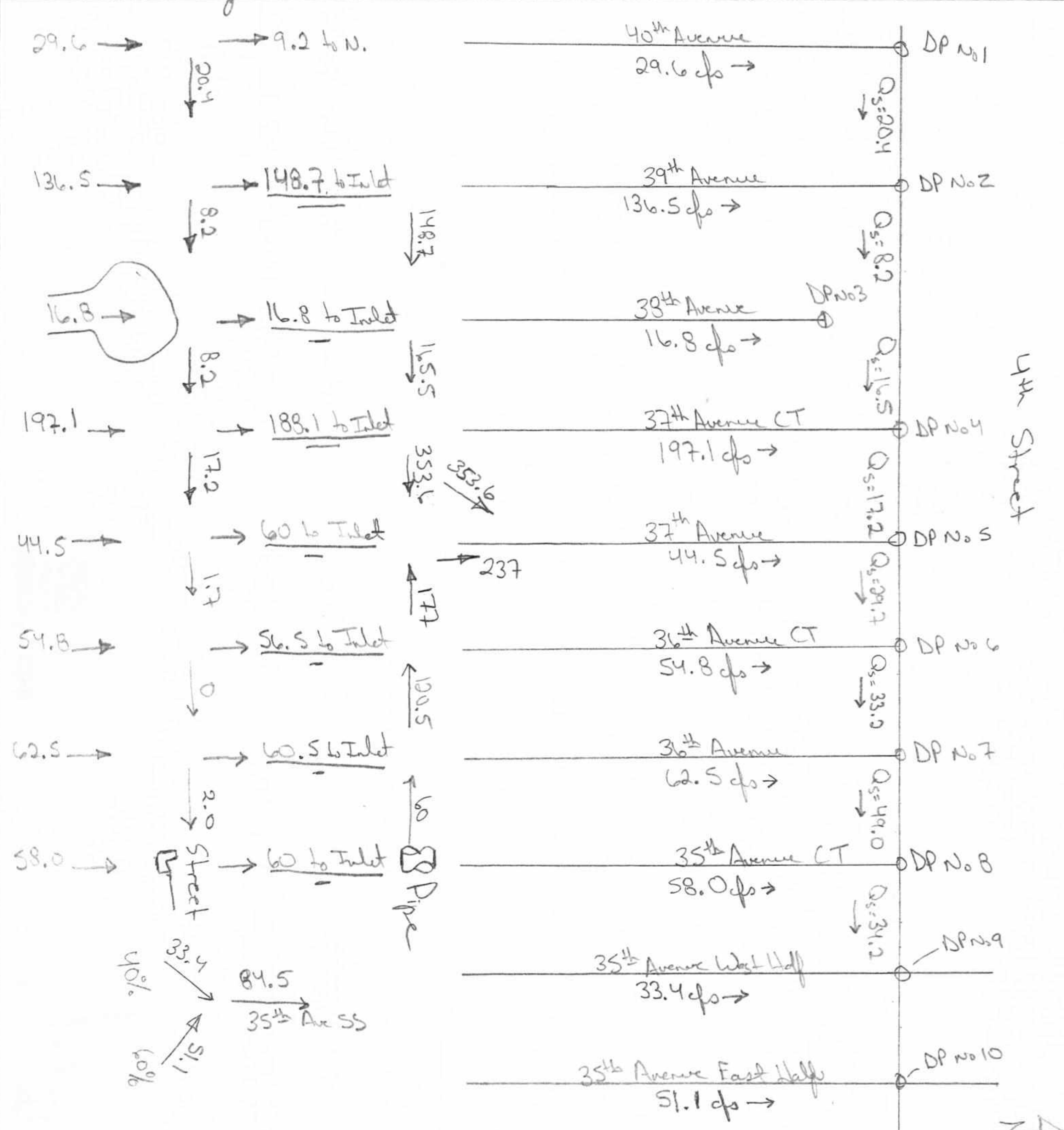
4^{TH} STREET
OFF-SITE FLOW STUDY
(TO BASIN O)


4TH
70'
60%
20 cfs
14cfs
50'
40%
STUDY Q100 = 33.5 cfs
26.4 = Overtop
N
1" = 30

ANDERSON CONSULTING ENGINEERS, INC
Civil • Water Resources • Environmental

Owner-Project	By	Date
4th Street Stormsewer Design	AMH	12/1/2011
Subject	**Checked By**	**Date**
Connectivity		

Project Number: | Page: Of:



Worksheet for 4th Street Weir

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Input Data		
Channel Slope:	0.00100	ft/ft
Discharge:	34.00	ft³/s

Options		
Current Roughness Weighted Metho	ImprovedLotters	
Open Channel Weighted Roughness	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	

Results		
Roughness Coefficient:	0.013	
Water Surface Elevation:	26.39	ft
Elevation Range:	26.00 to 27.00 ft	
Flow Area:	26.15	ft²
Wetted Perimeter:	121.40	ft
Top Width:	121.39	ft
Normal Depth:	0.39	ft
Critical Depth:	0.29	ft
Critical Slope:	0.00455	ft/ft
Velocity:	1.30	ft/s
Velocity Head:	0.03	ft
Specific Energy:	0.42	ft
Froude Number:	0.49	
Flow Type:	Subcritical	

Segment Roughness

Start Station	End Station	Roughness Coefficient
(0+00, 27.00)	(3+05, 27.00)	0.013

Section Geometry

Station	Elevation
0+00	27.00
0+36	26.80

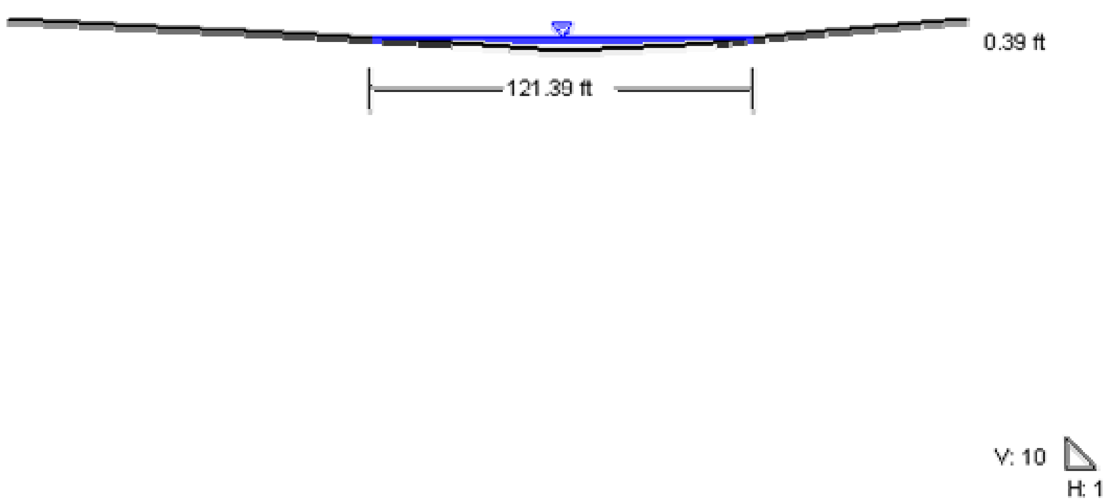
Worksheet for 4th Street Weir

Station	Elevation
0+80	26.60
1+14	26.40
1+48	26.20
1+75	26.00
1+79	26.00
2+21	26.20
2+38	26.40
2+58	26.60
2+82	26.80
3+05	27.00

Cross Section for 4th Street Weir

Project Description		
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	

Section Data		
Roughness Coefficient:	0.013	
Channel Slope:	0.00100	ft/ft
Normal Depth:	0.39	ft
Elevation Range:	26.00 to 27.00 ft	
Discharge:	34.00	ft³/s



FIRE STATION #3
WATER QUALITY POND
INFORMATION

UNION COLONY FIRE STATION #3
Greeley, Colorado

FINAL DRAINAGE REPORT

Prepared For
City of Greeley, Colorado

May 5, 2006
Project No. 05042

KBN ENGINEERS

Prepared By:
KETTERLING, BUTHERUS AND NORTON ENGINEERS, LLC.
820 8TH STREET
GREELEY, CO 80631

B. Sub-basin Description

For analysis purposes, the Union Colony Fire Station #3 site is divided into 12 separate on-site sub-basins. These sub-basins, which are delineated in the "Drainage Exhibit" in the back of this report, range from approximately 0.01 to 1.0 acres in size. Composite "C" values for all basins are based on proposed improvements and the future assumed buildout of 35th Avenue.

The area north of the north interior road will remain as unimproved land and will continue to release stormwater undetained into the Greeley No. 3 Ditch. Stormwater runoff from Basin I on the east end of the site will flow onto the undeveloped property (owned by the City of Greeley) east of the site and then into the Greeley No. 3 Ditch.

There is an existing double inlet on-grade at the W. 2nd St. entrance to the Northview Subdivision. Some stormwater runoff from the Northview Subdivision site carries over the inlet and flows into 35th Avenue. This flow is routed through the Union Colony Fire Station #3 site.

III. Drainage Design Criteria

A. Regulations

The primary criteria for the storm water management for this project is "Design Criteria and Construction Specifications, Volume II of V – Storm Drainage Design Criteria" (SDDC) as published by the City of Greeley Public Works Department, October 1, 1997.

The supplemental criteria is "Urban Storm Drainage Criteria Manual," Volumes I, II, & III, as published by the Urban Drainage and Flood Control District, Denver, Colorado.

Charts, graphs, and tables used in design are included in the Appendices at the back of this report.

B. Development Criteria Reference and Constraints

A stormwater detention storage pond will not be constructed for this site since the site will discharge undetained runoff into the Broadview Regional Detention Pond. 100-year runoff is safely conveyed through the site to the proposed on-site water quality pond where the runoff is piped to the west across 35th Avenue into the Broadview Regional Detention Pond.

C. Hydrological Criteria

The current City of Greeley rainfall intensity-duration curves were used in the drainage analysis of this site. The 100-year curve was used to analyze the major storm event and the 5-year curve was used to analyze the minor storm event.

B. Specific Details

	Water Quality Capture Pond	
Area Tributary to Water Quality Pond	3.52	Acres
Water Quality Capture Volume (WQCV)	0.06	Ac-Ft
Bottom of Pond Elevation	4,694.40	
WQCV Elevation	4,695.24	
100-Year Release Rate	14.39	cfs
100-Year Outlet Headwater	4,696.17	

Table 1. Water Quality Pond Summary

VI. Conclusions

A. Compliance with Standards

The drainage design for this project generally complies with the City of Greeley Criteria. As previously mentioned, stormwater detention will be provided by the City's Broadview Regional Detention Pond.

B. Drainage Concept

We believe that the drainage facility design will be effective in controlling damage to property from storm water runoff and will ensure a reasonable level of safety and well being for those living and working in the area.

VII. References

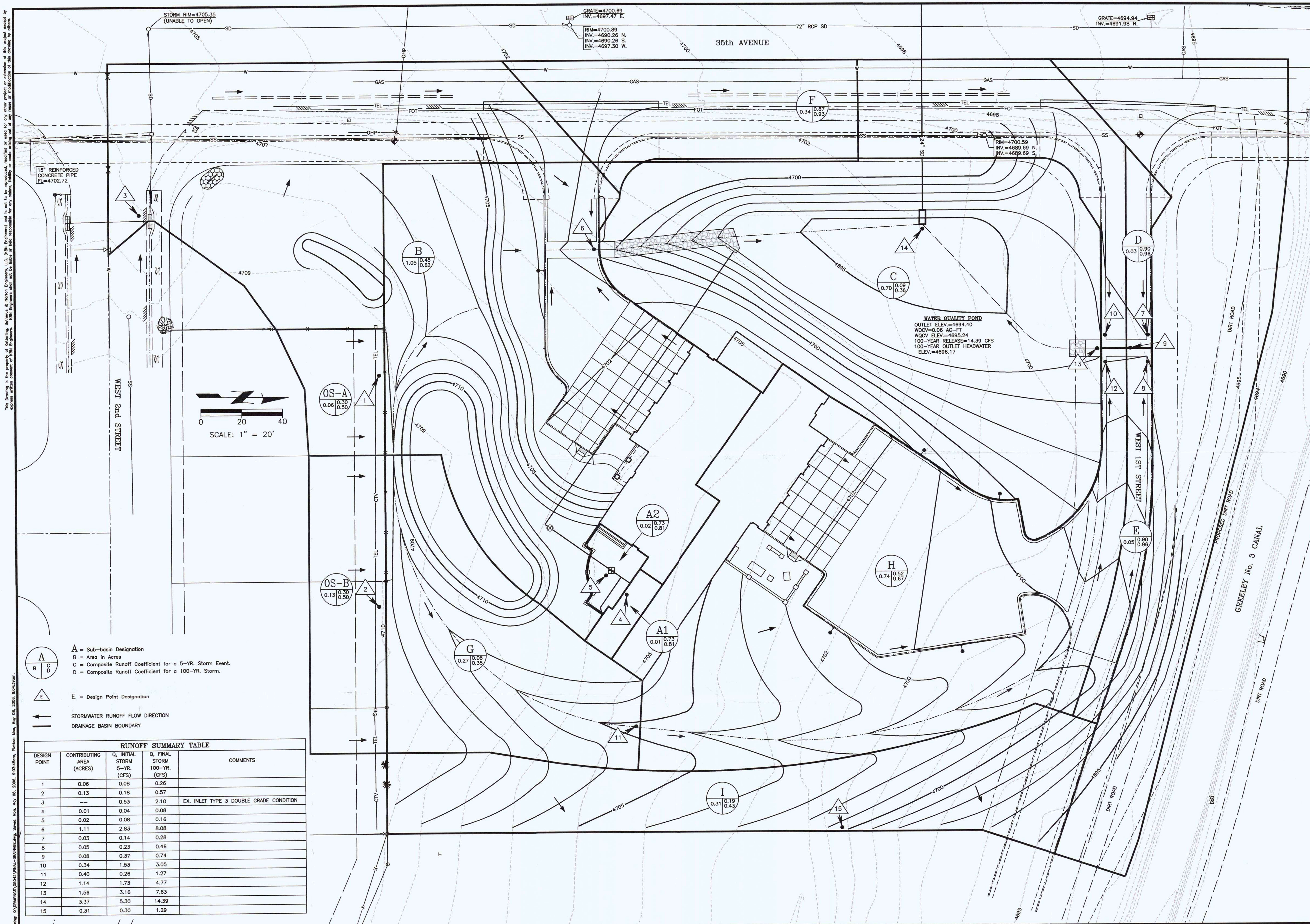
"Design Criteria and Construction Specifications, Volume II of V – Storm Drainage Design Criteria," City of Greeley Public Works Department, October 1, 1997.

"Urban Storm Drainage Criteria Manual," Volumes I, II, & III, Urban Drainage and Flood Control District, Denver, Colorado.

"Soil Survey of Weld County, Colorado, Southern Part," United States Department of Agriculture Soil Conservation Service in cooperation with Colorado Agriculture Experiment Station, September 1980.

"Comprehensive Drainage Plan, City of Greeley, Summary Document," Lidstone & Anderson, Inc., Revised April 5, 1999.

"Final Drainage Study for Northview Filing No. 1," Murray Consulting Engineers, Inc., Job No. 298, Revised July 24, 1996.



RUNOFF SUMMARY TABLE

DESIGN POINT	CONTRIBUTING AREA (ACRES)	Q, INITIAL STORM 5-YR. (CFS)	Q, FINAL STORM 100-YR. (CFS)	COMMENTS
1	0.06	0.08	0.26	
2	0.13	0.18	0.57	
3	--	0.53	2.10	EX. INLET TYPE 3 DOUBLE GRADE CONDITION
4	0.01	0.04	0.08	
5	0.02	0.08	0.16	
6	1.11	2.83	8.08	
7	0.03	0.14	0.28	
8	0.05	0.23	0.46	
9	0.08	0.37	0.74	
10	0.34	1.53	3.05	
11	0.40	0.26	1.27	
12	1.14	1.73	4.77	
13	1.56	3.16	7.63	
14	3.37	5.30	14.39	
15	0.31	0.30	1.29	

REVISIONS

DATE	DESCRIPTION	BY

KBN ENGINEERS

KETTERLING, BUTHERUS & NORTON
820 8th Street Greeley, Colorado
(970) 395-9880

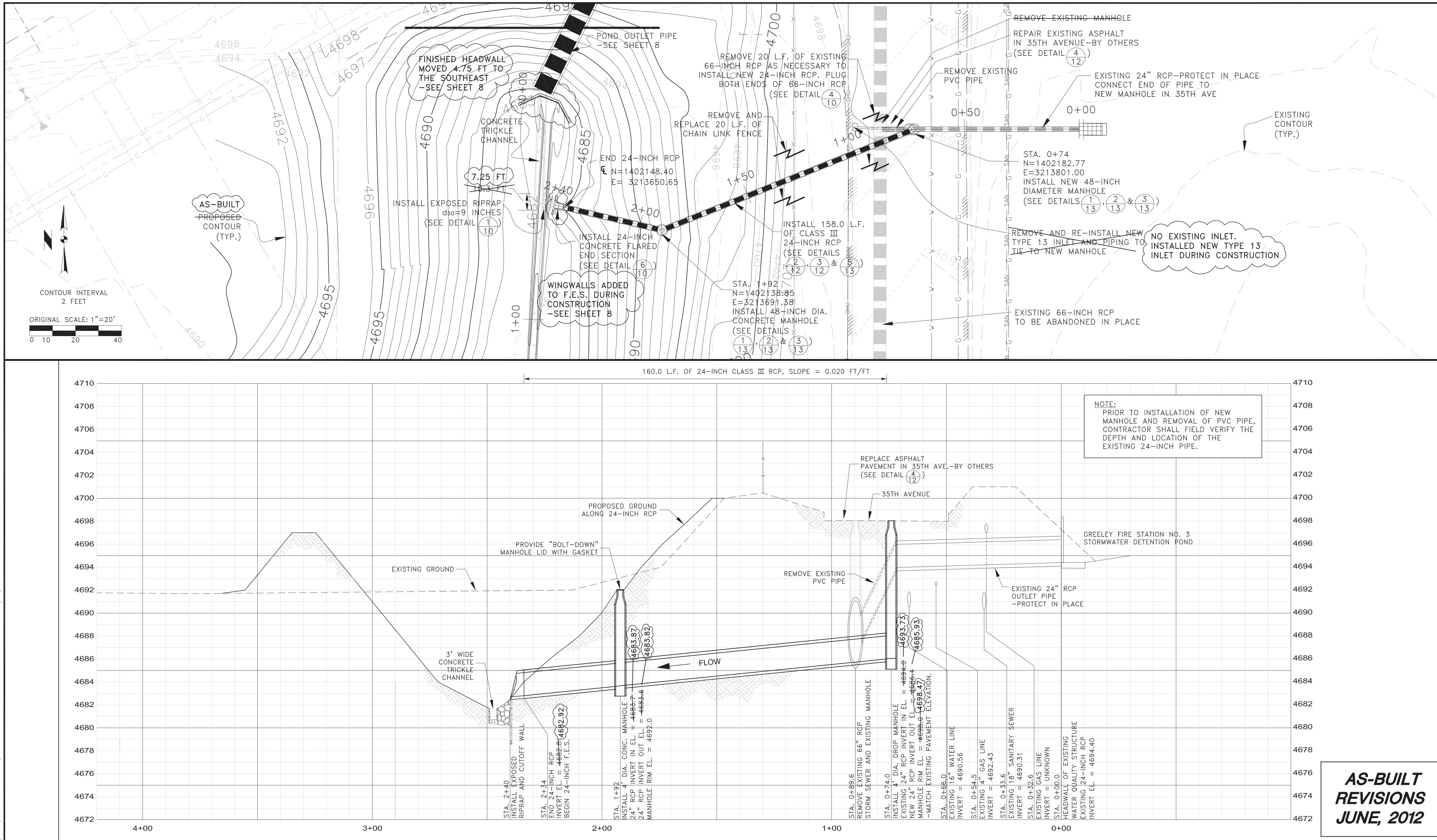
DESIGNED LAS
DRAWN LAS
CHECKED MCK

UNION COLONY FIRE STATION #3
GREELEY, COLORADO

DRAINAGE EXHIBIT

PROJECT NO. 05042
SCALE HORIZ.: 1" = 20' VERT.: NA
DATE 05/05/06
SHEETS 7 SHEET 7

Drawing: K:\DRAWINGS\05042\FINAL-DRAINAGE.dwg, Saved: Mon, May 08, 2006, 9:03:48am, Plotted: Mon, May 08, 2006, 9:04:38am



P:\COCOG10-BESTWAY POND\ACAD\AS-BUILT DRAWINGS\SHT 9 AS-BUILT FIRE STATION OUTLET PIPE.DWG 06/12/2012 TAW

REVISIONS: REV1 REV2 REV3 REV4 REV5 REV6	VERTICAL SCALE 1"=4' (0 2 4 8) HORIZONTAL SCALE 1"=20' (0 10 20 40)	PROJECT NUMBER: COCOG10 / ACAD FILE: SHT 9 AS-BUILT FIRESTA. OUTLET PIPE / DATE: 08/11/2008	DRAWN BY: TAW / DESIGNED BY: MKK / CHECKED BY: GJK	Anderson Consulting Engineers, Inc. Civil · Water Resources · Environmental 375 E. Horsetooth Road, Building #5, Fort Collins, CO 80525 Phone (970) 226-0120 / Fax (970) 226-0121 www.acewater.com	BEST-WAY DETENTION POND-PHASE ONE GREELEY, COLORADO	OUTLET PIPE FROM GREELEY FIRE STATION NO. 3 - PLAN AND PROFILE	39344 3/18/11 PROFESSIONAL ENGINEER	SHEET 9 / C8 SHEET INDEX

FAITH BIBLE BAPTIST CHURCH
POND INFORMATION

FINAL DRAINAGE AND EROSION CONTROL REPORT

Faith Bible Baptist Church
Building Addition
Greeley, Colorado

12-January-2011

Prepared for:
Hauser Architects, PC
Al Hauser
3780 East 15th Street, Suite 201
Loveland, CO 80538
Phone: 970.669.8220

Prepared by:
Troy W. Campbell, PE
Ridgeline Consultants, Inc.
16911 Potts Place
Mead, Colorado 80542
Phone: 970.535.0419
Fax: 720.247.9043

RCI Project Number: 0118

A
RAH
2/2/11

BASIN RUNOFF SUMMARY

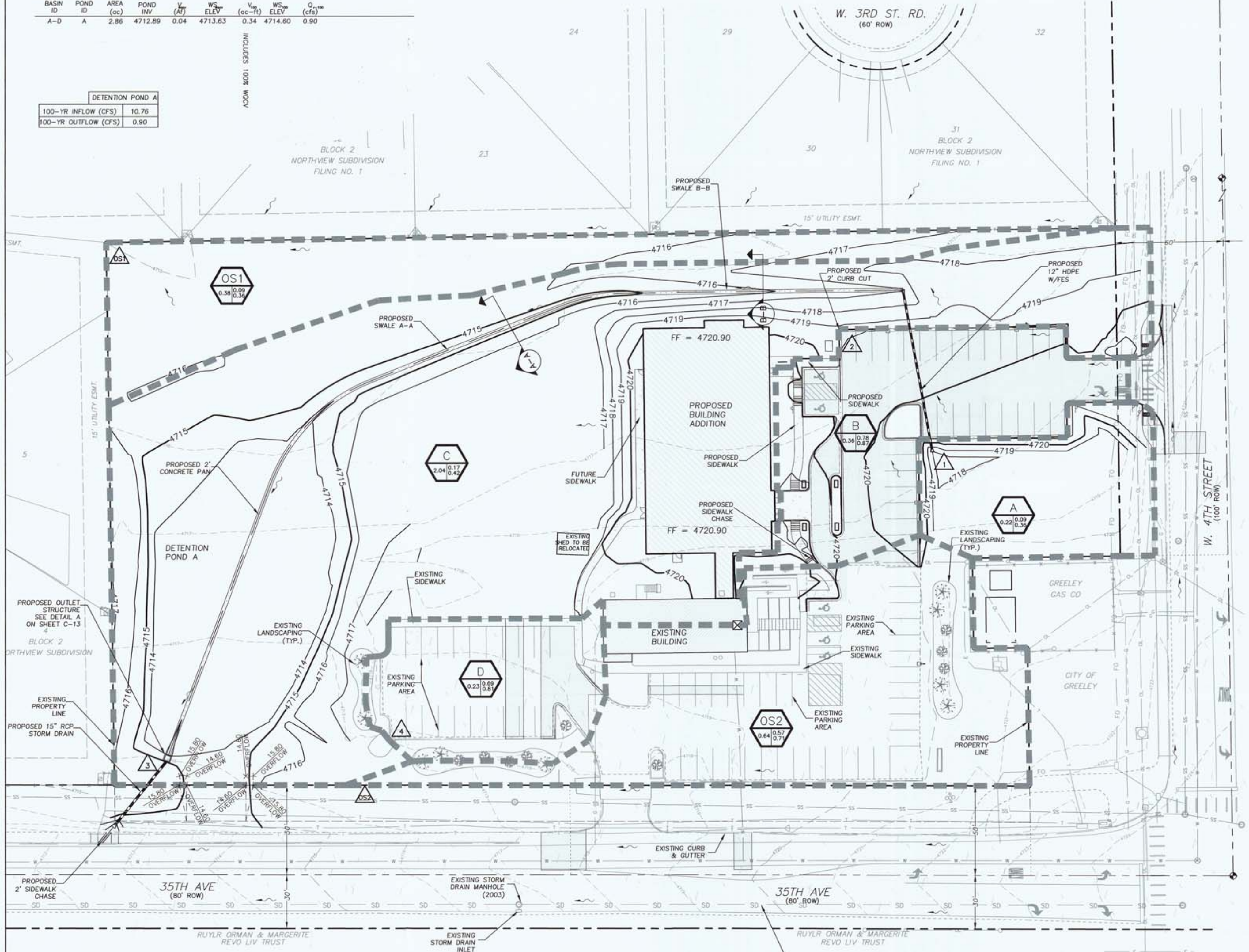
BASIN ID	DESIGN PT	AREA (ac)	DIRECT Q_5 (cfs)	Q_{100} (cfs)	DETAINED (y/n)	DESCRIPTION
A	1	0.22	0.10	0.77	y	TRIBUTARY TO 12" HDPE
B	2	0.36	1.45	3.01	y	TRIBUTARY TO SWALE A-A, B-B
C	3	2.04	1.42	6.42	y	INCLUDES DETENTION POND
D	4	0.23	0.83	1.81	y	TRIBUTARY TO DETENTION POND
OS-1	OS1	0.38	0.14	1.02	n	EAST BASIN – FLOWS OFFSITE
OS-2	OS2	0.64	1.85	4.32	n	EXISTING DEVELOPMENT – FLOWS OFFSITE

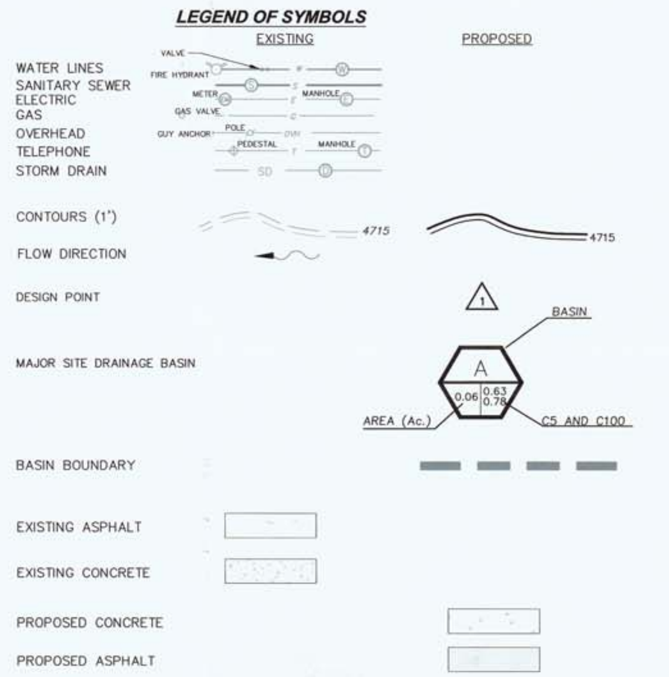
DETENTION SUMMARY

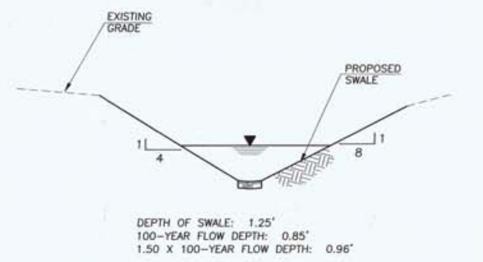
BASIN ID	POND ID	AREA (ac)	POND INV	V_{wqcv} (AF)	WS_{wqcv} ELEV	V_{100} (ac-ft)	WS_{100} ELEV	Q_{r-100} (cfs)
A-D	A	2.86	4712.89	0.04	4713.63	0.34	4714.60	0.90

INCLUDES 100% WQCV

DETENTION POND A	
100-YR INFLOW (CFS)	10.76
100-YR OUTFLOW (CFS)	0.90

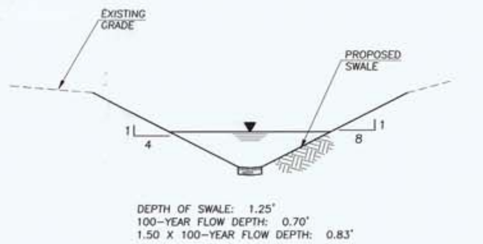






A/6 **SWALE A-A SECTION**

NTS



B/6 **SWALE B-B SECTION**

NTS

BENCHMARK

WEST 1/4 CORNER OF SECTION 1, T5N, R66W. A FOUND #6 REBAR WITH 3 1/4" ALUMINUM CAP IN MONUMENT BOX PROPERLY MARKED AND STAMPED "1994 LS 7242". CITY OF GREELEY PUBLISHED NAVD88 ELEV. = 4724.88.

Construction must be in accordance with applicable City of Greeley Construction Standards. The City's acceptance allows for plan distribution and permit application. The City's acceptance shall not relieve the design engineer's responsibility for errors, omissions, or design deficiencies for which the City is held harmless.

Accepted by: ______________________ __________
City Engineer Date

RIDGELINE Consultants, Inc.
16911 POTTS PLACE
MEAD, CO 80542
P: 970.535.0419
F: 720.247.9043
ridgelineconsultants.com

COLORADO REGISTERED PROFESSIONAL ENGINEER TROY W. CAMPBELL 41159 01/12/2011

FAITH BIBLE BAPTIST CHURCH
320 35TH AVENUE
FINAL DRAINAGE PLAN

LOCATED IN THE NW 1/4 SECTION 1 TOWNSHIP 5 NORTH, RANGE 66 WEST
CITY OF GREELEY, COUNTY OF WELD, STATE OF COLORADO

DATE	BY	REVISION/ISSUE	APPV	DATE

Design TWC	Drawn TWC
Checked TWC	Checked TWC
Date DECEMBER 17, 2010	
Job No. 0118	
D– 0118.1	

SHEET
C-06
OF 17 SHEETS

BESTWAY POND

Determine WQCV for Bestway Pond to treat Basins A-F and O-R

Project Name:	35th Street Improvements, Greeley
Project Number:	1397-083-00
Company:	INTERWEST CONSULTING GROUP
Designer:	ES
Date:	5/5/2020

1. Basin Storage Volume   Determine WQCV for Bestway Pond to treat Basins A-F and O-R

A) Tributary Area's Imperviousness Ratio (i=Ia/100)	Ia =	84	%
	i =	0.84	
B) Contributing Watershed Area (Area)	A =	4.61	acres
C) Water Quality Capture Volume (WQCV) 40 hour	WQCV =	0.354897	watershed inches
(WQCV = 1.0* (0.91 * i3 - 1.19 * i2 + 0.78i))			
D) Design Volume: Vol = WQCV/12 * Area * 1.2	Vol. =	0.163607	ac-ft

The WQCV is calculated as a function of imperviousness and BMP drain time using Equation 3-1, and as shown in Figure 3-2:

$$\mathrm{WQCV} = a(0.91I^3 - 1.19I^2 + 0.78I) \qquad \text{Equation 3-1}$$

Where:

WQCV = Water Quality Capture Volume (watershed inches)

a = Coefficient corresponding to WQCV drain time (Table 3-2)

I = Imperviousness (%/100) (see Figures 3-3 through 3-5 [single family land use] and /or the *Runoff* chapter of Volume 1[other typical land uses])

Table 3-2. Drain Time Coefficients for WQCV Calculations

Drain Time (hrs)	Coefficient, a
12 hours	0.8
24 hours	0.9
40 hours	1.0

4th St. Report – All Except
35th Int Gets To Pipes In 4th

IV. DESIGN COMPONENTS

During the 100-year storm event nearly 980 cfs is tributary to the area located just north of 4th Street, west of 35th Avenue. To alleviate street flooding on both 4th Street and on 35th Avenue as well as prevent these flows from spilling into the Greeley No. 3, both a stormwater collection system and a regional detention facility was constructed.

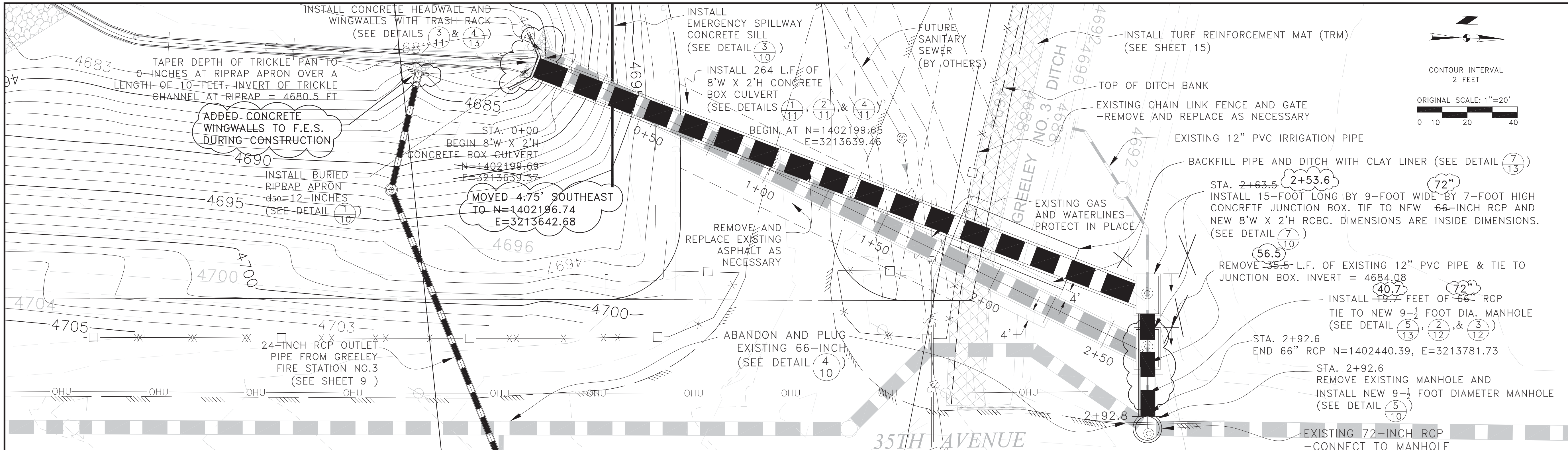
Supporting documentation for each of the design components is provided in Appendix C. Hydraulic models conducted in support of the design and final design drawings are included on the enclosed CD.

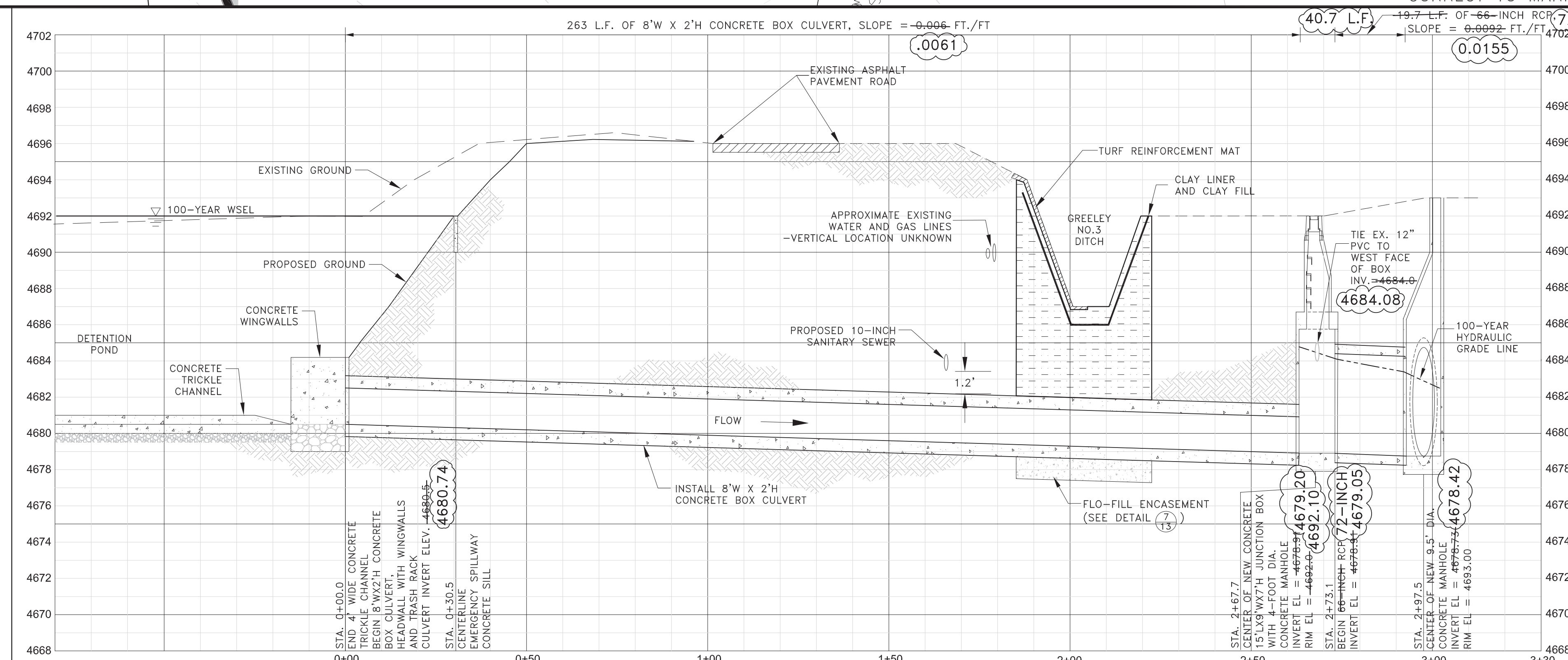
4.1 Bestway Detention Pond

The Bestway Detention Pond was identified by the City of Greely to be constructed in the area just north of 4th Street, west of 35th Avenue. The purpose of this regional detention pond is to attenuate the tributary 100-year peak discharge of nearly 980 cfs to a level that can be conveyed by the existing 72-inch RCP located under 35th Avenue north of the Greeley No. 3 (capacity of approximately 480 cfs). To design the pond, several grading plan configurations were considered along with various outlet connection scenarios to the existing 35th Avenue storm sewer. Design constraints included the following: (a) grading the pond such that groundwater was not exposed, thereby eliminating the need for a water augmentation plan; (b) grading the pond to provide the requisite 60 acre-feet of storage while fitting within the confines of Tracts B and C of the Bestway development plat; and (c) constructing an outfall that will avoid conflicts with existing utilities and the Greeley No. 3 Ditch.

Stage-storage-discharge rating curves were established for each of these configurations and were evaluated for performance in the Future Conditions/Proposed Facilities hydrologic model to determine hydraulic characteristics. The resulting pond configuration was a nearly 60 acre-foot detention pond that is approximately 30-feet deep with 3H:1V side slopes. The final pond outlet configuration was nearly 260 feet of 8'W x 2'H RCBC to convey flows under utilities and the Greeley No. 3 and an additional 20 feet of 66-inch RCP to tie into the existing 35th Avenue Storm Sewer. During a 100-year storm event, this pond configuration results in a peak discharge of 189 cfs, a depth of 4692.0 feet, and a total storage of 47.4 acre-feet.

In the event that the outlet becomes plugged, an emergency spillway was designed on the north end of the Bestway Detention Pond to safely spill storm flows into the Greeley No. 3. The SWMM model was analyzed assuming no discharge below the crest of the spillway and 1-foot of flow depth through the spillway. The resulting 100-year peak discharge that the spillway needs to convey is 264 cfs, which requires a 95 foot wide spillway assuming 1-foot of flow depth.





8'W X 2"H BOX CULVERT OUTLET

CONCRETE BOX CULVERT AND RCP ALIGNMENT SURVEY DATA		
STATION	DESCRIPTION	COURSE TO NEXT STATION
0+00.0	BEGINNING OF 8'W X 2'H BOX CULVERT	N25D58'40"E, 276.8'
2+62.7	END BOX CULVERT AT 15' X 9' BOX	
2+73.0	BEGIN 66" RCP OUT OF 15' X 9' BOX	N90D00'00"E, 24.5'
2+97.5	END 66" RCP (CENTER OF MANHOLE)	

15' X 9' JUNCTION BOX COORDINATES	
NE CORNER	N=1402445.69, ~~E=3213762.89~~ E=3213741.59
SE CORNER	N=1402435.09, ~~E=3213762.89~~ E=3213741.59
NW CORNER	N=1402445.69, ~~E=3213746.22~~ E=3213724.92
SW CORNER	N=1402435.02, ~~E=3213746.22~~ E=3213724.92

AS-BUILT REVISIONS JUNE, 2012

P:\COCO610-BESTWAY POND\ACAD\AS-BUILT DRAWINGS\SHT 8 AS-BUILT POND OUTLET PLAN AND PROFILE.DWG 06/11/2012 TAW

REVISIONS: REV1 REV2 REV3 REV4 REV5 REV6	VERTICAL SCALE 1"=4' (0 2 4 8) HORIZONTAL SCALE 1"=20' (0 10 20 40)	PROJECT NUMBER: COCO610 / ACAD FILE: SHT 8 AS-BUILT POND OUTLET P&P / DATE: 08/11/2008	DRAWN BY: TAW / DESIGNED BY: MKK / CHECKED BY: GJK	Anderson Consulting Engineers, Inc. Civil · Water Resources · Environmental 375 E. Horsetooth Road, Building #5, Fort Collins, CO 80525 Phone (970) 226-0120 / Fax (970) 226-0121 www.acewater.com	BEST-WAY DETENTION POND-PHASE ONE GREELEY, COLORADO	POND OUTLET PIPE - PLAN AND PROFILE	SHEET 8 / C7 SHEET INDEX

39344 3/18/11 PROFESSIONAL ENGINEER

STONEYBROOK POND

EXISTING Detention Pond - Stage/Storage - FROM AERIAL

LOCATION:	STONEY BROOK - TOTAL POND NEEDED
PROJECT NO:	1397-083-00
COMPUTATIONS BY:	mpo
SUBMITTED BY:	INTERWEST CONSULTING GROUP
DATE:	9/22/2020

V = 1/3 d (A + B + sqrt(A*B))

where V = volume between contours, ft^3

d = depth between contours, ft

A = surface area of contour

Ex Pond

	Stage (ft)	Surface Area (ft^2)	Incremental Storage (ac-ft)	Ex Total Storage (ac-ft)
	4668.9	115617		
	4669.0	120500	0.27	0.27
	4669.15	122450	0.42	0.69
	4669.3	124400	0.43	1.11
	4669.4	125700	0.29	1.40
	4669.5	127000	0.29	1.69
	4670.0	129000	1.47	3.16
	4671.0	142000	3.11	6.27
	4672.0	153204	3.39	9.66
	4672.4	158297	1.43	11.09
Existing Spillway	4672.6	160083	0.73	11.82

Existing Volume at Existing Spillway 11.82 ac-ft

New Contour Area

Stage (ft)	Surface Area (ft^2)	Incremental Storage (ac-ft)	New Total Storage (ac-ft)
4668.9	115075		
4669.0	115800	0.27	0.27
4669.15	**117300**	**0.40**	**0.67**
4669.3	118080	0.41	1.07
4669.4	118840	0.27	1.34
4669.5	119600	0.27	1.62
4670.0	123400	1.39	3.01
4671.0	136300	2.98	5.99
4672.0	148400	3.27	9.26
4672.4	151900	1.38	10.64
4672.6	153600	0.70	11.34

Provided Volume at Existing Spillway	11.34	ac-ft
Total Required WQCV for 100.9 acres	1.47	ac-ft
detention w/ set release (45 cfs)	10.6	ac-ft
Total required for full WQ and Detention	12.07	ac-ft
*shortfall	0.73	ac-ft
Required WQCV for Stoneybrook Lot 4 and 35th=	0.41	ac-ft
Proposed Provided WQCV	0.67	ac-ft
Provided Detention	10.67	ac-ft

Determine WQCV for Stoneybrook Lot 1 Pond to treat Lot 4 and Basins S and T

Project Name:	35th Street Improvements, Greeley
Project Number:	1397-083-00
Company:	INTERWEST CONSULTING GROUP
Designer:	ES
Date:	9/2/2020

1. Basin Storage Volume — Determine WQCV for Stoneybrook Lot 1 Pond to treat entire area to pond

A) Tributary Area's Imperviousness Ratio (i=Ia/100)	Ia =	41	%	
	i =	0.41		
B) Contributing Watershed Area (Area)	A =	100.9	acres	
C) Water Quality Capture Volume (WQCV) 40 hour (WQCV = 1.0* (0.91 * i3 - 1.19 * i2 + 0.78i))	WQCV =	0.182479	watershed inches	
12 hour (WQCV = 0.8* (0.91 * i3 - 1.19 * i2 + 0.78i))	WQCV =	0.145983	watershed inches	
D) Design Volume: Vol = WQCV/12 * Area * 1.2	Vol. =	1.84	ac-ft	**40 hour**
	Vol. =	1.47	ac-ft	**12 hour**

The WQCV is calculated as a function of imperviousness and BMP drain time using Equation 3-1, and as shown in Figure 3-2:

$$\mathrm{WQCV} = a(0.91I^3 - 1.19I^2 + 0.78I) \qquad \text{Equation 3-1}$$

Where:

WQCV = Water Quality Capture Volume (watershed inches)

a = Coefficient corresponding to WQCV drain time (Table 3-2)

I = Imperviousness (%/100) (see Figures 3-3 through 3-5 [single family land use] and /or the *Runoff* chapter of Volume 1[other typical land uses])

Table 3-2. Drain Time Coefficients for WQCV Calculations

Drain Time (hrs)	Coefficient, a
12 hours	0.8
24 hours	0.9
40 hours	1.0

Determine WQCV for Stoneybrook Lot 1 Pond to treat Lot 4 and Basins S,T, U and V

Project Name:	35th Street Improvements, Greeley
Project Number:	1397-083-00
Company:	INTERWEST CONSULTING GROUP
Designer:	ES
Date:	9/21/2020

1. Basin Storage Volume — Determine WQCV for Stoneybrook Lot 1 Pond to treat Lot 4 and Basins S and T

A) Tributary Area's Imperviousness Ratio (i=Ia/100)	Ia =	52	%
	i =	0.52	
B) Contributing Watershed Area (Area)	A =	24.42	acres
C) Water Quality Capture Volume (WQCV) 40 hour (WQCV = 1.0* (0.91 * i3 - 1.19 * i2 + 0.78i))	WQCV =	0.211777	watershed inches
12 hour (WQCV = 0.8* (0.91 * i3 - 1.19 * i2 + 0.78i))	WQCV =	0.169422	watershed inches
D) Design Volume: Vol = WQCV/12 * Area * 1.2	Vol. =	0.52 ac-ft	**40 hour**
	Vol. =	0.41 ac-ft	**12 hour**

The WQCV is calculated as a function of imperviousness and BMP drain time using Equation 3-1, and as shown in Figure 3-2:

$$\mathrm{WQCV} = a(0.91I^3 - 1.19I^2 + 0.78I) \qquad \text{Equation 3-1}$$

Where:

WQCV = Water Quality Capture Volume (watershed inches)

a = Coefficient corresponding to WQCV drain time (Table 3-2)

I = Imperviousness (%/100) (see Figures 3-3 through 3-5 [single family land use] and /or the *Runoff* chapter of Volume 1[other typical land uses])

Table 3-2. Drain Time Coefficients for WQCV Calculations

Drain Time (hrs)	Coefficient, a
12 hours	0.8
24 hours	0.9
40 hours	1.0

Project Name: 35th Ave. **Project No.:**

Client: **Subject:** Stoneybrook Pond

Date: 9/22/20 **By:** ES **Page:**

Stoneybrook

Aug. 30, 1995
Sept. 27, 1995

Total Area = 76.5 %Iw = 36.9%

Resid. Area = 62.3 45%

Comm Bldg = 0.07 90%

Comm Parking = 0.13 96%

Open Space = 14.0 0%

∴ A	%I	C_{100}	
76.5	37	0.45	Stoneybrook
2.02	82.5	0.81	35th Basins S,T,U,V
22.4	49	0.49	Stoneybrook Lot 4
100.9			

	A	%I	C_{100}
S	A = 0.87	86	0.83
T	A = 0.70	81	0.81
U	A = 0.25	75	0.78
V	A = 0.20	82	0.81
	2.02	82.5	0.81

} 35th Basins

	%I	C_{100}
Lot 4 + 35th	52	0.52

Total Weighted A = 100.9

%I = 0.41

C_{100} = 0.42

$WQCV_{12h}$ for 100.9 Area = $\boxed{1.47 \text{ Ac-ft}}$

$WQCV_{12h}$ for Lot 4 + 35th Basins (24.42) = $\boxed{0.41 \text{ Ac-ft}}$

1218 W. ASH, STE A • WINDSOR, COLORADO 80550
TEL.970.674.3300 • FAX.970.674.3303

Project Name: 35th Ave Project No.:

Client: Subject: Stonybrook Pond

Date: 9/29/20 By: ES Page:

Size Notch for WQ release

WQCV@ 4469.15 = 0.67 Ac-ft

Invert 36" FES = 4468.9 Δ 0.25'

= 3"

12hr Volume: 0.67Ac-ft * 43,560 = 29,185.2

29,185.2cf / 12hr · 1hr / 60min · 1min / 60s = 0.68cfs

INTERWEST CONSULTING GROUP

use 1.7ft long x 3" High Notch

From FlowMaster Calc.

1218 W. ASH, STE A • WINDSOR, COLORADO 80550
TEL.970.674.3300 • FAX.970.674.3303

Worksheet for STONEYBROOK WQ NOTCH

Project Description		
Flow Element:	Generic Weir	
Solve For:	Crest Length	

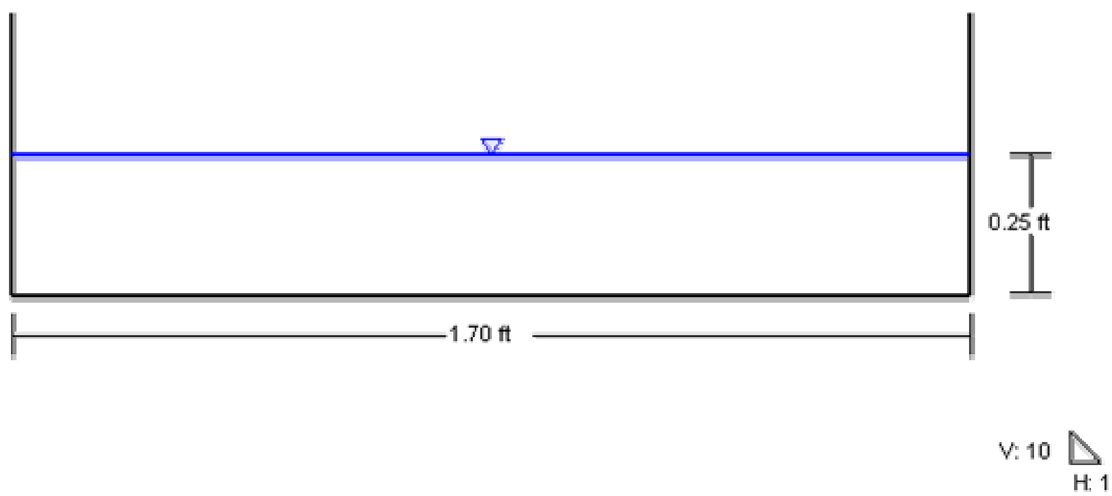
Input Data		
Discharge:	0.68	ft^3/s
Headwater Elevation:	0.25	ft
Crest Elevation:	0.00	ft
Weir Coefficient:	3.20	US

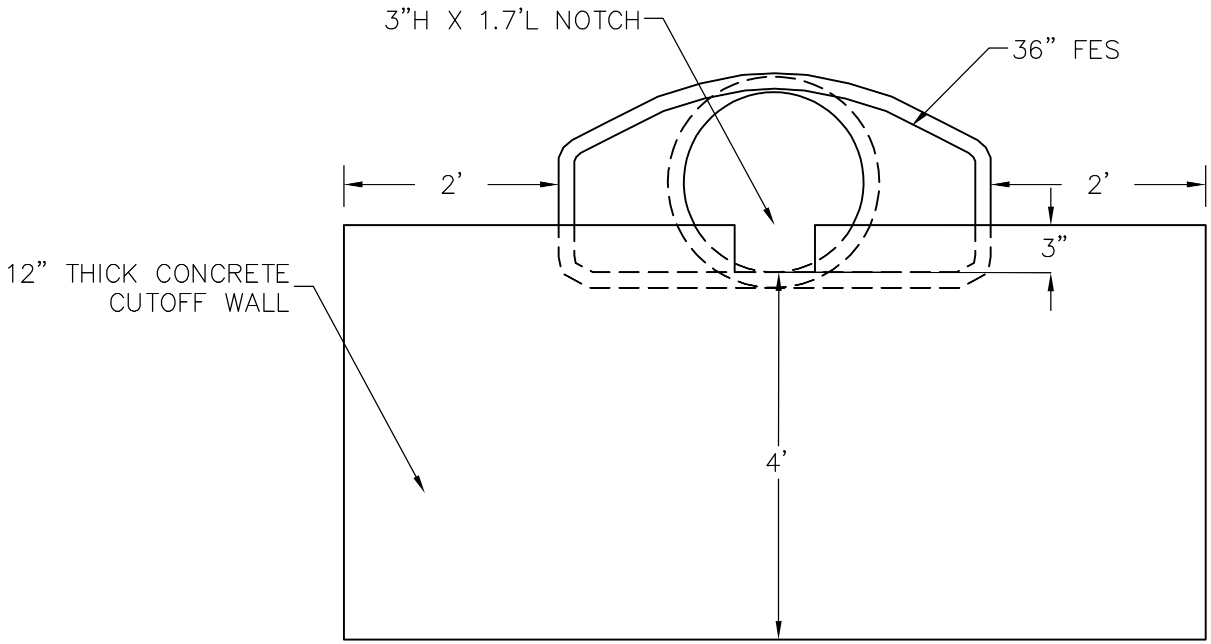
Results		
Crest Length:	1.70	ft
Headwater Height Above Crest:	0.25	ft
Flow Area:	0.43	ft^2
Velocity:	1.60	ft/s
Wetted Perimeter:	2.20	ft
Top Width:	1.70	ft

Cross Section for STONEYBROOK WQ NOTCH

Project Description		
Flow Element:	Generic Weir	
Solve For:	Crest Length	

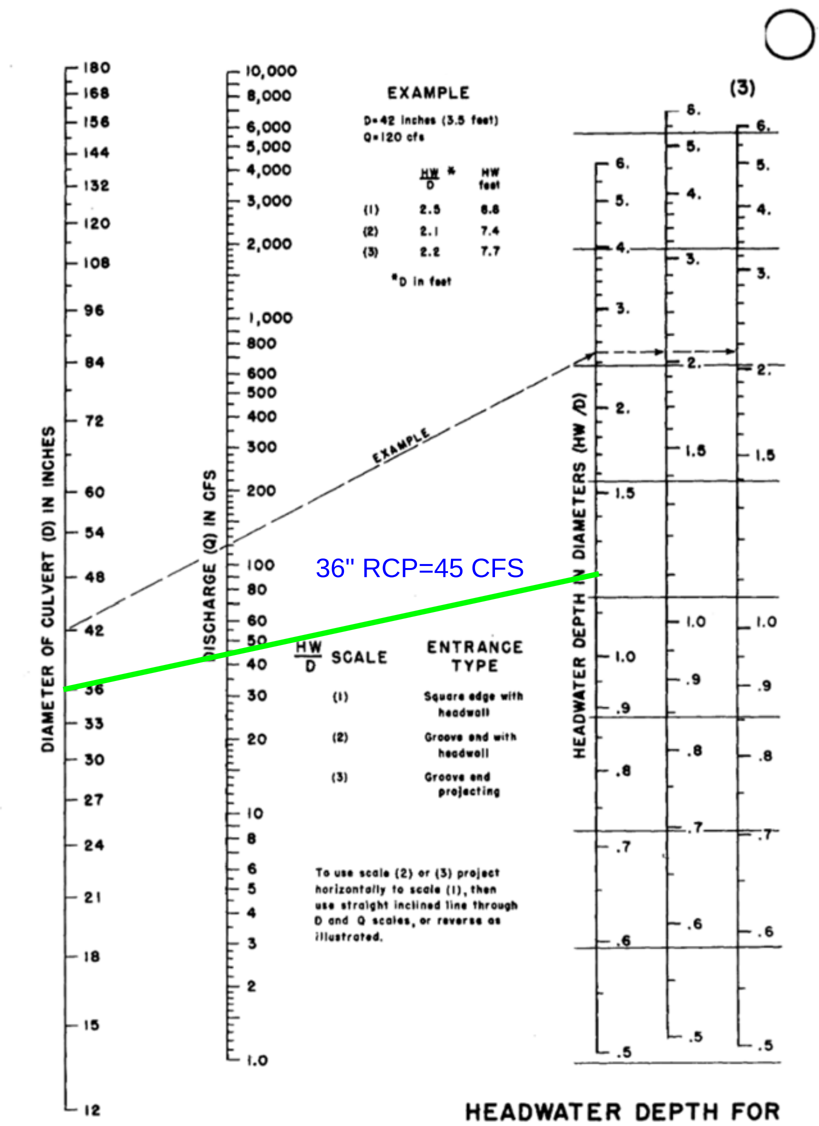
Section Data		
Discharge:	0.68	ft^3/s
Headwater Elevation:	0.25	ft
Crest Elevation:	0.00	ft
Weir Coefficient:	3.20	US
Crest Length:	1.70	ft





CUTOFF WALL WITH WQ NOTCH

N.T.S



Spillway=72.6
WQCV=69.15
36" FES INV=68.9
Hw=3.7'
Hw/D=3.7/3=1.2

HEADWATER SCALES 2&3
REVISED MAY 1964

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

DETENTION VOLUME CALCULATIONS
Rational Volumetric (FAA) Method
100-Year Event

LOCATION: **STONEY BROOK - TOTAL POND NEEDED**
PROJECT NO:
COMPUTATIONS BY:
DATE: 9/14/2020

Equations:				
	Area trib. to pond =	*100.5*	acre
Developed flow = Q_D = CIA	C (100) =	*0.62*	
Vol. In = Vi = T C I A = T Q_D	Developed C A =	62.3	acre
Vol. Out = Vo =K Q_{PO} T	**Release rate, Q_{PO} =**	***45.00***	**cfs**
storage = S = Vi - Vo	K =	*1.0*	(from fig 2.1)

Rainfall intensity from City of Greeley IDF Curve

Storm Duration, T (min)	Rainfall Intensity, I (in/hr)	Q_D (cfs)	Vol. In Vi (ft^3)	Vol. Out Vo (ft^3)	Storage S (ft^3)	Storage S (ac-ft)
5	9.67	602.5	180761	13500	167261	3.84
10	7.51	467.9	280769	27000	253769	5.83
20	5.34	332.7	399282	54000	345282	7.93
30	4.40	274.2	493495	81000	412495	9.47
40	3.59	223.7	536863	108000	428863	9.85
50	3.10	193.2	579483	135000	444483	10.20
60	**2.78**	**173.2**	**623598**	**162000**	**461598**	**10.60**
70	2.47	153.9	646404	189000	457404	10.50
80	2.16	134.6	646030	216000	430030	9.87
90	1.98	123.1	664536	243000	421536	9.68
100	1.79	111.5	669209	270000	399209	9.16
110	1.65	102.5	676500	297000	379500	8.71
120	1.50	93.5	672948	324000	348948	8.01

Required Storage Volume:	**461598**	**ft^3**
	10.60	**acre-ft**

CALCULATED BY GTW
DATE 2·95 REV. 3·95
REV. 8·95
CHECKED BY

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

JOB NO. MWD 107
PROJECT STONEYBROOK
DESIGN STORM

	STREET	DESIGN POINT	DIRECT RUNOFF: AREA DESIGN	AREA (AC)	RUNOFF COEFF	t_c (MIN)	C·A (AC)	I IN/HR	Q (CFS)	TOTAL RUNOFF: t_c (MIN)	Σ(C·A) (AC)	I (IN/HR)	Q (CFS)	STREET: SLOPE (%)	STREET FLOW (CFS)	PIPE: DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE	TRAVEL TIME: LENGTH (FT)	VELOCITY (FPS)	t_t (MIN)	REMARKS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
1	HISTORIC 2-YR.																					
2			S' BROOK	76.5	0.05	72.9	3.83	0.94	3.6													
3			O-A	20.7	"	31.2	1.04	1.60	1.7													
4	HISTORIC 5-YR.																					
5			S' BROOK	76.5	0.10	72.9	7.65	1.40	10.7													
6			O-A	20.7	"	31.2	2.07	2.30	4.8													
7	HISTORIC 100-YR.																					
8			S' BROOK	76.5	0.40	72.9	30.60	2.41	73.7													
9			O-A	20.7	"	31.2	8.28	4.30	35.6													
10																						
11																						

DETENTION REQUIREMENT FOR 100-YEAR STORM

A = 76.5 ACRES

C = 0.65

CA = 49.725

RELEASE RATE = $\boxed{10.7 \text{ CFS}}$

TIME MIN.	SEC.	INTENSITY	CA	INFLOW	OUTFLOW	DETENTION VOLUME
5	300	9.67	49.725	144252	3210	141042
10	600	7.51	49.725	224061	6420	217641
15	900	6.34	49.725	283731	9630	274101
20	1200	5.53	49.725	329975	12840	317135
25	1500	4.90	49.725	365479	16050	349429
30	1800	4.39	49.725	392927	19260	373667
35	2100	4.00	49.725	417690	22470	395220
40	2400	3.68	49.725	439171	25680	413491
45	2700	3.40	49.725	456476	28890	427586
50	3000	3.15	49.725	469901	32100	437801
55	3300	2.94	49.725	482432	35310	447122
60	3600	2.78	49.725	497648	38520	459128
70	4200	2.49	49.725	520024	44940	475084
80	4800	2.23	49.725	532256	51360	480896
90	5400	2.00	49.725	537030	57780	479250
100	6000	1.80	49.725	537030	64200	472830
110	6600	1.63	49.725	534942	70620	464322
120	7200	1.50	49.725	537030	77040	459990

REQUIRED VOLUME = 480896 CU.FT. = 11.04 AC.FT.

B-4a

RETENTION REQUIREMENT FOR 100-YEAR STORM

A = 76.5 ACRES

C = 0.65

CA = 49.725

RELEASE RATE = 0 CFS

TIME MIN.	SEC.	INTENSITY	CA	INFLOW	OUTFLOW	DETENTION VOLUME
5	300	9.67	49.725	144252	0	144252
10	600	7.51	49.725	224061	0	224061
15	900	6.34	49.725	283731	0	283731
20	1200	5.53	49.725	329975	0	329975
25	1500	4.90	49.725	365479	0	365479
30	1800	4.39	49.725	392927	0	392927
35	2100	4.00	49.725	417690	0	417690
40	2400	3.68	49.725	439171	0	439171
45	2700	3.40	49.725	456476	0	456476
50	3000	3.15	49.725	469901	0	469901
55	3300	2.94	49.725	482432	0	482432
60	3600	2.78	49.725	497648	0	497648
70	4200	2.49	49.725	520024	0	520024
80	4800	2.23	49.725	532256	0	532256
90	5400	2.00	49.725	537030	0	537030
100	6000	1.80	49.725	537030	0	537030
110	6600	1.63	49.725	534942	0	534942
120	7200	1.50	49.725	537030	0	537030

REQUIRED VOLUME = 537030 CU.FT. = 12.33 AC.FT. ✓

B-4b

PROJECT: STONEYBROOK DETENTION POND DATE: 8-25-95 100-YR STORM

PLANIMETER FACTOR: 1.00
HORIZONTAL SCALE: 20.00
VERT/HORZ SCALE: 20.00

STA/ELEV	PLANIMETER	SQ. INCHES	SQ. FEET	CU. FEET	CU. YARDS
4666.03	343.37	343.37	137348.00		
				140399.68	5199.99
4667.00	380.66	380.66	152264.00		
				157199.89	5822.22
4668.00	405.47	405.47	162188.00		
				167367.01	6198.78
4669.00	431.50	431.50	172600.00		
				17316.97	641.37
4669.10	434.35	434.35	173740.00		
				0.00	0.00
4669.10	0.00	0.00	0.00		
				0.00	0.00
	0.00	0.00	0.00		
				0.00	0.00
		0.00	0.00		
				0.00	0.00
		0.00	0.00		
				0.00	0.00
		0.00	0.00		
				0.00	0.00
		0.00	0.00		
				0.00	0.00
		0.00	0.00		
				0.00	0.00
		0.00	0.00		
				0.00	0.00
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				0.00	0.00
		0.00	0.00		
				0.00	0.00
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				0.00	0.00
		0.00	0.00		
				0.00	0.00
		0.00	0.00		
				0.00	0.00
		0.00	0.00		
				0.00	0.00
		0.00	0.00		
				0.00	0.00
		0.00	0.00		
				0.00	0.00
		0.00	0.00		
		TOTALS:		482283.55	17862.35

100-YEAR VOLUME PROVIDED @ EL. 4669.10 = 11.07 AC.FT.

B-27a

PROJECT: STONEYBROOK RETENTION POND DATE: 9-22-95 100-YR STORM

PLANIMETER FACTOR: 1.00
HORIZONTAL SCALE: 20.00
VERT/HORZ SCALE: 20.00

STA/ELEV	PLANIMETER	SQ. INCHES	SQ. FEET	CU. FEET	CU. YARDS
4666.03	343.37	343.37	137348.00		
				140399.68	5199.99
4667.00	380.66	380.66	152264.00		
				157199.89	5822.22
4668.00	405.47	405.47	162188.00		
				167367.01	6198.78
4669.00	431.50	431.50	172600.00		
				73495.19	2722.04
4669.42	443.47	443.47	177388.00		
				0.00	0.00
4669.42	0.00	0.00	0.00		
				0.00	0.00
	0.00	0.00	0.00		
				0.00	0.00
		0.00	0.00		
				0.00	0.00
		0.00	0.00		
				0.00	0.00
		0.00	0.00		
				0.00	0.00
		0.00	0.00		
				0.00	0.00
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		0.00	0.00		
				0.00	0.00
		0.00	0.00		
				0.00	0.00
		0.00	0.00		
		TOTALS:		538461.77	19943.03

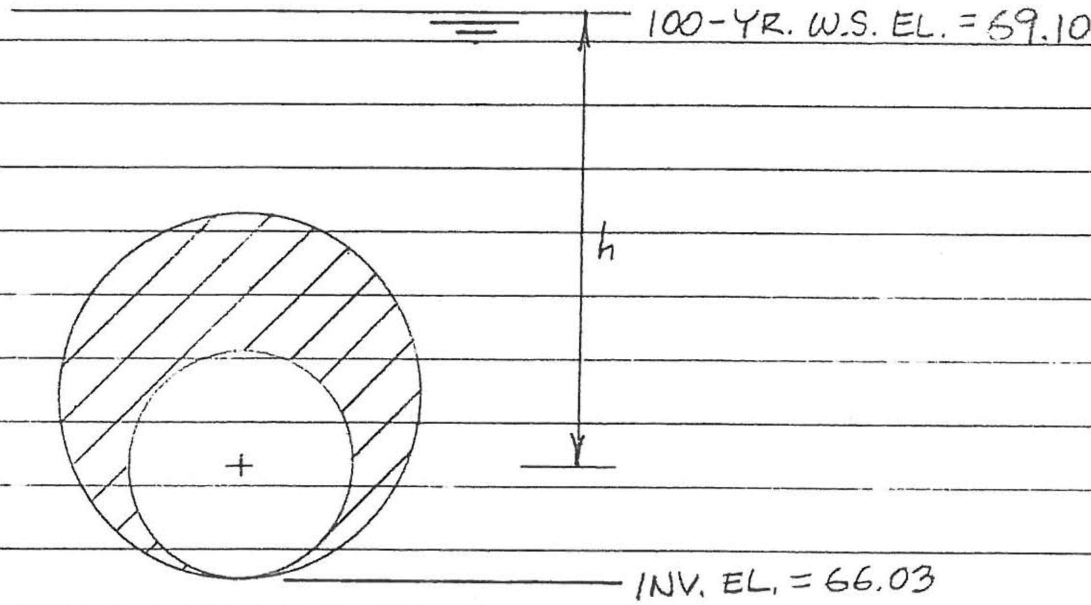
100-YEAR VOLUME PROVIDED @ EL. 4669.42 = 12.36 AC. FT.

B-276

DETERMINE DETENTION POND OUTLET SIZE

RELEASE RATE = 10.7 CFS

EXTEND EXISTING 24" CMP & INSTALL ORIFICE PLATE



FOR 15½" DIA. OPENING, A = 1.310 SQ. FT.

$h = 69.10 - (66.03 + 0.646) = 2.424$

$Q = C_d A (2gh)^{1/2}$

$Q = 0.65 (1.310)(2g \cdot 2.424)^{1/2}$

Q = 10.64 CFS OK

B-28a

DETERMINE BACKFLOW RATE THROUGH DETENTION POND OUTLET FOR PEAK 100-YEAR STORM FLOW IN GRAPEVINE DITCH

HIGH WATER ELEVATION IN GRAPEVINE DITCH @ OUTLET = 72.6 (FROM CITY OF GREELEY)

100-YR. WATER SURFACE ELEVATION IN DETENTION POND = 69.1

$\Delta h = 72.6 - 69.1 = 3.5$ FT.

$Q = C_d A (2g\Delta h)^{1/2}$

$Q = 0.65(1.310)(2g \cdot 3.5)^{1/2}$

$Q = 12.78$ CFS

B-286

DETERMINE REQUIRED EMERGENCY OVERFLOW SPILLWAY CAPACITY

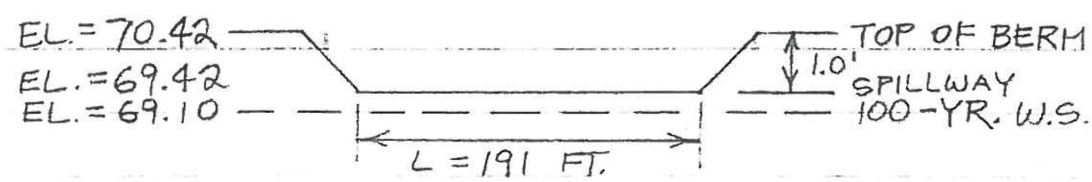
SIZE SPILLWAY FOR (1) ON-SITE 100-YEAR DEVELOPED FLOW + (2) ESTIMATED OFF-SITE FLOW FROM COUNTRY CLUB BASIN &/OR GREELEY NO. 3 DITCH + (3) BACKFLOW FROM GRAPEVINE DITCH + (4) 5-YEAR HISTORIC FLOW FROM OFF-SITE SUB-BASIN O-A (DETENTION REQ'D)

$$Q = 225.1 + 400 + 12.8 + 4.8 = 642.7 \text{ CFS}$$

DETERMINE LENGTH OF SPILLWAY

$$Q = 3.367\, L H^{3/2}$$

$$L = \frac{642.7}{3.367(1.0)^{3/2}} = 191 \text{ FT.}$$

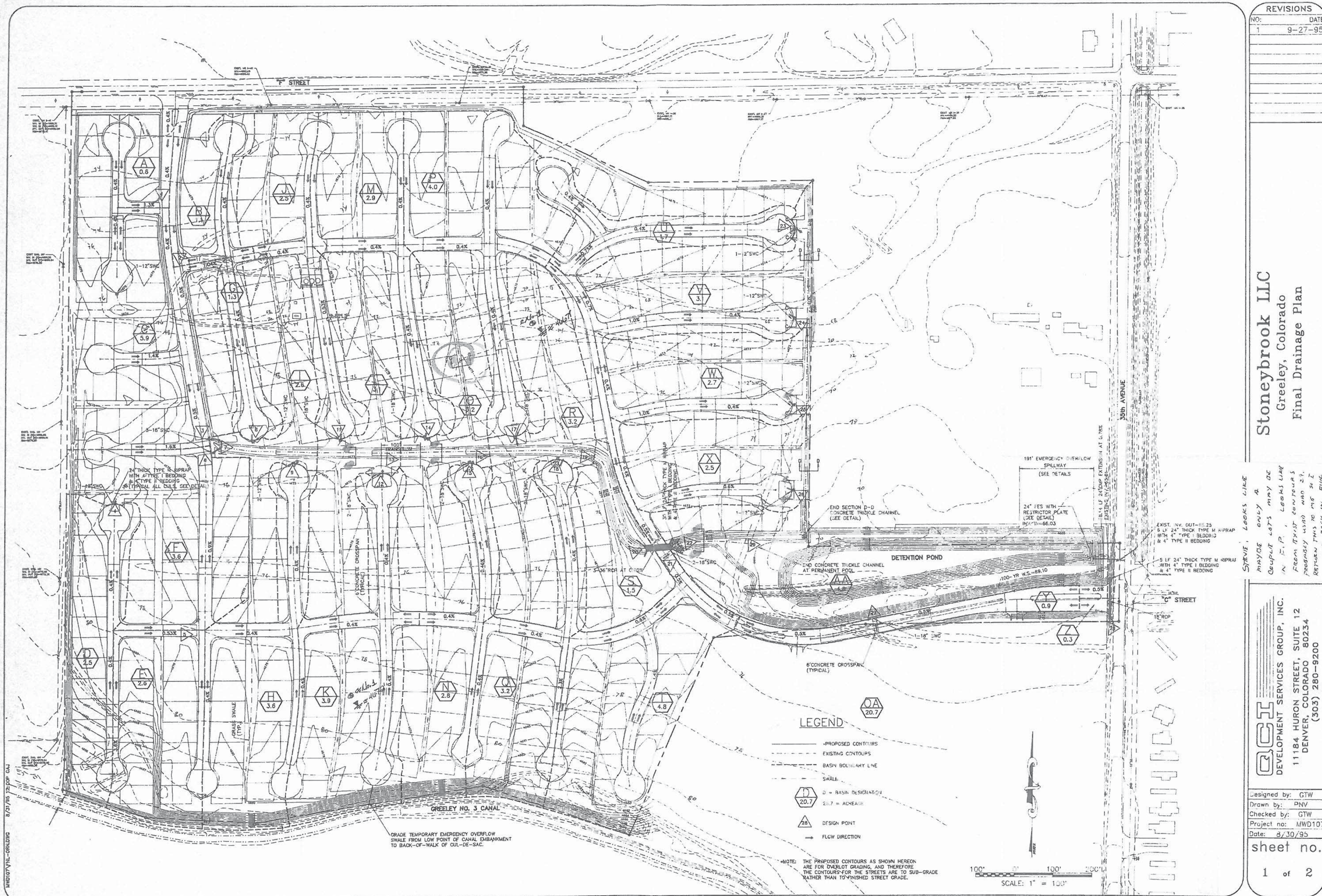


DETERMINE RIPRAP SIZE

SLOPE OF SPILLWAY = 4:1

USE BURIED TYPE M RIPRAP, 24" THICK WITH 4" OF TYPE I BEDDING & 4" OF TYPE II BEDDING

B-31


REVISIONS
NO. DATE
1 9-27-95
"F" STREET
35th AVENUE
"C" STREET
DETENTION POND
GREELEY NO. 3 CANAL
191' EMERGENCY OVERFLOW SPILLWAY (SEE DETAILS)
24" FES WITH RESTRICTOR PLATE (SEE DETAIL)
END SECTION D-D CONCRETE TRICKLE CHANNEL (SEE DETAIL)
END CONCRETE TRICKLE CHANNEL AT PERMANENT POOL
100-YR W.S.=89.10
6'CONCRETE CROSSPAN (TYPICAL)
GRASS SWALE (TYP.)
24" THICK TYPE M RIPRAP WITH 4" TYPE I BEDDING & 4" TYPE II BEDDING
GRADE TEMPORARY EMERGENCY OVERFLOW SWALE FROM LOW POINT OF CANAL EMBANKMENT TO BACK-OF-WALK OF CUL-DE-SAC.
LEGEND
*PROPOSED CONTOURS
EXISTING CONTOURS
BASIN BOUNDARY LINE
SWALE
D = BASIN DESIGNATION
20.7 = ACREAGE
DESIGN POINT
FLOW DIRECTION
*NOTE: THE PROPOSED CONTOURS AS SHOWN HEREON ARE FOR OVERLOT GRADING, AND THEREFORE THE CONTOURS FOR THE STREETS ARE TO SUB-GRADE RATHER THAN TO FINISHED STREET GRADE.
SCALE: 1" = 100'
Stoneybrook LLC
Greeley, Colorado
Final Drainage Plan
QCH DEVELOPMENT SERVICES GROUP, INC.
11184 HURON STREET, SUITE 12
DENVER, COLORADO 80234
(303) 280-9200
Designed by: GTW
Drawn by: PNV
Checked by: GTW
Project no: MWD107
Date: 8/30/95
sheet no.
1 of 2

LEGEND

- PROPERTY BOUNDARY
- EXISTING LOT LINE
- PROPOSED CURB & GUTTER
- EXISTING CURB & GUTTER
- PROPOSED SIDEWALK
- PROPOSED CONCRETE PAVEMENT
- SECTION LINE
- PROPOSED EASEMENT
- EXISTING EASEMENT
- PROPOSED 2' CONTOURS
- EXISTING 2' CONTOURS

A = BASIN DESIGNATION
B = AREA IN ACRES
C = 2 YR RUNOFF COEFFICIENT
D = 100 YR RUNOFF COEFFICIENT

- DESIGN POINT
- MAJOR DRAINAGE BASIN BOUNDARY
- DRAINAGE FLOW ARROW
- HP LP HIGH OR LOW POINT

Proposed Basin	Area (Acres)	Imperv. (%)	Design Point	Q_2 (cfs)	Q_{100} (cfs)
A1	1.22	53	1	0.85	3.39
A2	0.80	56	2	0.65	2.53
A3	2.36	54	3	1.53	6.04
A4	1.50	51	4	1.01	4.11
A5	2.64	50	5	1.59	6.52
A6	1.52	54	6	1.11	4.37
A7	1.63	54	7	1.09	4.31
A8	2.15	49	8	1.21	5.04
A9	1.49	55	9	1.15	4.49
A10	3.26	35	10	1.20	6.02
TOTAL A	**18.57**			**11.39**	**46.82**
B1	1.63	48	11	0.82	3.44
B2	0.24	2	12	0.01	0.17
TOTAL B	**1.87**			**0.83**	**3.61**
TOTAL SITE*	**20.44**			**12.22**	**50.43**
OS1	0.27	2	13	0.01	0.21
OS2	0.19	7	14	0.01	0.20
OS3	0.20	96	15	0.36	1.10

*After ROW dedication

50 0 50 100
(IN FEET)
1 inch = 50 ft.

Know what's below. Call before you dig.

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NOTICE:
CONSTRUCTION SITE SAFETY IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR; NEITHER THE OWNER NOR THE ENGINEER SHALL BE EXPECTED TO ASSUME ANY RESPONSIBILITY FOR SAFETY OF THE WORK, OF PERSONS ENGAGED IN THE WORK, OF ANY NEARBY STRUCTURES, OR OF ANY OTHER PERSONS.

ATWELL
866.850.4200 www.atwell-group.com
143 UNION BOULEVARD, SUITE 700
LAKEWOOD, CO 80228
303.462.1100

DEVELOPER
DEVELOPER ADDRESS
DEVELOPER ADDRESS
DEVELOPER ADDRESS
DEVELOPER PHONE/FAX
DEVELOPER CONTACT NAME

CLIENT
STONEYBROOK 234, LLC
STONEYBROOK LOT 4
GREELEY, COLORADO
PROPOSED DRAINAGE MAP

DATE

REVISIONS

DR. MMC CH. DEB
P.M. DEB
JOB 19004136
SHEET NO. 1 OF 1

CAD FILE: 19004136 DRAINAGE MAP.DWG

WATER QUALITY:
SNOUT INFO
FLEXSTORM® INFO
SAFL BAFFLE
POND WQCV
BIOSWALE ANALYSIS

Quick-Start Application Guide with SNOUT® to Structure Ratio (STSR) Methodology

Background:

The SNOUT system from Best Management Products, Inc. (BMP, Inc.) is based on a vented hood that can reduce floatable trash and debris, free oils, and other solids from stormwater discharges. In its most basic application, a SNOUT hood is installed over the outlet pipe of a catch basin or other stormwater quality structure which incorporates a deep sump (see Installation Drawing). The SNOUT forms a baffle in the structure which collects floatable debris and free oils on the surface of the captured stormwater, while permitting heavier solids to sink to the bottom of the sump. The clarified intermediate layer is forced out of the structure through the open bottom of the SNOUT by displacement from incoming flow. The resultant discharge contains considerably less unsightly trash and other gross pollutants, and can also offer reductions of free-oils and finer solids. What follows are basic design tips to optimize the performance of SNOUT systems.

Design Recommendations for Site:

- Establish SNOUT to Structure Ratio (***STSR***) for site as follows:

Heavy Traffic and Pollutant Loading Applications (STSR 1:1): This includes gas stations, convenience stores, fast food restaurants, vehicle repair facilities, stores with "drive through" service (e.g. banks, drug stores, dry cleaners, coffee shops), loading docks, distribution facilities, marinas, hospitals, transportation terminals (air, bus, train, sea, shipping), school bus loading areas, maintenance facilities, light industrial sites, waste disposal facilities or "dumpster areas", parking and roadway areas of shopping centers close to the stores, etc. <u>In "Heavy Traffic and Pollutant Load" areas a SNOUT in every structure is indicated (STSR 1:1).</u> The exception will be where an inlet can not be maintained. In this case, and where additional treatment is desired, non-inlet polishing structures can be added to the drainage network prior to discharge (e.g. with a cover not a grate thus it receives no surface flow). An oil absorbing boom may also be deployed in structures that will receive heavy hydrocarbon loading and flow deflectors may be added to a polishing structure to increase solids removals.

Moderate Traffic and Pollutant Loading Applications (STSR 1:2): This includes office buildings, multi-residential complexes, schools (other than bus areas), most shopping mall parking areas, mixed retail commercial facilities, municipal/government buildings, athletic/entertainment/recreational facilities, non-fast food restaurants, special event/remote parking areas, etc. In "Moderate Traffic and Pollutant Load" areas a SNOUT in at least every other structure is indicated (STSR 1:2). The downstream structures (prior to discharge) are most critical, and oil absorbing booms may be useful if heavier hydrocarbon loading is expected. Flow deflectors may be employed in a polishing structure to increase solids separation.

Low Traffic and Pollutant Loading Applications (STSR 1:3): This includes grassy or vegetated areas, single family residences, parks*, parking for offices within residences, flow excess from permeable paving areas, etc. In Low Traffic and Pollutant Load areas one SNOUT in every three structures may be adequate (STSR 1:3). The need for oil booms or flow deflectors is unlikely as such a need would indicate a Moderate or Heavy Pollutant load scenario.

** If discharge in a park setting is to a "high-value" water body, additional treatment may be indicated even if it is otherwise defined as a low traffic low load area.*

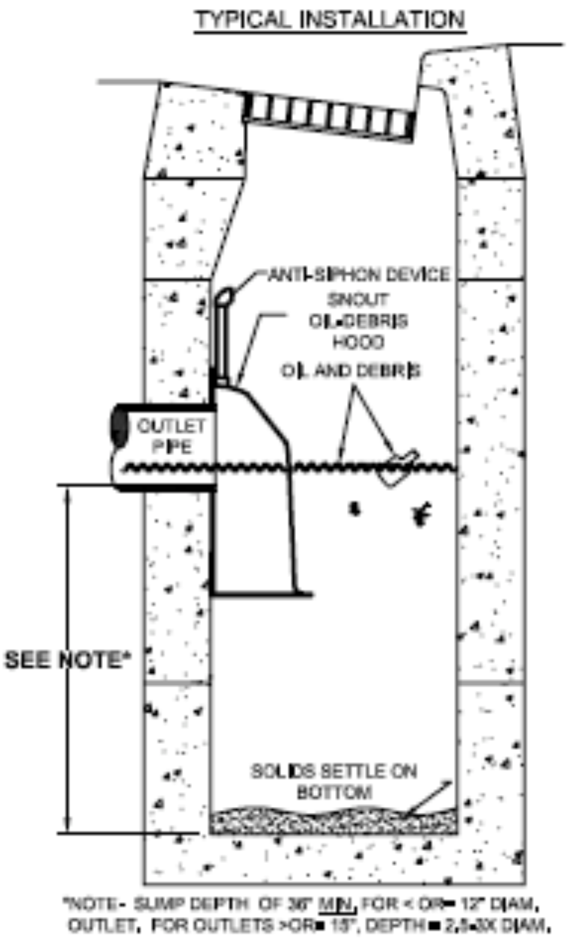
STSR Note: A large site may have different STSR areas, just like it may have different runoff coefficients. For instance, a shopping mall may have an STSR of 1:1 in heavy traffic roadways and loading/unloading areas, but may have a STSR 1:2 in a remote parking area. Therefore apply the appropriate STSR to each area of the site to arrive at the total number of SNOUT equipped structures for the project.

Design Recommendations for Individual Structures:

- ❖ The SNOUT size will always be bigger than the nominal pipe size as the SNOUT must over the pipe OD (e.g. use an 18" SNOUT for 12" pipe).
- ❖ As a rule of thumb, BMP, Inc. recommends *minimum* sump depths based on outlet pipe inside diameters of 2.5 to 3 times the outlet pipe size. (Special Note for Smaller Pipes: A minimum sump depth of 36 inches for all pipe sizes 12 inches ID or less, and 48 inches for pipe 15-18 inches ID is required if collection of finer solids is desired.)
- ❖ The plan dimension of the structure should be up to 6 to 7 times the flow area of the outlet pipe.
- ❖ Bio-Skirts (for hydrocarbon and bacteria reduction in any structure) and flow deflectors (for settleable solids in a final polishing structure) can increase pollutant removals. Bio-Skirts are highly recommended for gas or vehicle service stations, convenience stores, restaurants, loading docks, marinas, or high traffic applications. Bio-Skirts are most effective when used in conjunction with a SNOUT.
- ❖ The "R" series SNOUTs are available for round manhole type structures of up to 72" ID with pipes up to 50" OD; the "F" series SNOUTs are available for flat walled box type structures for pipes up to 94" OD; the "NP" series SNOUTs are available for PVC Nyloplast® type structures up to 30" ID.

Further structural design guidelines including CAD drawings, hydraulic spreadsheets, and site inspection and maintenance field reports and installation inspection sheets are available from BMP, Inc.

<u>APPLICATION DRAWINGS:</u>



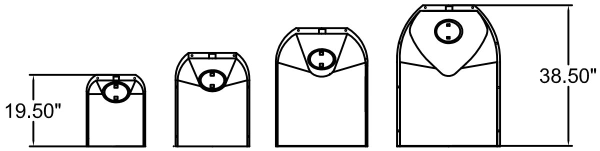
Contact Information:

Please contact us if we can offer further assistance. 53 Mt. Archer Rd. Lyme, CT 06371. Technical Assistance: T. J. Mullen (800-504-8008, tjm@bmpinc.com) or Lee Duran (888-434-0277). Website: www.bmpinc.com

The SNOUT® is protected by:

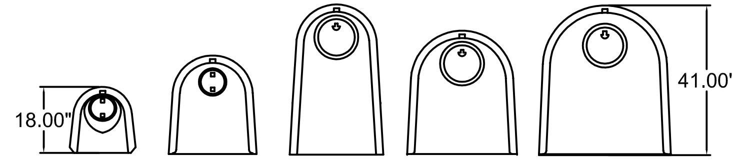
US PATENT # 6126817 CANADIAN PATENT # 2285146
SNOUT® is a registered trademark of Best Management Products, Inc.
Nyloplast® is a registered trademark of ADS Structures, Inc.

NYLOPLAST SNOUTS FOR PVC STRUCTURES

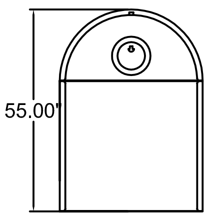


NP1218 NP1524 NP1830 NP2430

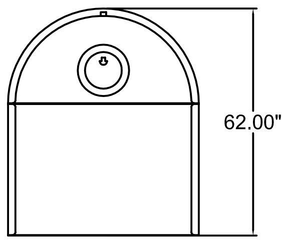
SNOUT RELATIVE SIZE COMPARISON



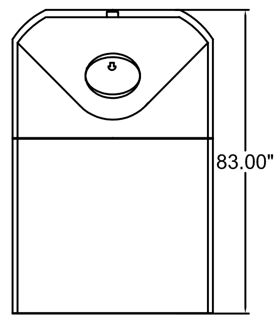
12" F or R* SERIES | 18" F or R* SERIES | 18R10XD R ONLY EXTRA DEEP | 24" F or R* SERIES | 30" F or R* SERIES



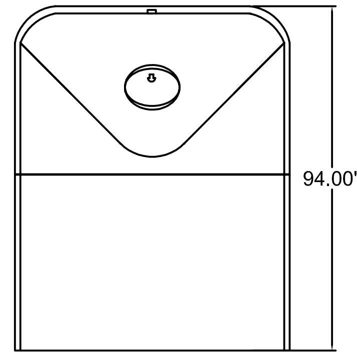
36F 2 PC
FLAT
ONLY



48F 2 PC
FLAT
ONLY



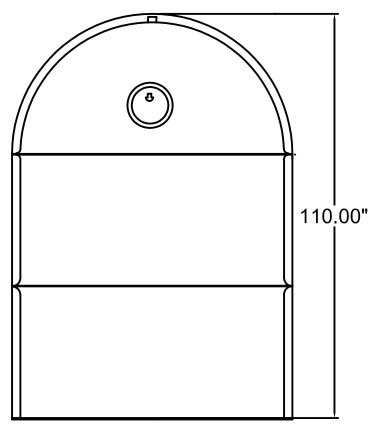
52R/72 2 PC
ROUND ONLY
(FOR 72" DIAM. STRUCTURE)



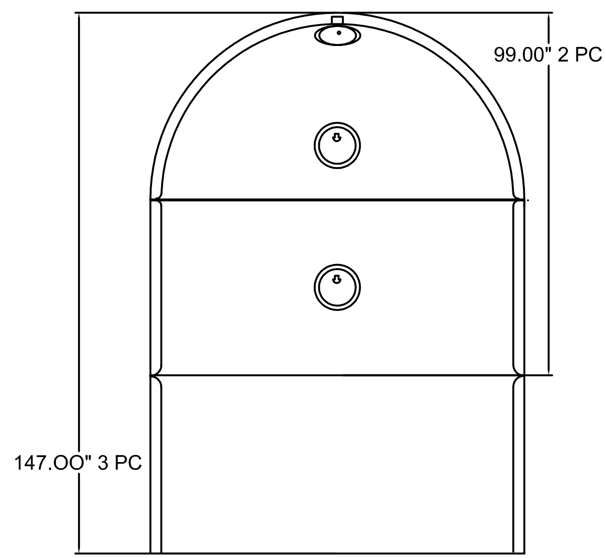
72R/96 2 PC
ROUND ONLY
(FOR 96" DIAM. STRUCTURE)

*** R SERIES STRUCTURE INSTALLATION NOTE:**
12R- FITS 36-48" DIAM.
18R- FITS 48-60" DIAM.
24R- FITS 48-60" DIAM.
30R- FITS 60-72" DIAM.
54R- FITS 72" DIAM. ONLY
72R- FITS 96" DIAM. ONLY
NP1218- FITS 18" DIAM. ONLY
NP1524- FITS 24" DIAM. ONLY
NP1830- FITS 30" DIAM. ONLY
NP2430- FITS 30" DIAM. ONLY

MAX. PIPE ID SIZE RECOMMENDATION:**
12" SNOUT- 10" PIPE; 18" SNOUT- 15" PIPE;
24" SNOUT- 18" PIPE; 30" SNOUT- 24" PIPE;
36F SNOUT- 30" PIPE; 48F SNOUT- 36" PIPE;
52R SNOUT- 42" PIPE; 72" SNOUT- 60" PIPE;
96F- 72" PIPE
***PIPE MUST ALWAYS HAVE SMALLER OD THAN NOMINAL SNOUT SIZE REGARDLESS OF PIPE ID*



72FTB 2PC
FLAT ONLY
72FTBB 3 PC



96FTB 2 PC
FLAT ONLY
96FTBB 3PC

Best Management Products, Inc.

SNOUT Oil-Water-Debris Separator

Flow Rate Worksheet

% OF SNOUT INLET AREA vs. PIPE INSIDE DIAMETER

MODEL	**12F**	**12R**	**18F**	**18R**	**24F**	**24R**	**30F**	**30R**	**36F**	**48F**	**54R**	**72F**	**96F**
(SQFT.)	*0.393*	*0.455*	*1.091*	*1.264*	*1.843*	*2.118*	*2.793*	*3.210*	*3.534*	*6.278*	*9.045*	*14.13702*	*25.132*
PIPE I.D.													
4	450.3%	521.4%	*N/O*	*N/O*	*N/O*	*N/O*	*N/O*	*N/O*	*N/O*	*N/O*	*N/O*	*N/O*	*N/O*
6	200.2%	231.7%	555.6%	643.8%	*N/O*	*N/O*	*N/O*	*N/O*	*N/O*	*N/O*	*N/O*	*N/O*	*N/O*
8	112.6%	130.3%	312.6%	362.1%	528.1%	606.8%	*N/O*	*N/O*	*N/O*	*N/O*	*N/O*	*N/O*	*N/O*
10	72.1%	83.4%	200.0%	231.8%	338.0%	388.3%	*N/O*	*N/O*	*N/O*	*N/O*	*N/O*	*N/O*	*N/O*
12	*N/A*	*N/A*	138.9%	160.9%	234.7%	269.7%	355.6%	409%	450%	*N/O*	*N/O*	*N/O*	*N/O*
15	*N/A*	*N/A*	88.9%	103.0%	150.2%	172.6%	227.6%	262%	288%	*N/O*	*N/O*	*N/O*	*N/O*
18	*N/A*	*N/A*	61.7%	71.5%	104.3%	119.9%	158.1%	182%	200%	355%		*N/O*	*N/O*
21	*N/A*	*N/A*	*N/A*	*N/A*	76.6%	88.1%	116.1%	133%	147%	261%	376%	*N/O*	*N/O*
24	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	88.9%	102%	112%	200%	288%	*N/O*	*N/O*
27	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	70.2%	81%	89%	158%	227%	*N/O*	*N/O*
30	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	56.9%	65%	72%	128%	184%	288%	*N/O*
36	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	50%	89%	128%	200%	355.5%
42	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	65%	94%	147%	261.2%
48	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	50%	72%	113%	200.0%
54	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	57%	89%	158.0%
60	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	72%	128.0%
66	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	60%	105.8%
72	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	50%	88.9%
78	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	75.7%
84	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	65.3%
90	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	56.9%

Use "F" for flat back SNOUT in rectangular structure
Use "R" for round back SNOUT in cylindrical structure

VALUE%	=> Marginal Sizing
N/A	=> Not Applicable
N/O	=> Not Optimal

BMP, Inc.	
Phone:	(800) 504-8008
Fax:	(410) 687-6757
Website:	www.bmpinc.com
Email:	tjm@bmpinc.com

DOCUMENTED 3rd PARTY PERFORMANCE:

Performance measured in multiple catch basins with SNOUT (drop inlets) over 2 year period in Peekskill, NY (Dutchess County) with flow to Peekskill Lake. Mean TSS removals of 53% were recorded.[1]

Monitoring in Lower Makefield Twp., PA (Bucks County) with flow to Core Creek/ Lake Luxemburg of 9 SNOUT drop inlets show minimum TSS removals of 58%.[2]

Floatable Trash and Debris Removals with hooded catch basins in New York City show average litter retention of 85%.[3]

ANECDOTAL PERFORMANCE MEASUREMENTS:

Multiple in line structures can improve solids removal performance and exceed 70% TSS removals. Various sites including Bryn Mawr Regional Stormwater Facility, Bryn Mawr, PA

Removals of free oils can exceed 50%. Use of Bio-Skirts recommended for longest term retention and 80%+ removals. Various sites around North America.

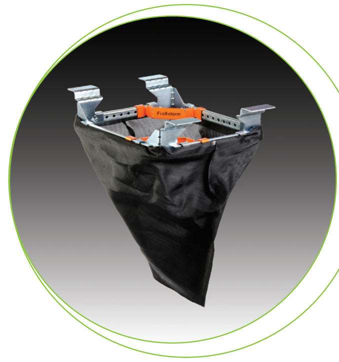
SOURCES:

1. Revised Restoration/Management Plan for Lake Luxembourg/CoreCreek Watershed, Core Creek Park, Bucks County, Pennsylvania, Project No: 121.012 PA DEP, March 2005, (Princeton Hydro for Bucks County Conservation District)

2. Structural Restoration Practices: A Collection of Successful Examples, F. Lubnow, PhD, Princeton Hydro, February 2007

3. Combined Sewer Overflow Technology Fact Sheet Floatables Control United States Environmental Protection Agency, Washington, D.C. EPA 832-F99-008, September 1999

FLEXSTORM® CATCH-IT®
REUSABLE INLET PROTECTION



SPECIFY WITH CONFIDENCE

State DOTs and Municipalities across the country now have a universal structural BMP to address the issue of storm sewer inlet protection: FLEXSTORM CATCH-IT Inlet Filters — the temporary *and* reusable solution.

The FLEXSTORM CATCH-IT system complies with ASTM D8057 Standard Specification for Inlet Filters with a Rigid Frame. FLEXSTORM CATCH-IT is the preferred choice for temporary inlet protection and storm water runoff control. CATCH-IT frames are configured to fit any drainage structure and are equipped with high-efficiency filter bags. Whether you are the specifier or the user, it's clear to see how FLEXSTORM CATCH-IT Inlet Filters outperform the competition.

APPLICATIONS:

DOT	Road Construction
Commercial	Parking Lots
Industrial	Maintenance
Residential Developments	

FEATURES:

- **Configurable:** steel frames configured and guaranteed to fit ANY storm drainage structure
- **Adjustable:** although shipped to fit your inlet, rectangular framing may be field adjusted in 1/2" increments if necessary
- **Reusable:** galvanized framing will last year after year in harsh conditions, while geotextile filter bags are easily replaced after several years of use
- **Effective:** works below grade; overflow feature allows streets to drain with full bag; third party testing results of the FX filter bag show 82%
- **Affordable:** low per-unit cost; installs in seconds; easily maintained with Universal Removal Tool (no machinery required)

BENEFITS:

- Reduce jobsite flooding and keep projects running
- Minimize residential complaints with cleaner, dryer streets during all construction phases
- Prevent hazardous road icing conditions by eliminating ponding at curb inlets
- Significantly reduce cleanup costs
- Prevent siltation and pollution of rivers, lakes, and ponds
- Helps prevent fines; NPDES PHASE II Compliant
- Lowest cost alternative for the highest level of Inlet Protection
- Available through 5,000 ADS distributors nationwide
- Ships within 48 hours

ADS Service:
ADS representatives are committed to providing you with the answers to all your questions, including selecting the proper filter, specifications, installation and more. Also try the ADS FLEXSTORM Online Product Configurator at www.inletfilters.com

FLEXSTORM CATCH-IT INLET FILTERS SPECIFICATION

IDENTIFICATION
The installer shall inspect the plans and/or worksite to determine the quantity of each drainage structure casting type. The foundry casting number, exact grate size and clear opening size, or other information will be necessary to finalize the FLEXSTORM part number and dimensions. The units are shipped to the field configured precisely to fit the identified drainage structure.

MATERIAL AND PERFORMANCE
The FLEXSTORM Inlet Filter system is comprised of a corrosion resistant steel frame and a replaceable geotextile filter bag attached to the frame with a stainless steel locking band. The filter bag hangs suspended at a distance below the grate that shall allow full water flow into the drainage structure if the bag is completely filled with sediment. The standard Woven Polypropylene FX filter bags are rated for 200 gpm/sqft with a removal efficiency of 82% when filtering a USDA Sandy Loam sediment load. CATCH-IT Inlet Filters are certified to meet the new ASTM D8057 Standard Specification for Inlet Filters with a Rigid Frame.

INSTALLATION
Remove the grate from the casting or concrete drainage structure. Clean the ledge (lip) of the casting frame or drain- age structure to ensure it is free of stone and dirt. Drop in the FLEXSTORM Inlet Filter through the clear opening and be sure the suspension hangers rest firmly on the inside ledge (lip) of the casting. Replace the grate and confirm it is elevated no more than 1/8”, which is the thickness of the steel hangers. For wall mount units, follow instructions for attaching the stainless steel mounting brackets using the provided concrete fasteners.

INSPECTION FREQUENCY
Construction site inspection should occur following each 1/2” or more rain event. Post Construction inspections should occur three times per year (every four months) in areas with mild year round rainfall and four times per year (every three months Feb–Nov) in areas with summer rains before and after the winter snowfall season. Industrial application site inspections (loading ramps, wash racks, maintenance facilities) should occur on a regularly scheduled basis no less than three times per year.

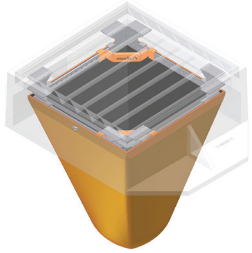
MAINTENANCE GUIDELINES
Empty the filter bag if more than half filled with sediment and debris, or as directed by the Engineer. Remove the grate, engage the lifting bars or handles with the FLEXSTORM Removal Tool, and lift from the drainage structure. Dispose of the sediment or debris as directed by the Engineer or Maintenance Contract in accordance with EPA guidelines.

As an alternative, an industrial vacuum may be used to collect the accumulated sediment. Remove any caked on silt from the sediment bag and reverse flush the bag with medium spray for optimal filtration. Replace the bag if torn or punctured to 1/2” diameter or greater on the lower half of the bag.

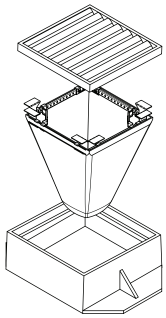
FILTER BAG REPLACEMENT
Remove the bag by loosening or cutting off the clamping band. Take the new filter bag, which is equipped with a stainless steel worm drive clamping band, and use a screw driver to tighten the bag around the frame channel. Ensure the bag is secure and that there is no slack around the perimeter of the band.

Replaceable Sediment Bag

1/8” thick steel hangers& channels; precision stampings **configured to fit each individual casting**

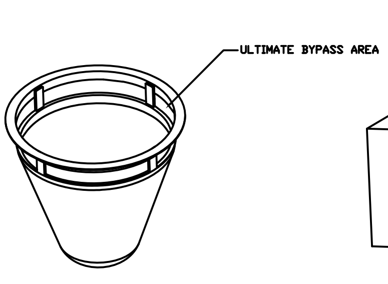


CAD drawings, work instructions and test reports on website: ***www.inletfilters.com***

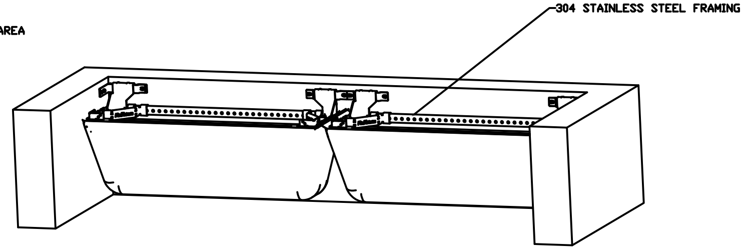


For more information on FLEXSTORM Inlet Filters and other ADS products, please contact our Customer Service Representatives at 1-800-821-6710
Try the ADS FLEXSTORM Online Product Configurator at www.inletfilters.com.

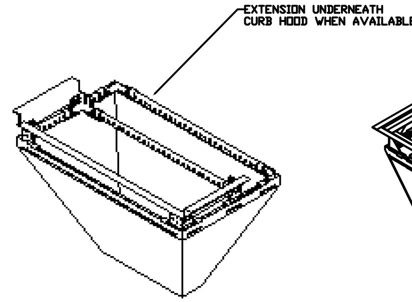
FLEXSTORM PURE FILTERS FOR PERMANENT INLET PROTECTION
PRODUCT SELECTION AND SPECIFICATION DRAWING



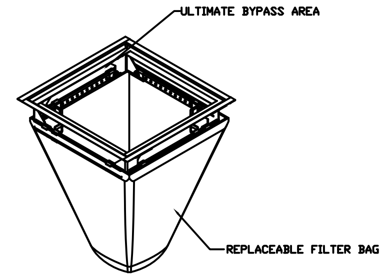
FLEXSTORM PURE INLET FILTERS
FOR ROUND OPENINGS



FLEXSTORM PURE WALL MOUNT INLET
FILTERS FOR OPEN THROAT GUTTERS



FLEXSTORM PURE INLET FILTERS
FOR COMBINATION INLETS



FLEXSTORM PURE INLET FILTERS
FOR RECTANGULAR OPENINGS
WITH GRATES

For Round Openings with Grates		Minimum Bypass Flow Rates (CFS)* Based on Nominal Frame Size with minimum 2" Bypass flow gap
Drop Thru Opening Size Dia	**Flexstorm Frame P/N**	
Small: 10.0" - 18.0"	62SHDR	1.6
Medium: 18.1" - 24.0"	62MHDR	2.7
Large: 24.1" - 36.0"	62LHDR	3.8

For Open Throat Curb Inlets - Mounted to Wall Beneath Curb Opening	
Curb Opening Size	**Flexstorm Frame P/N**
Up to 4' curb openings (1 Filter)	62HDWM1
Between 4' and 8' curb openings (2 Filters)	62HDWM2
Between 8' and 12' curb openings (3 Filters)	62HDWM3
Between 12' and 16' curb openings (4 Filters)	62HDWM4

For Rectangular/Square Openings with Grates			Minimum Bypass Flow Rates (CFS)* Based on Nominal Frame Size with minimum 2" Bypass flow gap
Clear Drop Thru Opening Size *(not grate or seat size)*	**Flexstorm Frame P/N**	**Combination P/N**	
Small: 12" x 12" up to 16" x 16" (or 64" max perimeter)	62SHD	62SHDCB	2.4
Medium: 18" x 18" up to 24" x 24" (or 96" max perimeter)	62MHD	62MHDCB	3.5
Large: 26" x 26" up to 30" x 30" (or 120" max perimeter)	62LHD	62LHDCB	5.0
XL: 32" x 32" up to 48" x 48" (or 192" max perimeter) typ 2 pc set	62XLHD	62XLHDCB	7.2

<u>CREATE YOUR ADS FLEXSTORM PART NUMBER BY COMBINING FRAME P/N AND BAG P/N</u>

1. IDENTIFY YOUR FLEXSTORM FRAME PART NUMBER FROM TABLES ABOVE
2. SELECT YOUR BAG PART NUMBER BASED ON APPLICATION NEEDS

FLEXSTORM FILTER BAGS	(22" depth) STD Bag P/N	(12" depth) Short Bag P/N	Clean Water Flow Rate (GPM/SqFt)	Min A.O.S. (US Sieve)
FX: Standard Woven Bag	FX	FX-S	200	40
FX+: Woven w/ MyCelx	FXP	FXP-S	200	40
FXO: Woven w/ Oil Boom	FXO	FXO-S	200	40
PC: Post Construction Bag	PC	PC-S	137	140
PC+: PC Bag w/ MyCelx	PCP	PCP-S	137	140
LL: Litter and Leaf Bag	LL	LL-S	High	3.5
IL: IDOT Non-Woven Bag	IL	IL-S	145	70

SPECIFICATIONS FOR STANDARD BAGS BY NOMINAL BAG / FRAME SIZE							
Nominal Bag Size *Matched to Frame Size*	Solids Storage (CuFt)	Filtered Flow Rate at 50% Max (CFS) FX (Woven)	PC (Post Constr)	IL (NonWoven)	* PC Oil Retention (Oz)	**PC+ Oil Retention (Oz)	**FX+ Oil Retention (Oz)
Small	1.6	1.2	0.8	0.9	79	168	89
Medium	2.1	1.7	1.2	1.3	115	204	89
Large	3.8	2.7	1.8	1.9	173	262	89
XL	4.2	3.6	2.4	2.6	230	319	178
Filtration Efficiency		82%	NA	Large scale 3rd party testing per ASTM D 7351 using 7% concentration USDA Sandy Loam			
TSS (total suspended solids rem)		NA	99%	Large Scale testing at 90 GPM using US Silica OK-110 sand at 1750 mg/L measuring TSS per SM 2540D.			
TPH (tot petroleum hydrocarbons)		NA	96%	Large Scale testing at 90 GPM with used motor oil at 243 mg/L measuring per EPA Method 1664A.			

* PC filter bag at 50% max adsorption capacity

** PC filter bag at 50% capacity and MyCelx skimmer at 100% capacity

3. CREATE YOUR FLEXSTORM INLET FILTER PART NUMBER

Frame P/N from Step 1.	Filter Bag P/N from Step 2.

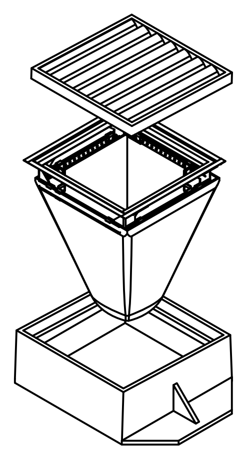
PRODUCT
#62LHDRFX

<u>NOTES:</u>

1. ALL FRAMING IS CONSTRUCTED OF 304 STAINLESS STEEL FOR 25 YEAR SERVICE LIFE RATING
2. TOTAL BYPASS CAPACITY: BYPASS CAPACITY WILL VARY WITH EACH SIZE DRAINAGE STRUCTURE. FLEXSTORM DESIGNS FRAMING BYPASS TO MEET OR EXCEED THE DESIGN FLOW OF THE PARTICULAR DRAINAGE STRUCTURE.
3. UPON ORDERING CONFIRMATION OF THE DOT CALLOUT, PRECAST OR CASTING MAKE AND MODEL, OR DETAILED DIMENSIONAL FORMS MUST BE PROVIDED TO CONFIGURE AND ASSEMBLE YOUR CUSTOMIZED FLEXSTORM INLET FILTER. PART NUMBER ALONE IS NOT SUFFICIENT.
4. FOR WRITTEN SPECIFICATIONS AND MAINTENANCE GUIDELINES VISIT WWW.INLETFILTERS.COM

<u>INSTALLATION:</u>

1. REMOVE GRATE
2. DROP FLEXSTORM INLET FILTER ONTO LOAD BEARING LIP OF CASTING OR CONCRETE STRUCTURE
3. REPLACE GRATE



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SIZE	DWG NO	REV
C	FLEXSTORM_PURE	A
SCALE		SHEET 1 OF 1

600 County Road D West, Suite 14
New Brighton, MN 55112
June 23, 2020

Erika Schneider, PE
Interwest Group
P.O. Box 18330
Boulder, CO 80308

RE: SAFL Baffle Sediment Removal for 35th Avenue Widening

Ms. Schneider:

This letter is a summary of the results of analyses of sediment removal efficiency for six proposed sump manholes with SAFL Baffles for 35th Avenue between 4th Street and F Street in Greeley, Colorado. This analysis was performed using SHSAM software by Barr Engineering.

Sediment Concentration

The sediment (TSS) removal efficiency for all six SAFL Baffles is 80%. Therefore, since the project requires TSS concentration to be 30mg/L when the stormwater leaves the site, the SAFL Baffles, sediment concentrations can be up to 150 mg/L prior to treatment from the SAFL Baffles:

$$\frac{30mg}{L}\, x\, \frac{1}{1-0.80} = 150mg/L$$

This is a reasonable sediment concentration for stormwater runoff from a street or parking lot. There is a detailed technical justification of this on Page 6 of this report.

Recommended Sump Sizes

The following tables provide the sediment removal efficiencies for various sump sizes at each structure. The recommended size is highlighted in yellow for each structure. The overall sediment removal efficiency is 80% for all of the SAFL Baffles combined. Some of the SAFL Baffles individually achieve slightly less than 80%, and some slightly more. The calculation for the site weighted average sediment removal efficiency is shown at the bottom of Page 3.

Storm Sewer layout sheets are attached to this report, along with a shop drawing for each structure. The installation/orientation of the SAFL Baffle is shown on the shop drawings.

SAFL Baffle Structure 1

Sump Diameter (feet)	*Sump Depth (feet)*	*Sediment Removal Efficiency (%)*
4	2	73.6
4	4	81.2
5	5	85.0
6	3	82.3
6	6	87.6
8	6	89.4
10	6	90.6

SAFL Baffle Structure 2

Sump Diameter (feet)	*Sump Depth (feet)*	*Sediment Removal Efficiency (%)*
4	2	56.8
4	4	69.3
5	5	75.3
6	3	71.2
6	6	79.3
8	6	82.0
10	6	83.9

SAFL Baffle Structure 3

Sump Diameter (feet)	*Sump Depth (feet)*	*Sediment Removal Efficiency (%)*
4	2	87.0
4	4	91.3
5	5	93.5
6	3	92.0
6	6	94.7
8	6	95.5
10	6	96.0

SAFL Baffle Structure 4

Sump Diameter (feet)	*Sump Depth (feet)*	*Sediment Removal Efficiency (%)*
4	2	56.3
4	4	68.9
5	5	75.0
6	3	70.9
6	6	79.2
8	6	82.0
10	6	83.9

SAFL Baffle Structure 5

Sump Diameter (feet)	*Sump Depth (feet)*	*Sediment Removal Efficiency (%)*
4	2	81.7
4	4	87.1
5	5	89.9
6	3	88.0
6	6	91.9
8	6	93.2
10	6	94.0

SAFL Baffle Structure 6

Sump Diameter (feet)	*Sump Depth (feet)*	*Sediment Removal Efficiency (%)*
4	2	84.9
4	4	89.6
5	5	92.0
6	3	90.4
6	6	93.7
8	6	94.7
10	6	95.4

Site Weighted Average Sediment Removal

The following table shows the calculation for the site weighted average sediment removal for the SAFL Baffle structures. It does not account for sediment removal from other BMP's such as bioswales.

Structure	Drainage Area (acres)	% of Total Drainage Area	Sump Depth (feet)	Sump Diameter (feet)	Sediment Removal Efficiency	Weighted Average Sediment Removal
1	0.62	10.7%	4	4	81.2%	8.7%
2	1.77	30.5%	5	5	75.3%	22.9%
3	0.48	8.3%	5	5	93.5%	7.7%
4	1.87	32.2%	5	5	75.0%	24.1%
5	0.53	9.1%	4	4	87.1%	7.9%
6	0.54	9.3%	5	5	92.0%	8.6%
Site Totals	5.81	100.0%				**80.0%**

Inputs to SHSAM Software

The SHSAM software used for this analysis was developed by Barr Engineering in Minneapolis and is based on data from several years of testing at the University of Minnesota's St. Anthony Falls Laboratory. It is available at no charge at the following website:

https://www.barr.com/WhatsNew/SHSAM/SHSAMapp.asp

The inputs used for the analysis on this project are summarized in the following table:

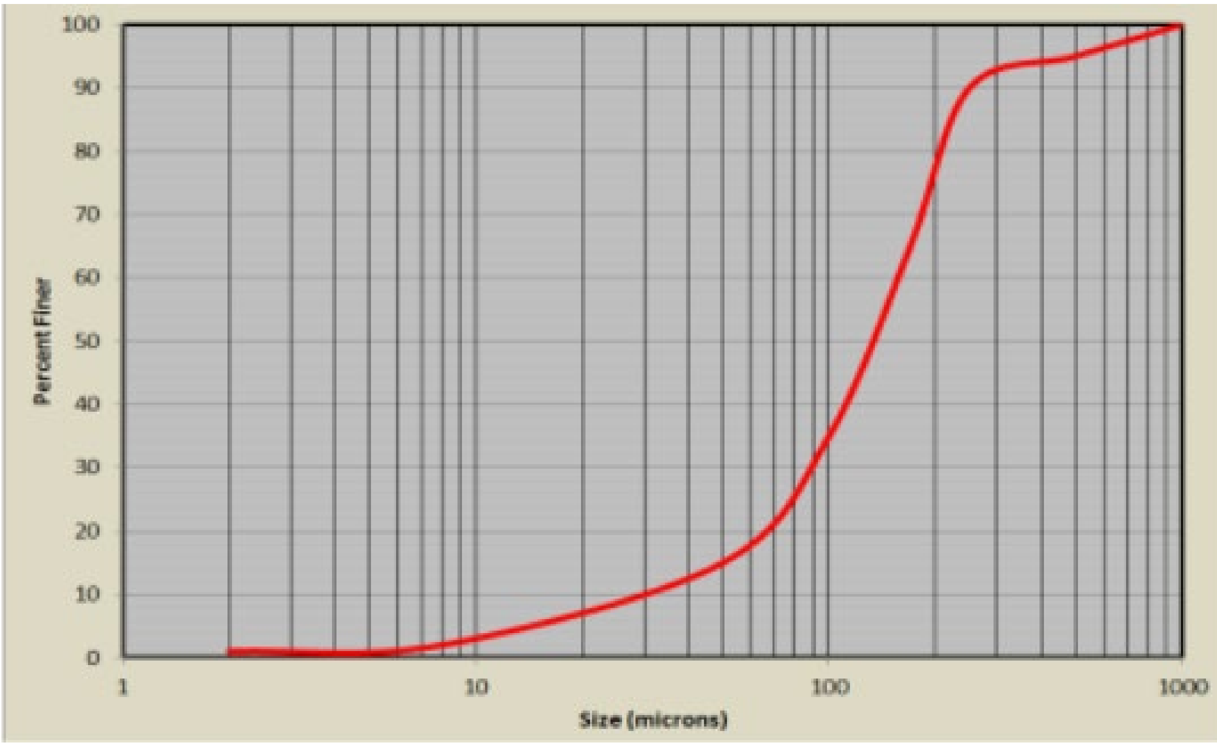
Structure	*Drain Area (acres)*	*Percent Impervious Area*	*Inlet Pipe Diameter (inches)*	*Hydraulic Length (feet)*	*Average Slope (%)*	*Curve Number*
1	0.62	89	18	300	0.5	70
2	1.77	80	24	505	0.5	70
3	0.48	75	24	270	0.5	70
4	1.87	83	18	520	0.5	70
5	0.53	18	18	270	0.5	70
6	0.54	86	24	270	0.5	70

The analysis used NOAA 15 minute precipitation files from a weather station in Fort Collins, Colorado. The precipitation data was continuous from 1975 to 2014. Sediment concentration was set at 250 mg/L. SHSAM uses a continuous rainfall model that calculates the TSS removal efficiency for each storm event over the entire analysis period. It then calculates an average annual TSS removal efficiency.

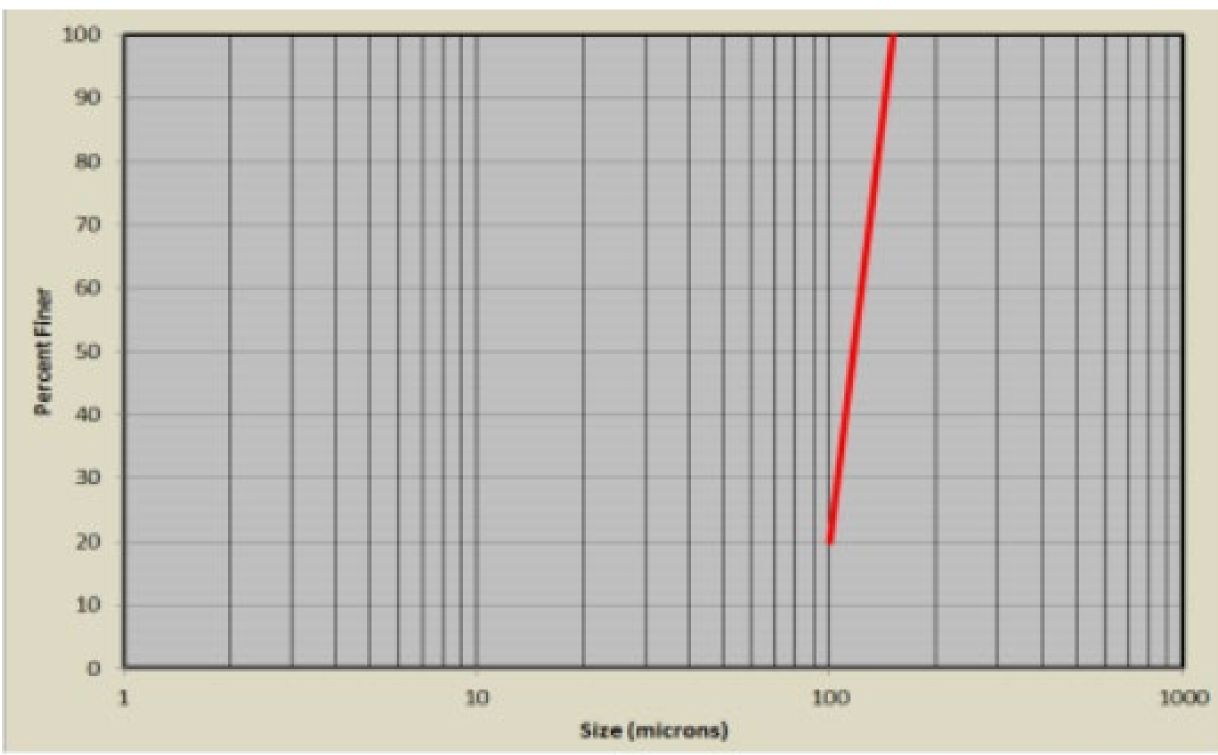
Average annual TSS removal efficiencies were calculated for two separate particle size distributions that represent the typical range found in stormwater runoff from paved areas. The results for both particle size distributions were averaged, and this average is reported in the tables on Pages 2 and 3. The sediment particle size distributions are shown in the two figures on Page 5.

Maintenance

Maintenance of the SAFL Baffle consists of removing the captured sediment from the sump, using a vacuum truck. Use the high-pressure washer on the vacuum truck to knock off any leaves or other debris that is stuck to the SAFL Baffle. Remove the accumulated sediment when the top of the sediment is 12 inches below the bottom of the SAFL Baffle. The analysis for this site indicates that the sump will fill with sediment twice per year.



Sediment Particle Size Distribution 1



Sediment Particle Size Distribution 2

Justification of Sediment Concentration

To determine if 150 mg/L is a reasonable sediment concentration for runoff from an urban highway, we considered approaches developed by two states.

<u>Mississippi Watershed Management Organization</u>

MWMO performed a comprehensive study throughout 2018, of concentrations of various pollutants in stormwater runoff at various locations in Minneapolis. They determined that on average, the runoff from city streets contained 80mg/L of TSS. The range throughout the year was 30mg/L to 200mg/l, with the highest concentration of over 600 mg/L occurring in a snow melt event in early spring.

Runoff from rain events throughout the year rarely exceeded 150mg/L and were typically closer to the average of 80 mg/L. This is shown on Figure 15 of “Analysis of Runoff from Impervious Surfaces in Downtown Minneapolis”, which you can download here:

https://www.mwmo.org/wp-content/uploads/2019/04/MWMO-Downtown-Runoff-Final-Report-2018.pdf

Based on this research, 150 mg/L is a reasonable sediment concentration to use for runoff from streets and other paved surfaces.

<u>Washington State TAPE</u>

Washington State “Technology Assessment Protocol – Ecology” (TAPE) provides standard procedures for testing hydrodynamic separators, to determine their ability to meet Washington State requirements for removal of various pollutants. This include TSS, total phosphorus, dissolved metals, and oil. To demonstrate removal of 80% TSS, they require testing each device using an influent sediment concentration of between 100 mg/L and 200 mg/L. This is in Table 1 of the TAPE Process Overview document that can be downloaded here:

https://fortress.wa.gov/ecy/publications/documents/1810039.pdf

Since 150 mg/L is within this range, it is considered acceptable for evaluation of the SAFL Baffle as a hydrodynamic separator.

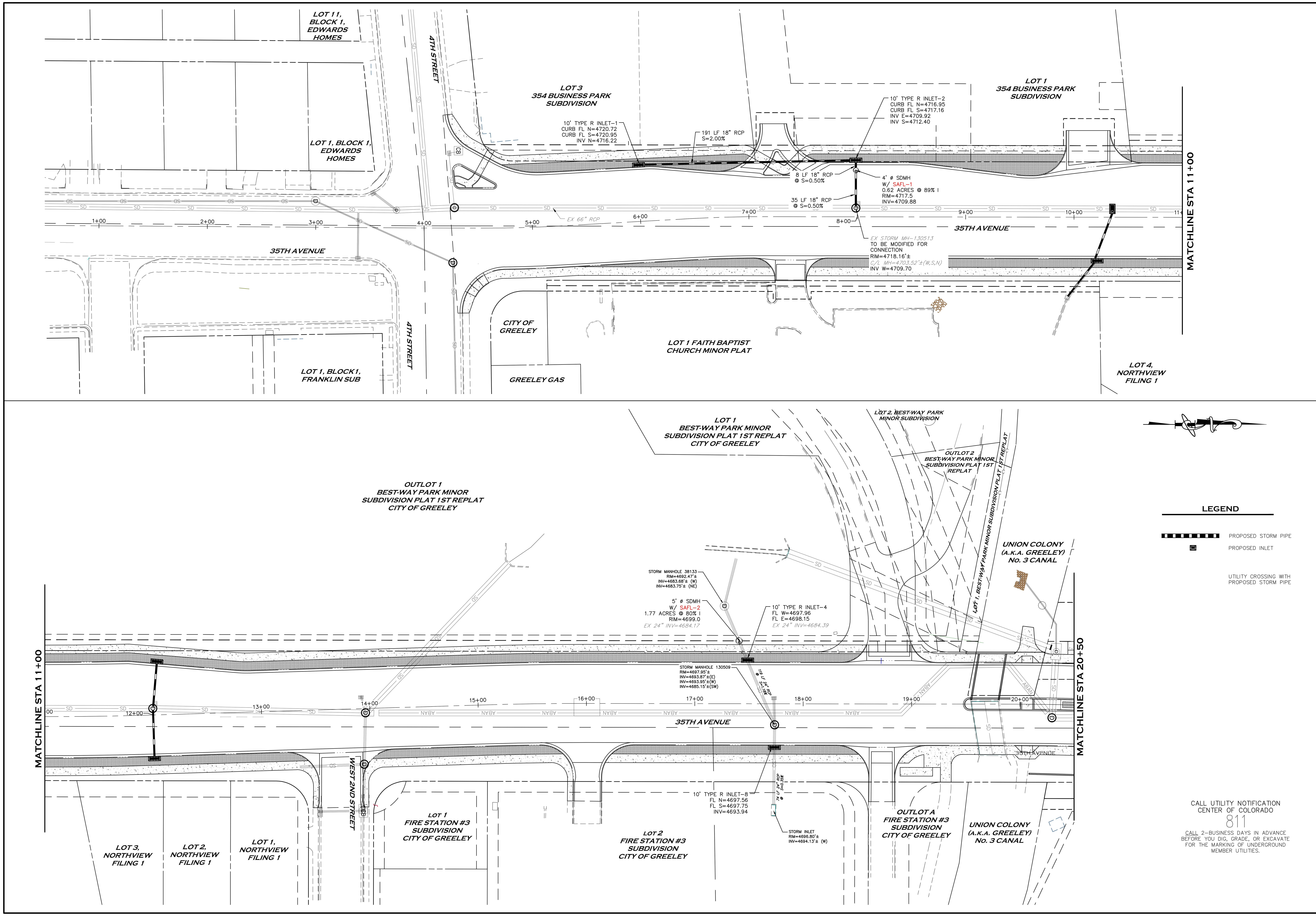
Contact Information

Please call me at 651-237-5123 if you have any questions about these recommendations or how the analysis was performed.

Sincerely,

Arthur Schwidder

A.J. Schwidder, PE
Upstream Technologies Inc.



INTERWEST CONSULTING GROUP

City of Greeley Colorado

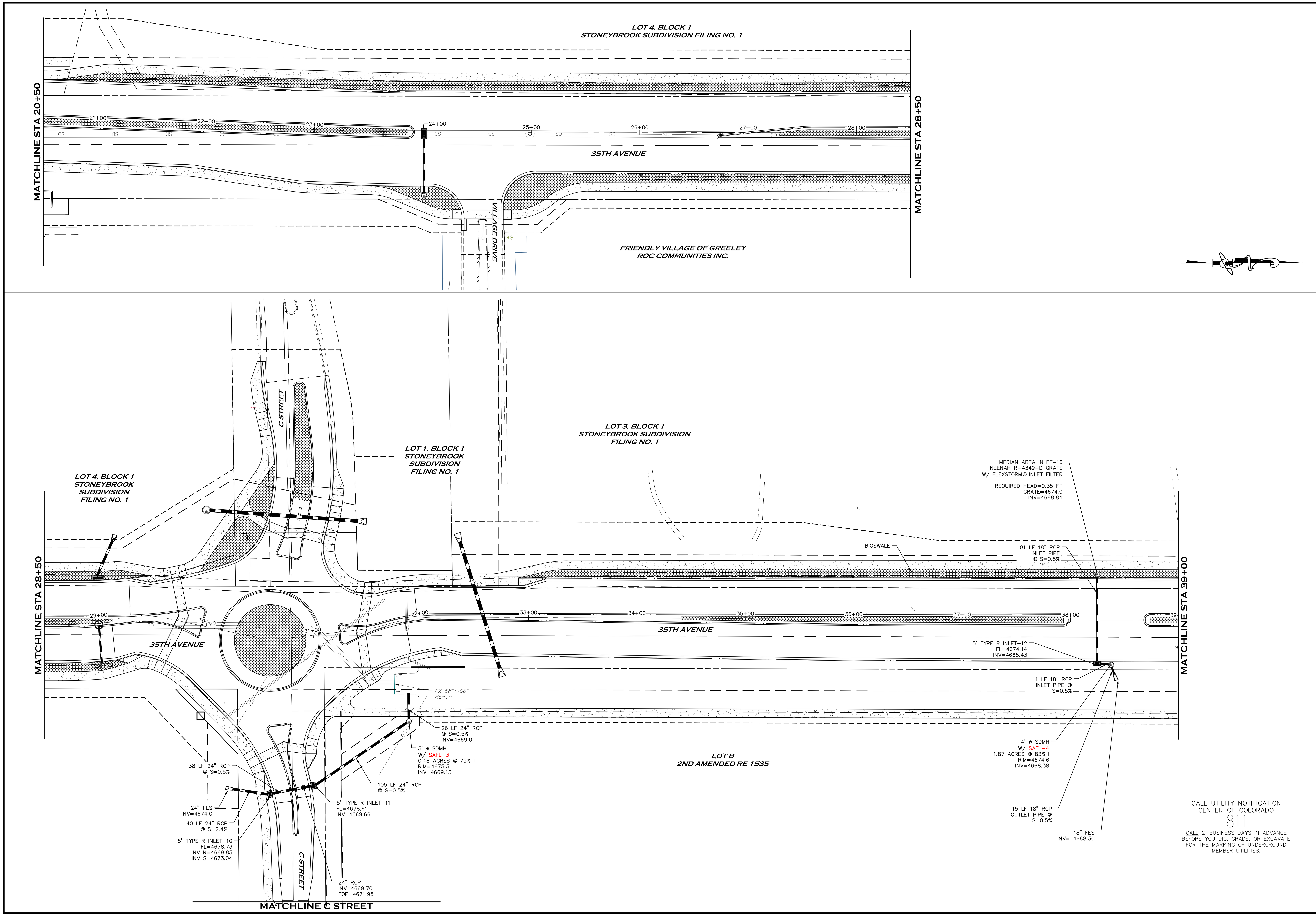
35TH AVENUE WIDENING

STORM SYSTEM PLAN

DATE: 6/17/20
SCALE (H): 1"=40'
SCALE (V): N/A
DESIGNED BY: LAJ
CHECKED BY: MPO

PROJ. NO. 1397-083-00

20 OF 32



CALL UTILITY NOTIFICATION
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CALL 2-BUSINESS DAYS IN ADVANCE
BEFORE YOU DIG, GRADE, OR EXCAVATE
FOR THE MARKING OF UNDERGROUND
MEMBER UTILITIES.

INTERWEST CONSULTING GROUP
1218 W. Ash, Suite A
Windsor, Colorado 80550
Phone: (970) 674-3300
Fax: (970) 674-3303

City of Greeley Colorado

35TH AVENUE WIDENING
STORM SYSTEM PLAN

DATE: 6/17/20
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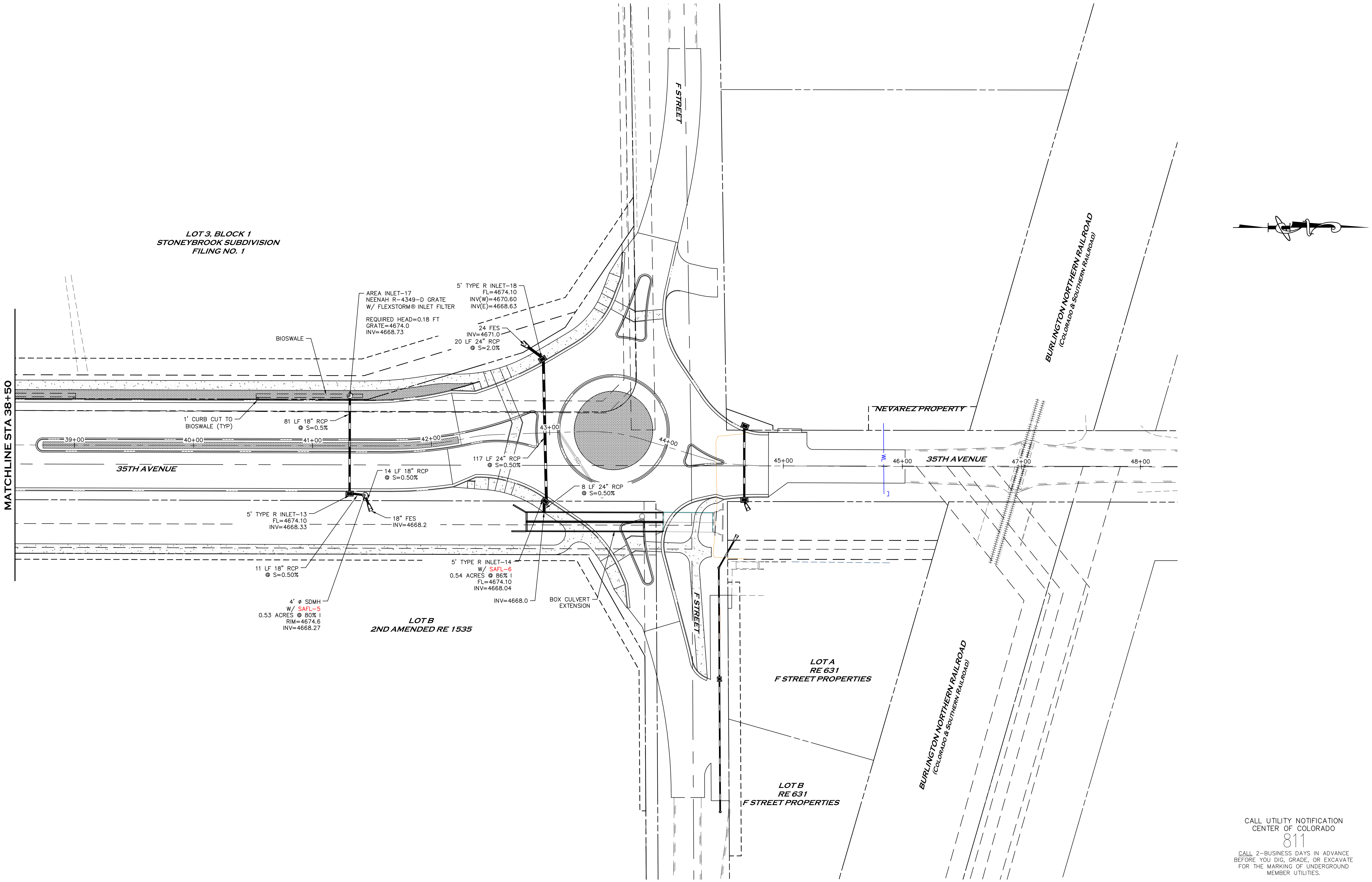
SCALE (V): N/A
DESIGNED BY: LAJ
CHECKED BY: MPO

PROJ. NO. 1397-083-00

21 OF 32



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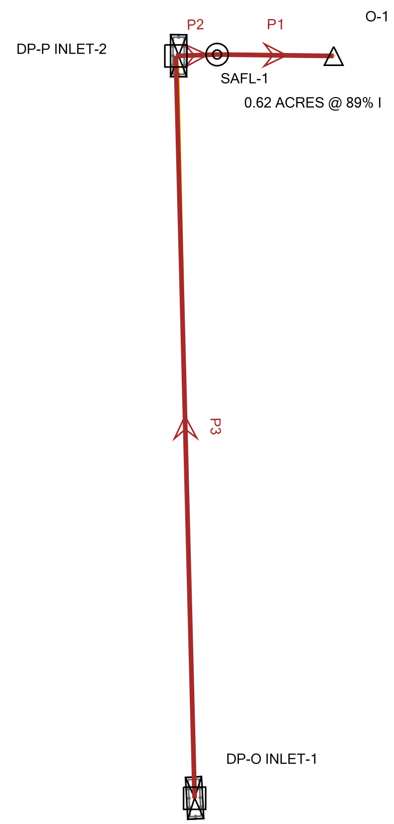
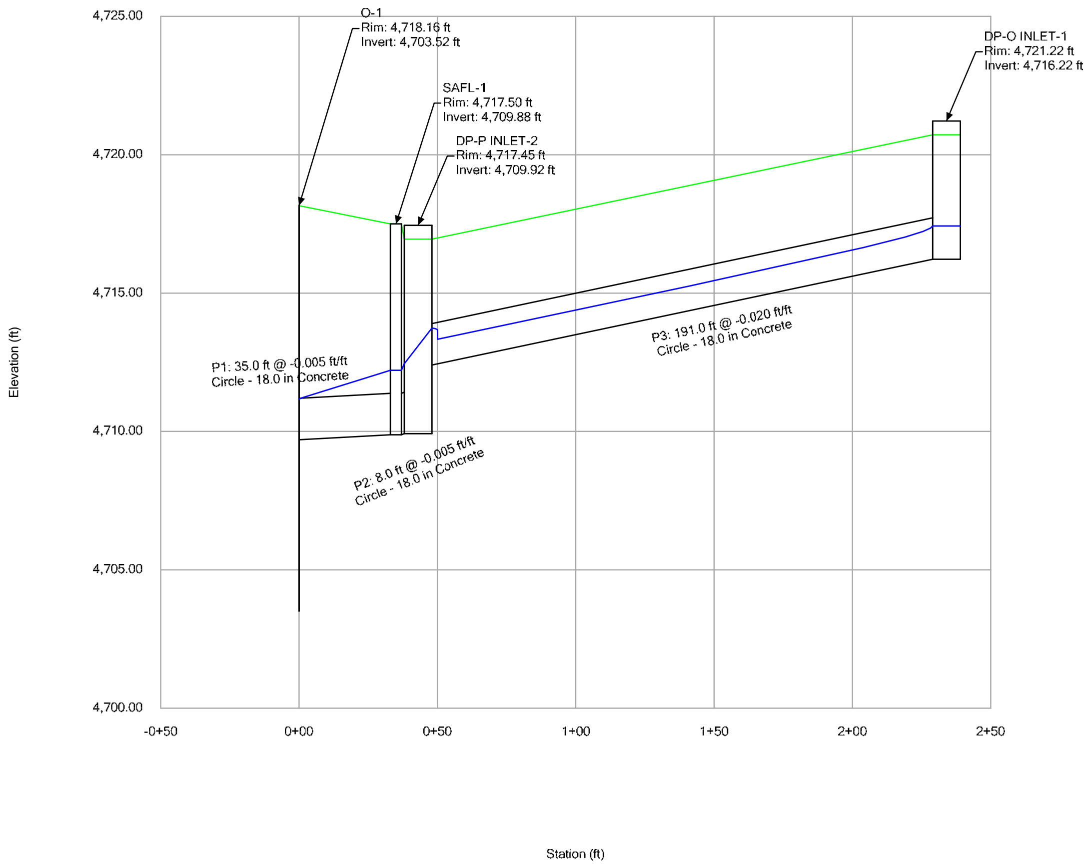
PROJ. NO. 1397-083-00

SAFL-1

Scenario: 100-yr

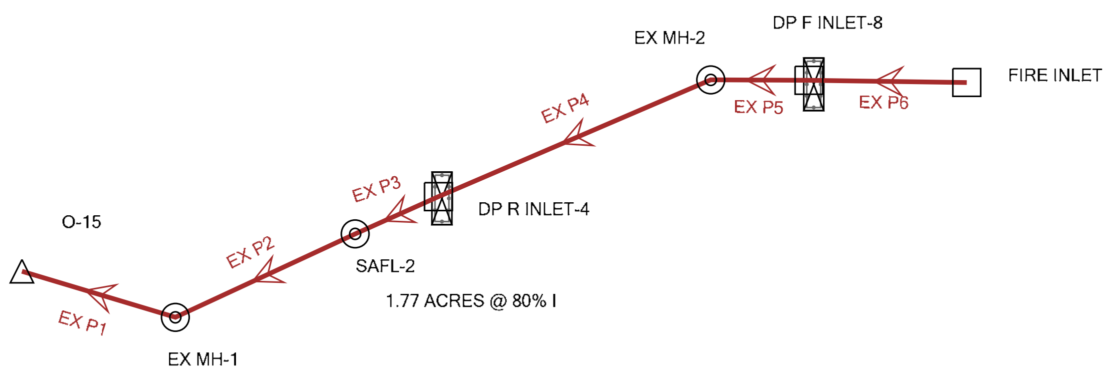


Profile Report
Engineering Profile - SAFL 1 (6-17-20 SAFL Storm.stsw)



SAFL-2

Scenario: 100-yr

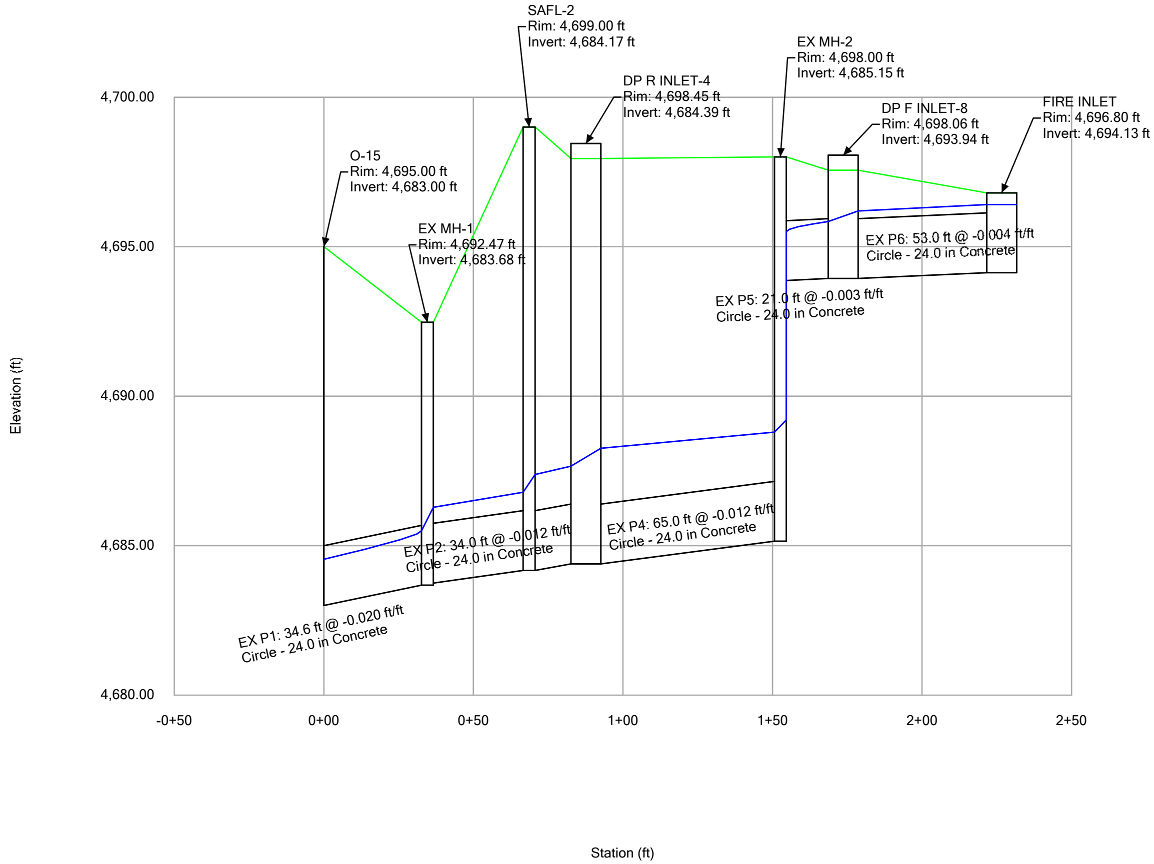


6-17-20 SAFL Storm.stsw
6/17/2020

Bentley Systems, Inc. Haestad Methods Solution Center
27 Siemon Company Drive Suite 200 W Watertown, CT 06795 USA
+1-203-755-1666

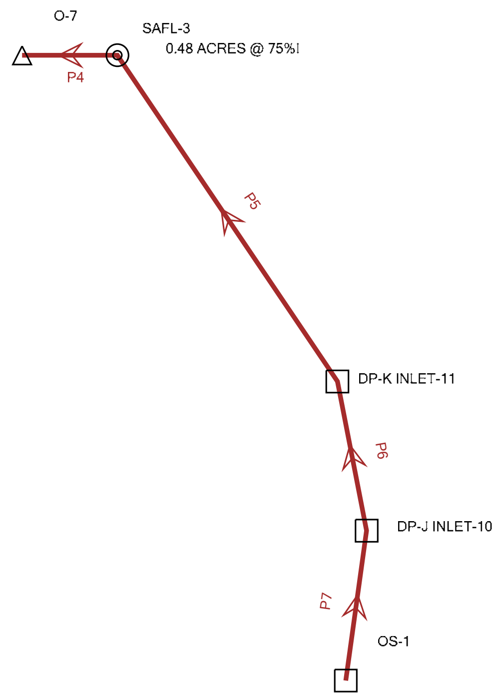
Bentley StormCAD V8i (SELECTseries 3)
[08.11.03.84]
Page 1 of 1

Profile Report
Engineering Profile - SAFL 2 (6-17-20 SAFL Storm.stsw)

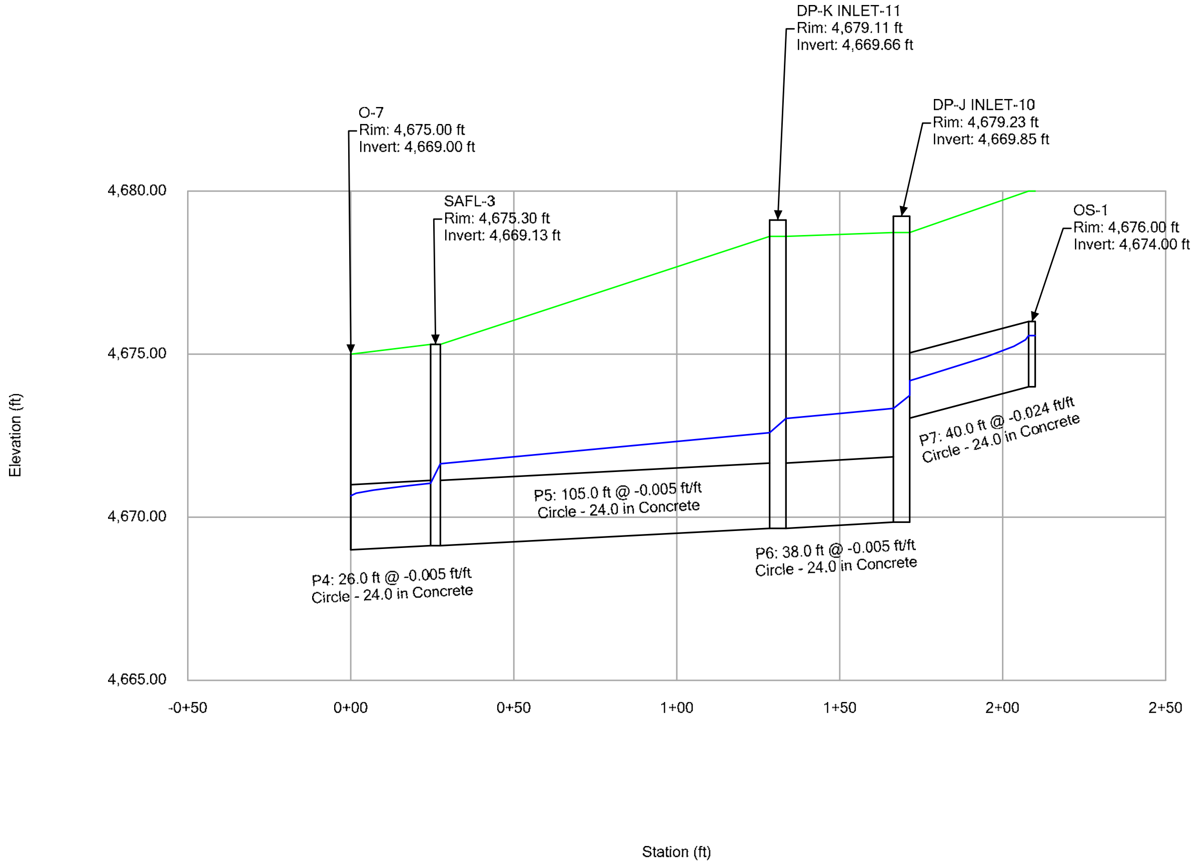


SAFL-3

Scenario: 100-yr

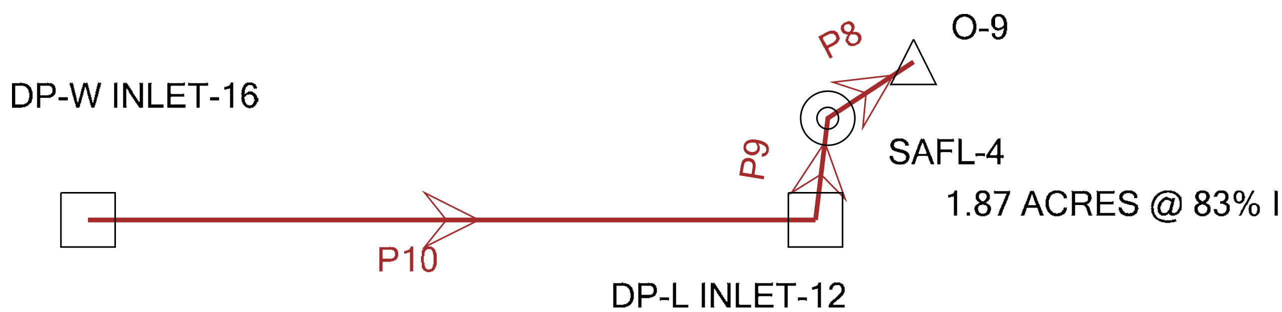


Profile Report
Engineering Profile - SAFL 3 (6-17-20 SAFL Storm.stsw)



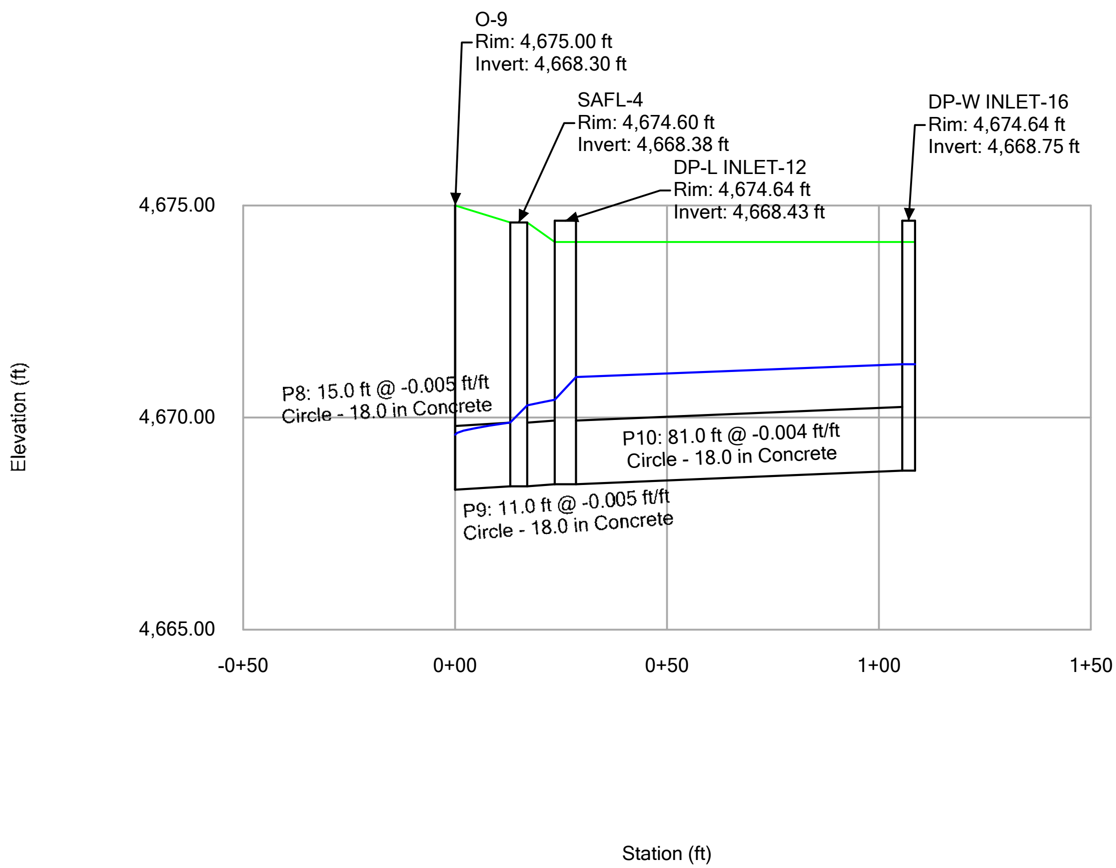
Scenario: 100-yr

SAFL-4



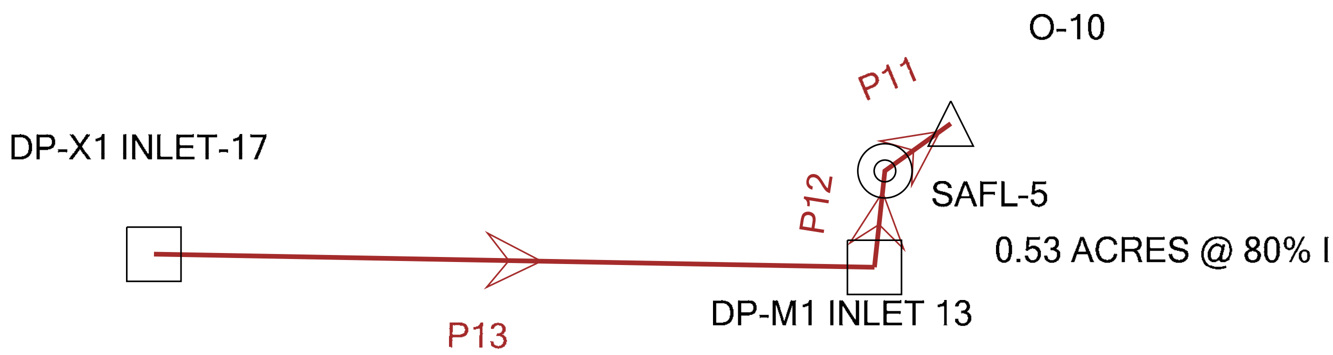
Profile Report

Engineering Profile - SAFL 4 (6-17-20 SAFL Storm.stsw)



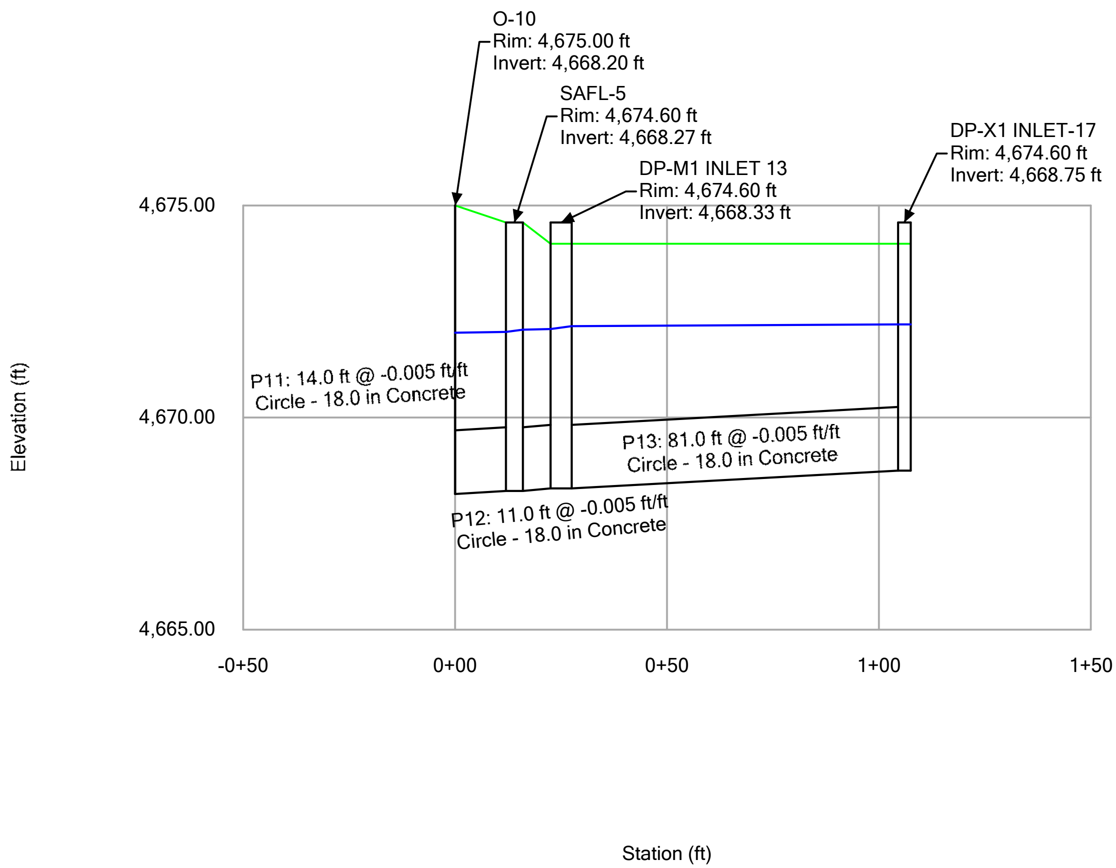
Scenario: 100-yr

SAFL-5



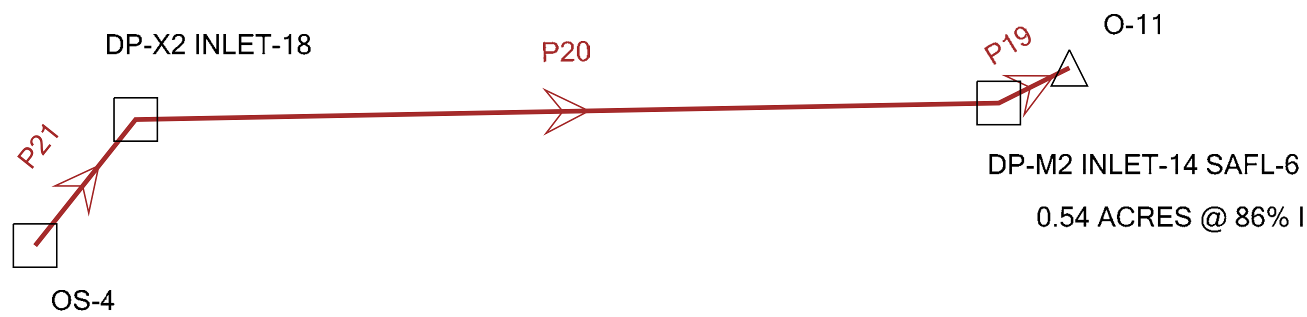
Profile Report

Engineering Profile - SAFL 5 (6-17-20 SAFL Storm.stsw)

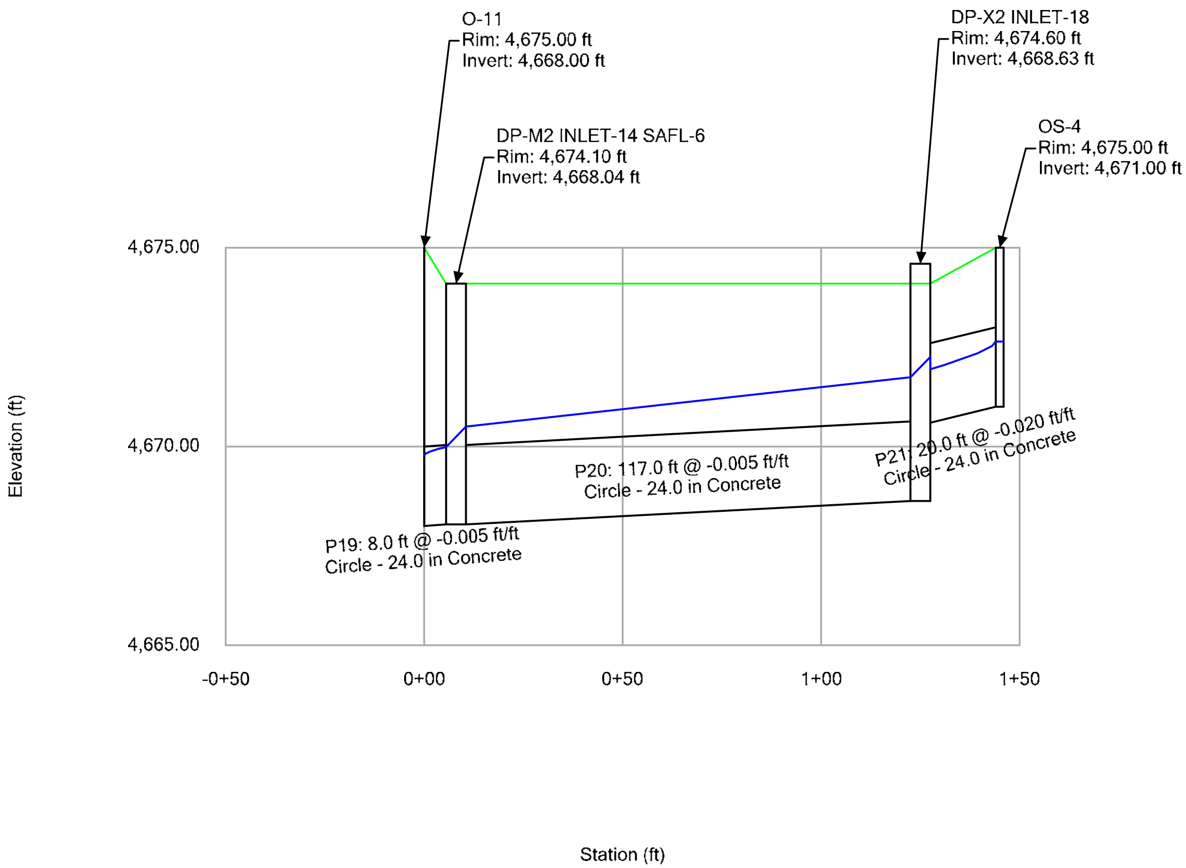


Scenario: 100-yr

SAFL-6



Profile Report
Engineering Profile - SAFL 6 (6-17-20 SAFL Storm.stsw)



Conduit FlexTable: Combined Pipe/Node Report

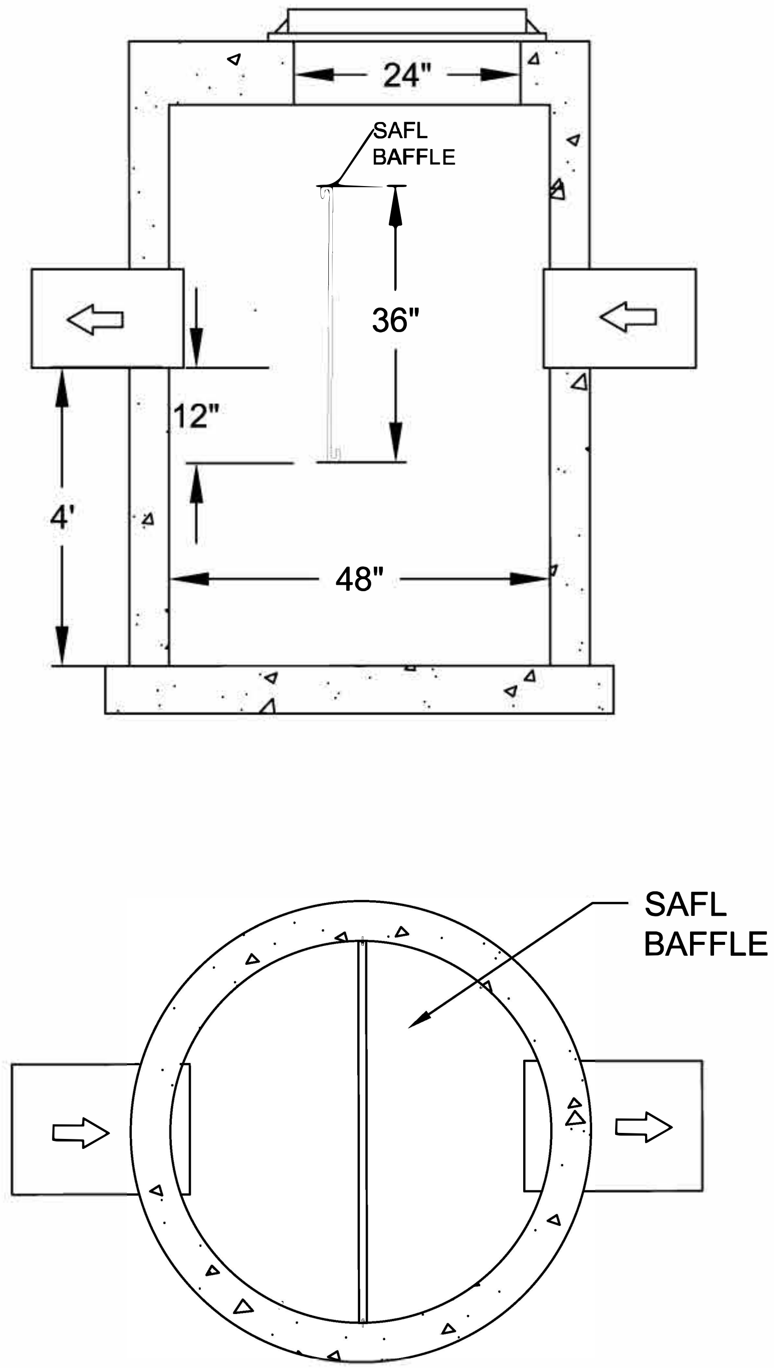
Label	Start Node	Stop Node	Length (Unified) (ft)	Material	Diameter (in)	Flow (cfs)	Velocity (ft/s)	Invert (Start) (ft)	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
EX P1	O-15	EX MH-1	34.6	Concrete	24.0	27.50	11.36	4,683.00	4,683.68	-0.020	4,685.50	4,684.54	4,686.80	4,686.28
EX P2	EX MH-1	SAFL-2	34.0	Concrete	24.0	27.50	8.75	4,683.75	4,684.17	-0.012	4,686.78	4,686.28	4,687.98	4,687.47
EX P3	SAFL-2	DP R INLET-4	19.0	Concrete	24.0	27.50	8.75	4,684.17	4,684.39	-0.012	4,687.66	4,687.38	4,688.85	4,688.57
EX P4	DP R INLET-4	EX MH-2	65.0	Concrete	24.0	20.70	6.59	4,684.39	4,685.15	-0.012	4,688.80	4,688.26	4,689.48	4,688.93
EX P5	EX MH-2	DP F INLET-8	21.0	Concrete	24.0	20.70	6.59	4,693.87	4,693.94	-0.003	4,695.84	4,695.50	4,696.54	4,696.39
EX P6	DP F INLET-8	FIRE INLET	53.0	Concrete	24.0	14.40	4.58	4,693.94	4,694.13	-0.004	4,696.41	4,696.19	4,696.73	4,696.52
P1	O-1	SAFL-1	35.0	Concrete	18.0	18.00	10.19	4,709.70	4,709.88	-0.005	4,712.21	4,711.15	4,713.82	4,712.80
P2	SAFL-1	DP-P INLET-2	8.0	Concrete	18.0	18.00	10.19	4,709.88	4,709.92	-0.005	4,712.44	4,712.21	4,714.06	4,713.82
P3	DP-P INLET-2	DP-O INLET-1	191.0	Concrete	18.0	9.80	8.98	4,712.40	4,716.22	-0.020	4,717.43	4,713.73	4,718.07	4,714.28
P4	O-7	SAFL-3	26.0	Concrete	24.0	21.50	6.84	4,669.00	4,669.13	-0.005	4,671.04	4,670.66	4,671.79	4,671.58
P5	SAFL-3	DP-K INLET-11	105.0	Concrete	24.0	21.50	6.84	4,669.13	4,669.66	-0.005	4,672.59	4,671.64	4,673.32	4,672.37
P6	DP-K INLET-11	DP-J INLET-10	38.0	Concrete	24.0	20.50	6.53	4,669.66	4,669.85	-0.005	4,673.34	4,673.03	4,674.00	4,673.69
P7	DP-J INLET-10	OS-1	40.0	Concrete	24.0	19.00	11.38	4,673.04	4,674.00	-0.024	4,675.57	4,674.19	4,676.37	4,675.80
P8	O-9	SAFL-4	15.0	Concrete	18.0	11.60	6.56	4,668.30	4,668.38	-0.005	4,669.89	4,669.60	4,670.56	4,670.39
P9	SAFL-4	DP-L INLET-12	11.0	Concrete	18.0	11.60	6.56	4,668.38	4,668.43	-0.005	4,670.42	4,670.29	4,671.09	4,670.96
P10	DP-L INLET-12	DP-W INLET-16	81.0	Concrete	18.0	6.40	3.62	4,668.43	4,668.75	-0.004	4,671.26	4,670.96	4,671.46	4,671.16
P11	O-10	SAFL-5	14.0	Concrete	18.0	4.10	2.32	4,668.20	4,668.27	-0.005	4,672.02	4,672.00	4,672.10	4,672.08
P12	SAFL-5	DP-M1 INLET 13	11.0	Concrete	18.0	4.10	2.32	4,668.27	4,668.33	-0.005	4,672.09	4,672.07	4,672.17	4,672.16
P13	DP-M1 INLET 13	DP-X1 INLET-17	81.0	Concrete	18.0	2.40	1.36	4,668.33	4,668.75	-0.005	4,672.20	4,672.16	4,672.23	4,672.18
P19	O-11	DP-M2 INLET-14 SAFL-6	8.0	Concrete	24.0	25.40	8.09	4,668.00	4,668.04	-0.005	4,669.99	4,669.77	4,671.02	4,670.93
P20	DP-M2 INLET-14 SAFL-6	DP-X2 INLET-18	117.0	Concrete	24.0	23.30	7.42	4,668.04	4,668.63	-0.005	4,671.74	4,670.50	4,672.60	4,671.36
P21	DP-X2 INLET-18	OS-4	20.0	Concrete	24.0	21.00	10.86	4,670.60	4,671.00	-0.020	4,672.64	4,672.26	4,673.54	4,673.14

FlexTable: Catch Basin Table

ID	Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Flow (Additional Carryover) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
28	DP-P INLET-2	4,716.95	4,717.45	4,709.92	8.20	4,713.73	4,712.44	4,714.28	4,714.06
29	DP-O INLET-1	4,720.72	4,721.22	4,716.22	9.80	4,717.43	4,717.43	4,718.07	4,718.07
53	OS-1	4,680.00	4,676.00	4,674.00	19.00	4,675.57	4,675.57	4,676.37	4,676.37
54	DP-J INLET-10	4,678.73	4,679.23	4,669.85	1.50	4,673.74	4,673.34	4,675.35	4,674.00
64	DP-L INLET-12	4,674.14	4,674.64	4,668.43	5.20	4,670.96	4,670.42	4,671.16	4,671.09
65	DP-W INLET-16	4,674.14	4,674.64	4,668.75	6.40	4,671.26	4,671.26	4,671.46	4,671.46
69	DP-M1 INLET 13	4,674.10	4,674.60	4,668.33	1.70	4,672.16	4,672.09	4,672.18	4,672.17
70	DP-X1 INLET-17	4,674.10	4,674.60	4,668.75	2.40	4,672.20	4,672.20	4,672.23	4,672.23
74	DP-M2 INLET-14 SAFL-6	4,674.10	4,674.10	4,668.04	2.10	4,670.50	4,669.99	4,671.36	4,671.02
75	DP-X2 INLET-18	4,674.10	4,674.60	4,668.63	2.30	4,672.26	4,671.74	4,673.14	4,672.60
76	OS-4	4,675.00	4,675.00	4,671.00	21.00	4,672.64	4,672.64	4,673.54	4,673.54
85	DP-K INLET-11	4,678.61	4,679.11	4,669.66	1.00	4,673.03	4,672.59	4,673.69	4,673.32
119	FIRE INLET	4,696.80	4,696.80	4,694.13	14.40	4,696.41	4,696.41	4,696.73	4,696.73
120	DP F INLET-8	4,697.56	4,698.06	4,693.94	6.30	4,696.19	4,695.84	4,696.52	4,696.54
121	DP R INLET-4	4,697.95	4,698.45	4,684.39	6.80	4,688.26	4,687.66	4,688.93	4,688.85

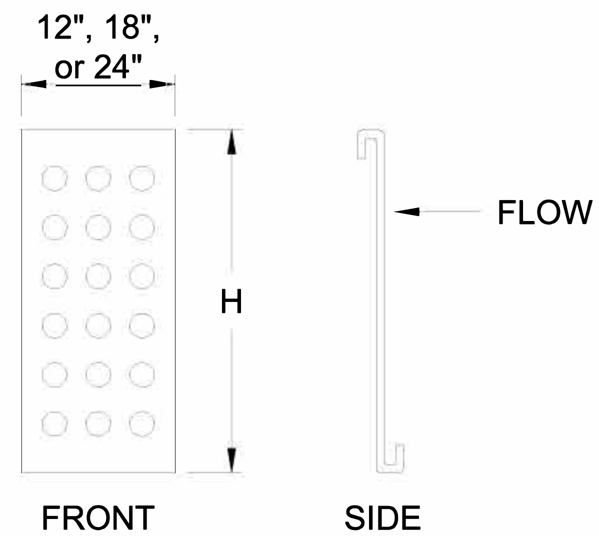
FlexTable: Manhole Table

Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
SAFL-3	4,675.30	4,675.30	4,669.13	21.50	4,671.04	4,671.64	4,672.37	4,671.79
SAFL-1	4,717.50	4,717.50	4,709.88	18.00	4,712.21	4,712.21	4,713.82	4,713.82
EX MH-2	4,698.00	4,698.00	4,685.15	20.70	4,688.80	4,689.21	4,690.09	4,689.47
SAFL-2	4,699.00	4,699.00	4,684.17	27.50	4,686.78	4,687.38	4,688.57	4,687.98
EX MH-1	4,692.47	4,692.47	4,683.68	27.50	4,685.50	4,686.28	4,687.47	4,686.80
SAFL-4	4,674.60	4,674.60	4,668.38	11.60	4,669.89	4,670.29	4,670.96	4,670.56
SAFL-5	4,674.60	4,674.60	4,668.27	4.10	4,672.02	4,672.07	4,672.15	4,672.11

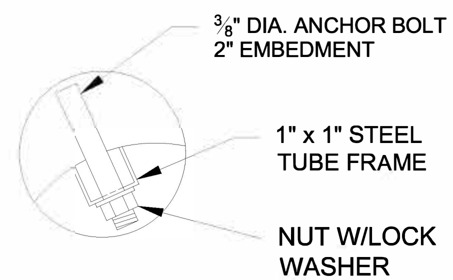


SAFL BAFFLE INSTALLATION

DETAIL (TYP)



SAFL BAFFLE PANEL

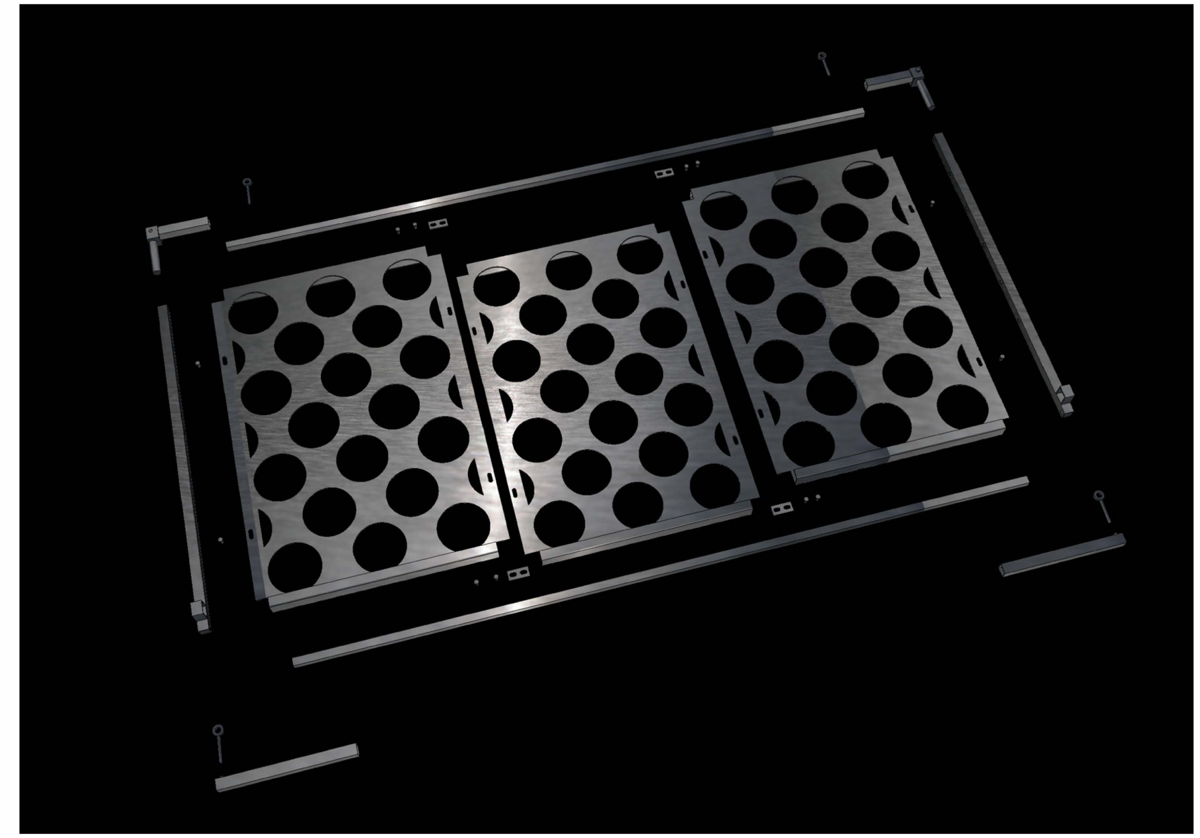


SAFL BAFFLE ATTACHMENT

BOLT DETAIL

NOTES:

1) CONTRACTOR MUST VERIFY LOCATION OF CASTING AND STEPS PRIOR TO INSTALLATION OF STRUCTURE.
2) 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 THE UNIVERSITY OF MINNESOTA AND UPSTREAM TECHNOLOGIES, INC. NEITHER UPSTREAM TECHNOLOGIES NOR THE UNIVERSITY OF MINNESOTA APPROVES PLANS, SIZING, OR SYSTEM DESIGNS.



SAFL Baffle STRUCTURE 1

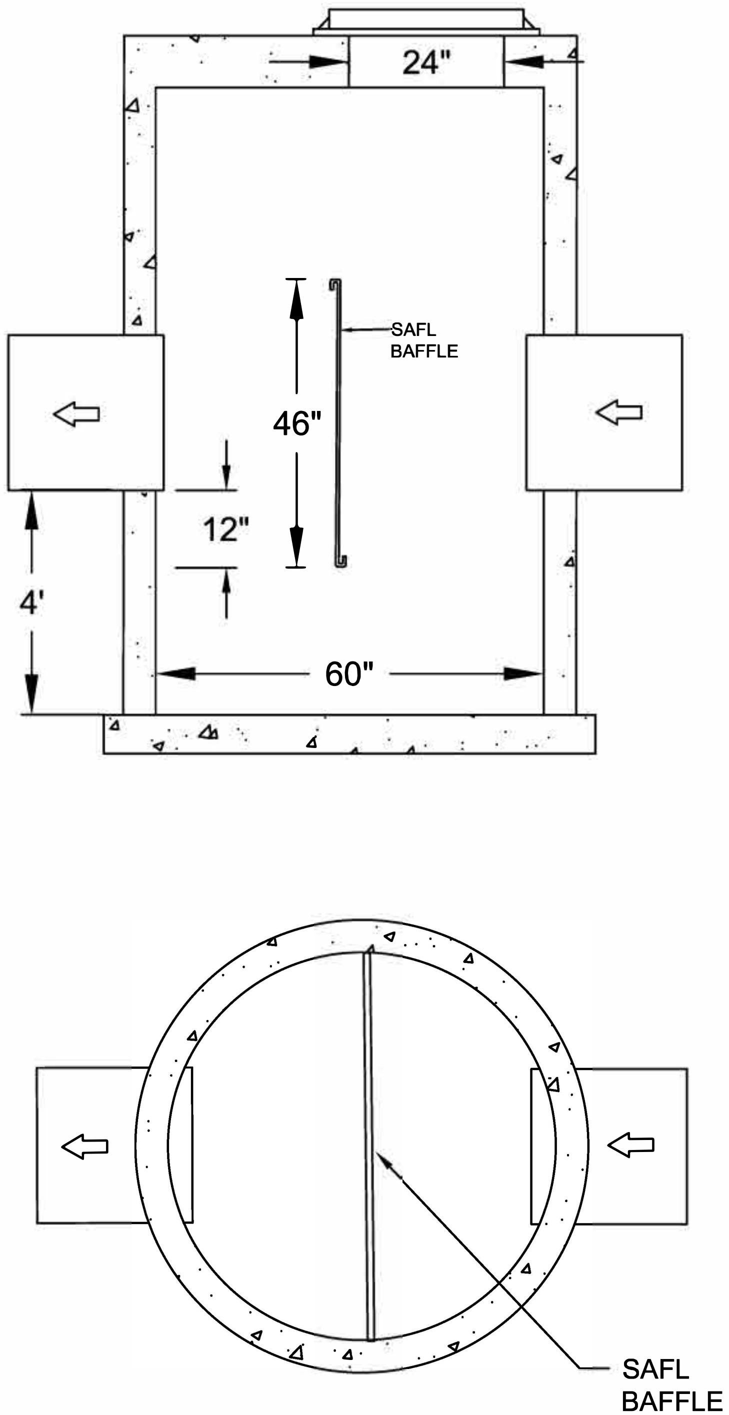
SAFL Baffle Installation: INSTALL BAFFLE AS CLOSE TO THE CENTER OF THE STRUCTURE AND AS PERPENDICULAR AS POSSIBLE THE INLET PIPE. ROTATE UP TO 45 DEGREES AS NEEDED.

Structure Diameter (W) = 48 inches
Rim Elevation = 4717.5'
Inlet Pipe (S) is 18" at Invert Elevation 4709.88'
Outlet Pipe (E) is 18" at Invert Elevation 4709.88'
Sump Elevation = 4705.88' (4')
SAFL Baffle Bottom Elevation = 4708.88' (12" below outlet pipe Invert)
SAFL Baffle Width (W) = 48 inches
SAFL Baffle Height (H) = 36 inches

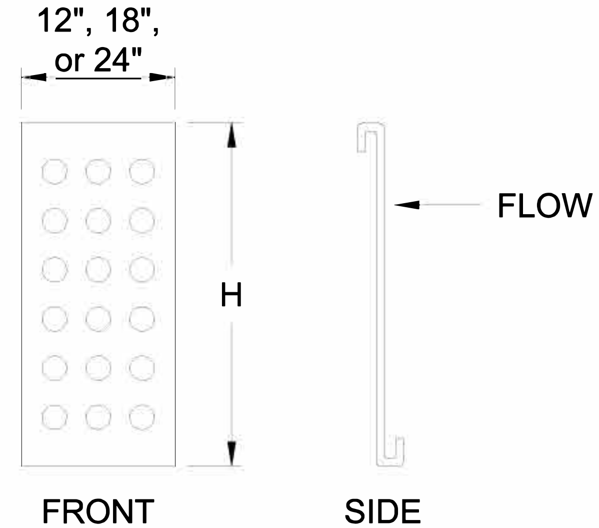
PROJECT NAME: 35th Avenue Widening in Greeley, Colorado.

SAFL BAFFLE STANDARD DETAIL
UPSTREAM TECHNOLOGIES INC.
600 COUNTY ROAD D WEST, SUITE 14
NEW BRIGHTON, MN 55112
651.237.5123

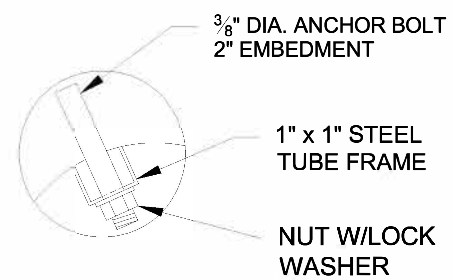
SAFL BAFFLE



SAFL BAFFLE INSTALLATION DETAIL (TYP)



SAFL BAFFLE PANEL



SAFL BAFFLE ATTACHMENT BOLT DETAIL

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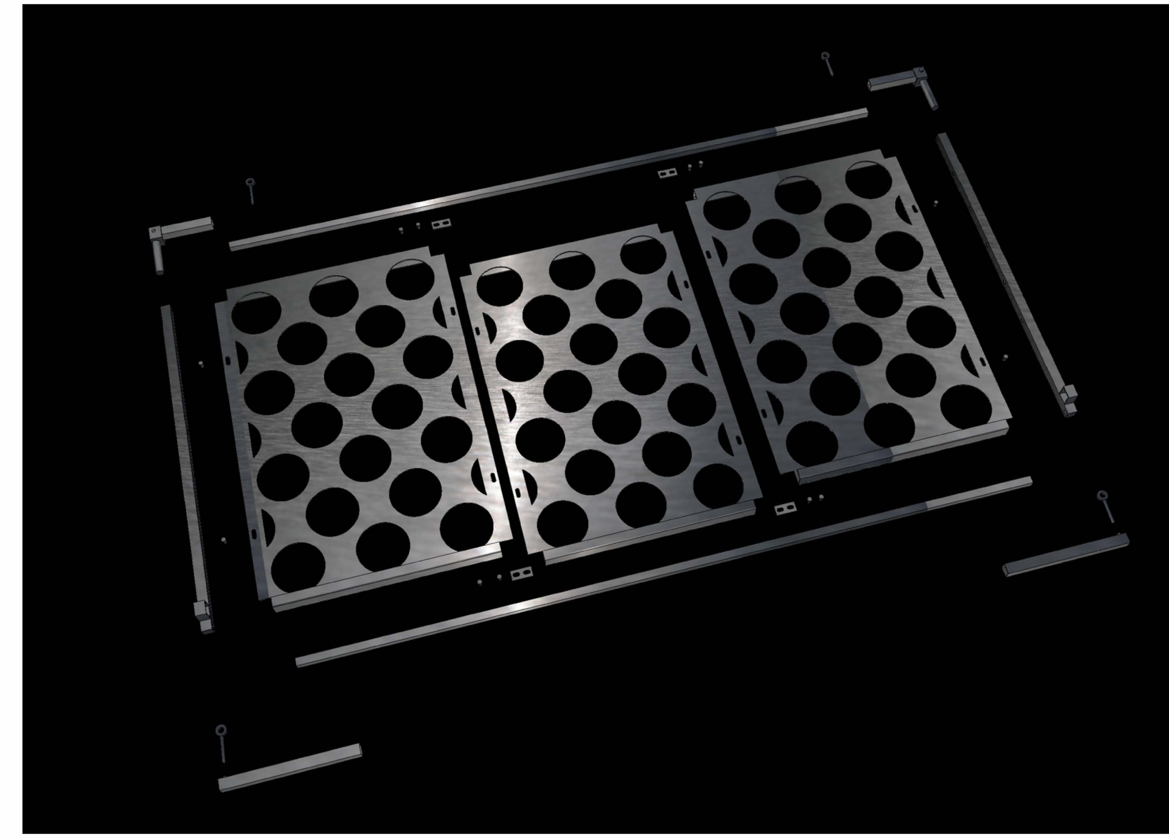


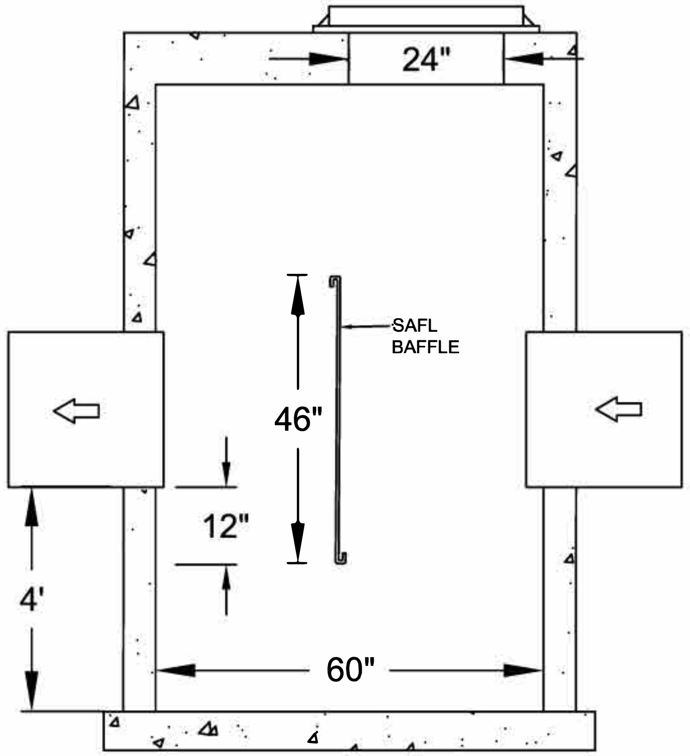
SAFL Baffle Structure 2
SAFL Baffle Installation: INSTALL BAFFLE AS SHOWN.

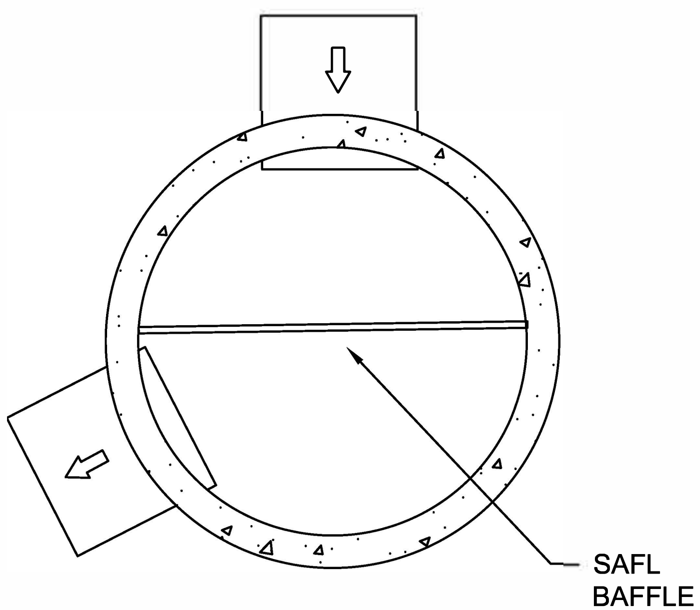
Structure Diameter (W) = 60 inches
Rim Elevation = 4699.0'
Inlet Pipe (N) is 24" at Invert Elevation 4684.17'
Outlet Pipe (W) is 24" at Invert Elevation 4684.17'
Sump Elevation = 4679.14' (5')
SAFL Baffle Bottom Elevation = 4683.14' (12" below outlet pipe Invert)
SAFL Baffle Width (W) = 60 inches
SAFL Baffle Height (H) = 46 inches

PROJECT NAME: 35th Avenue Widening in Greeley, Colorado.

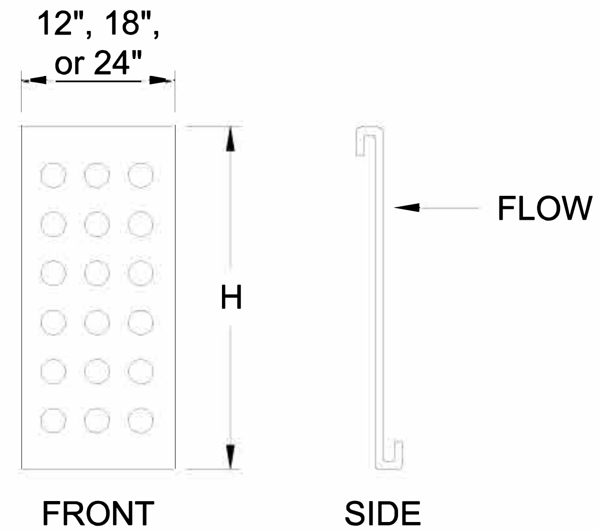
SAFL BAFFLE STANDARD DETAIL
UPSTREAM TECHNOLOGIES INC.
600 COUNTY ROAD D WEST, SUITE 14
NEW BRIGHTON, MN 55112
651.237.5123

SAFL BAFFLE

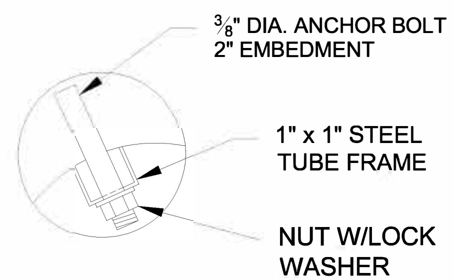




SAFL BAFFLE INSTALLATION DETAIL (TYP)



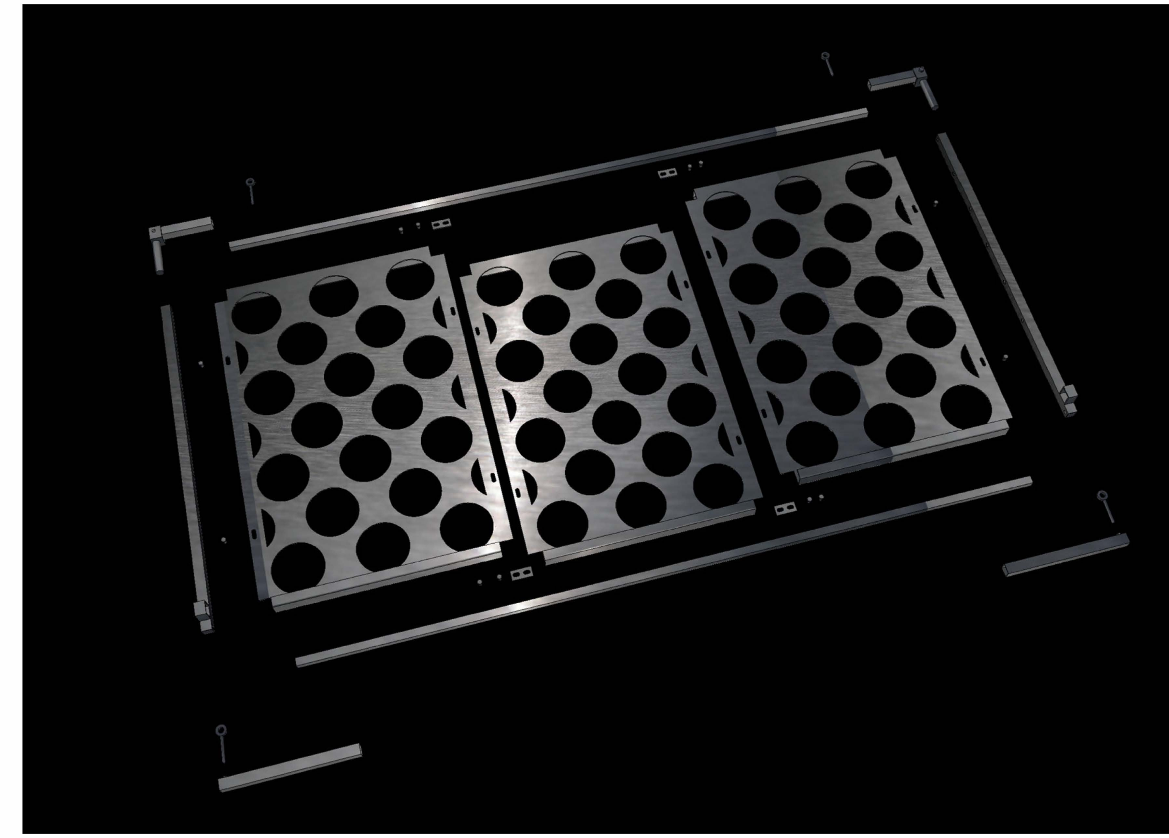
SAFL BAFFLE PANEL



SAFL BAFFLE ATTACHMENT BOLT DETAIL

NOTES:

1) CONTRACTOR MUST VERIFY LOCATION OF CASTING AND STEPS PRIOR TO INSTALLATION OF STRUCTURE.
2) 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 THE UNIVERSITY OF MINNESOTA AND UPSTREAM TECHNOLOGIES, INC. NEITHER UPSTREAM TECHNOLOGIES NOR THE UNIVERSITY OF MINNESOTA APPROVES PLANS, SIZING, OR SYSTEM DESIGNS.



SAFL Baffle Structure 3

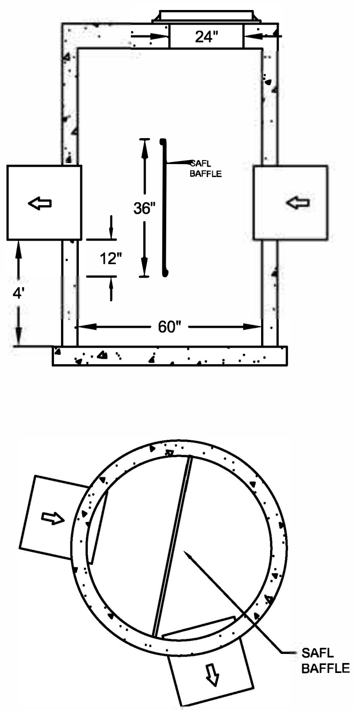
SAFL Baffle Installation: INSTALL BAFFLE AS SHOWN.

Structure Diameter (W) = 60 inches
Rim Elevation = 4675.30'
Inlet Pipe (N) is 24" at Invert Elevation 4669.13'
Outlet Pipe (W) is 24" at Invert Elevation 4669.13'
Sump Elevation = 4664.13' (5')
SAFL Baffle Bottom Elevation = 4668.13' (12" below outlet pipe Invert)
SAFL Baffle Width (W) = 60 inches
SAFL Baffle Height (H) = 46 inches

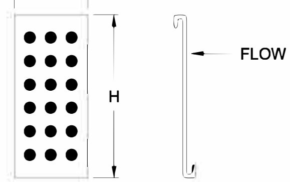
PROJECT NAME: 35th Avenue Widening in Greeley, Colorado.

SAFL BAFFLE STANDARD DETAIL
UPSTREAM TECHNOLOGIES INC.
600 COUNTY ROAD D WEST, SUITE 14
NEW BRIGHTON, MN 55112
651.237.5123

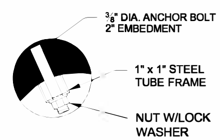
SAFL BAFFLE



SAFL BAFFLE INSTALLATION DETAIL (TYP)



SAFL BAFFLE PANEL



SAFL BAFFLE ATTACHMENT BOLT DETAIL

NOTES:

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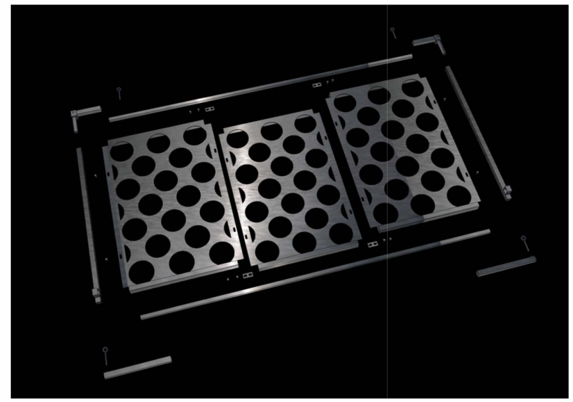


SAFL Baffle Structure 4

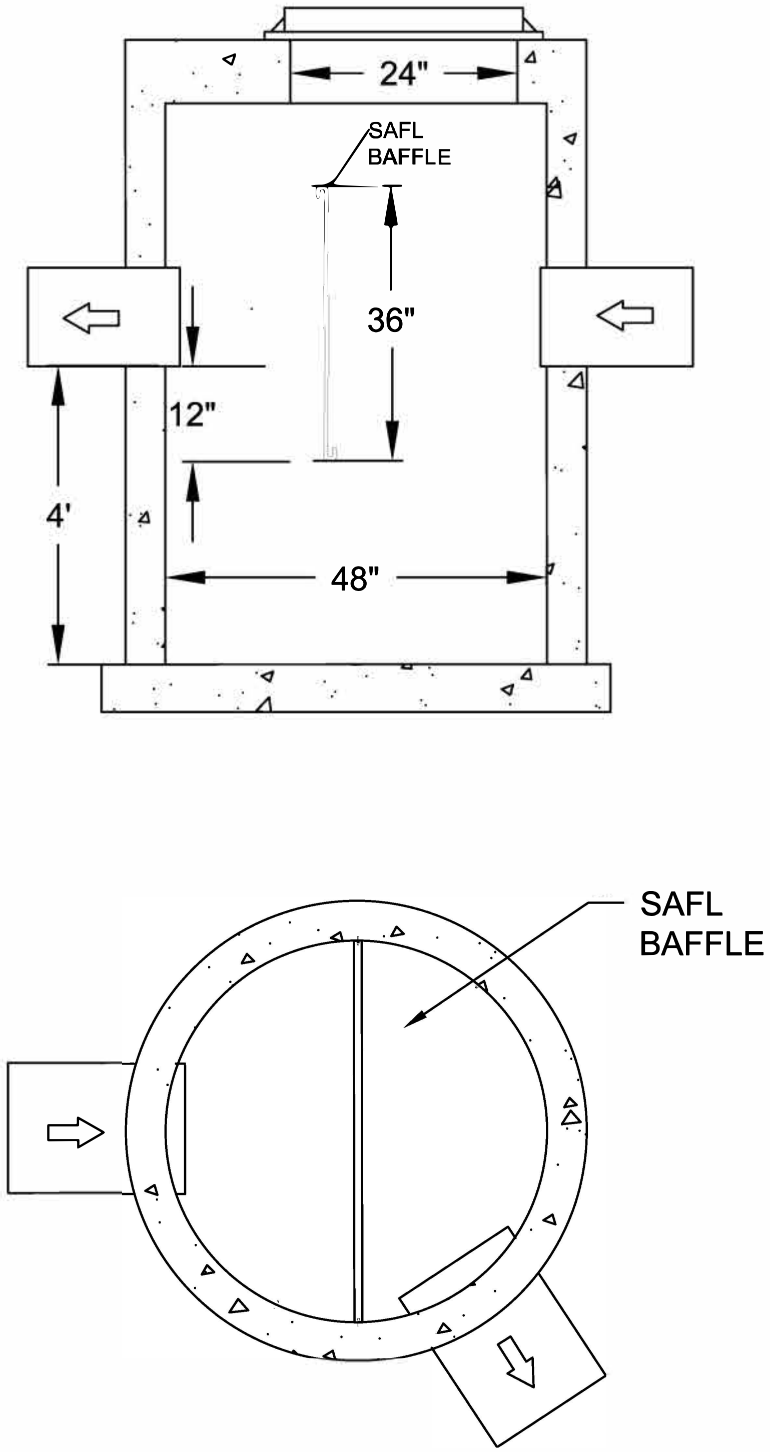
SAFL Baffle Installation: INSTALL BAFFLE AS SHOWN.

Structure Diameter (W) = 60 inches
Rim Elevation = 4674.60'
Inlet Pipe (N) is 18" at Invert Elevation 4668.38'
Outlet Pipe (W) is 18" at Invert Elevation 4668.38'
Sump Elevation = 4663.38' (5')
SAFL Baffle Bottom Elevation = 4667.38' (12" below outlet pipe Invert)
SAFL Baffle Width (W) = 60 inches
SAFL Baffle Height (H) = 36 inches

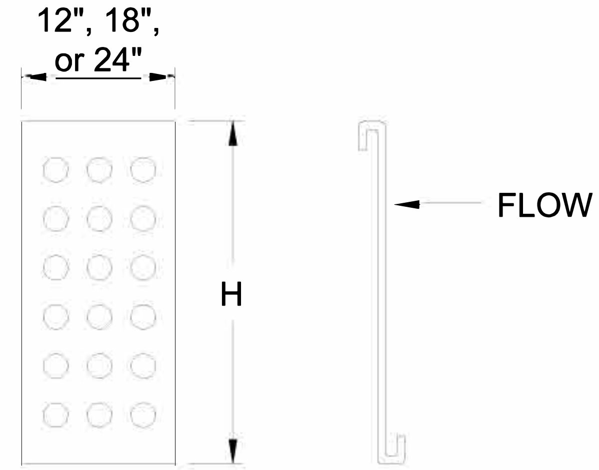
PROJECT NAME: 35th Avenue Widening in Greeley, Colorado

SAFL BAFFLE STANDARD DETAIL
UPSTREAM TECHNOLOGIES INC.
600 COUNTY ROAD D WEST, SUITE 14
NEW BRIGHTON, MN 55112
651.237.5123

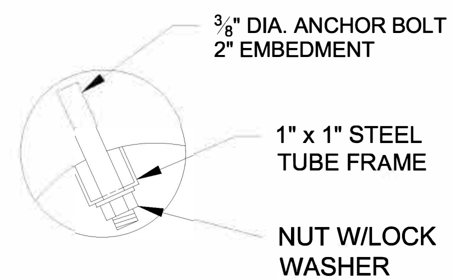
SAFL BAFFLE



SAFL BAFFLE INSTALLATION DETAIL (TYP)



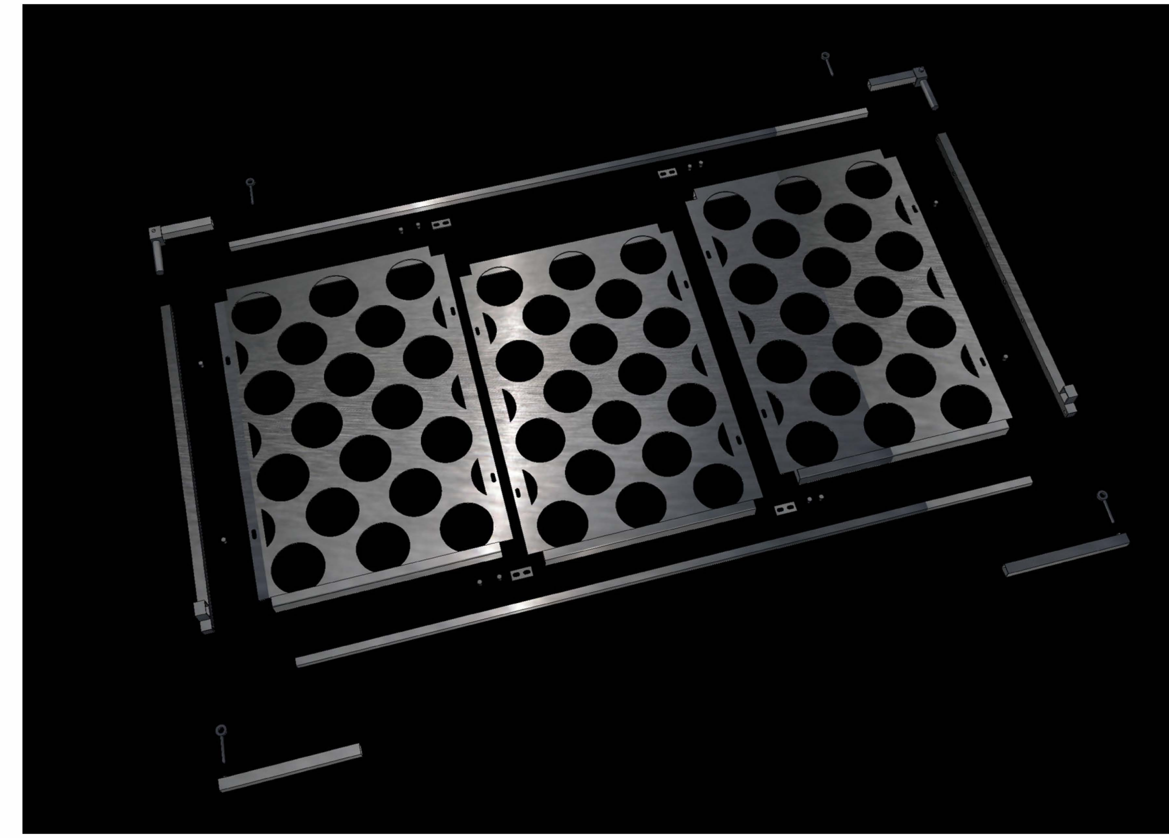
SAFL BAFFLE PANEL



SAFL BAFFLE ATTACHMENT BOLT DETAIL

NOTES:

1) CONTRACTOR MUST VERIFY LOCATION OF CASTING AND STEPS PRIOR TO INSTALLATION OF STRUCTURE.
2) 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 THE UNIVERSITY OF MINNESOTA AND UPSTREAM TECHNOLOGIES, INC. NEITHER UPSTREAM TECHNOLOGIES NOR THE UNIVERSITY OF MINNESOTA APPROVES PLANS, SIZING, OR SYSTEM DESIGNS.



SAFL Baffle STRUCTURE 5

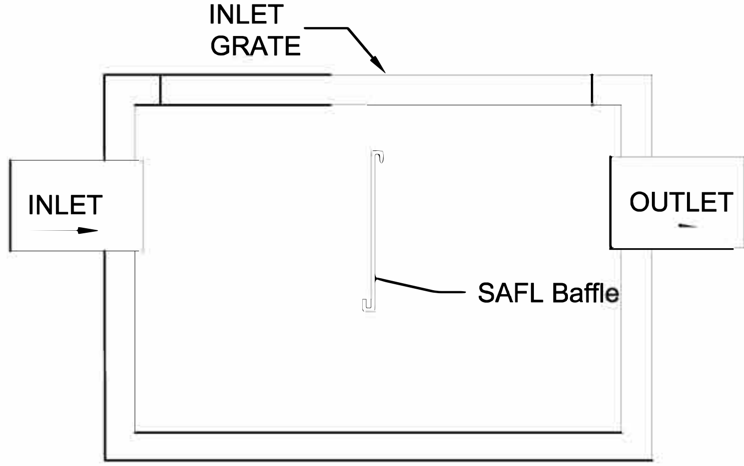
SAFL Baffle Installation: INSTALL BAFFLE AS CLOSE TO THE CENTER OF THE STRUCTURE AND AS PERPENDICULAR AS POSSIBLE THE INLET PIPE. ROTATE UP TO 45 DEGREES AS NEEDED.

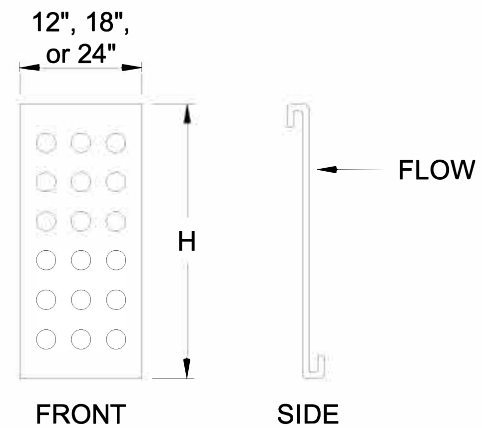
Structure Diameter (W) = 48 inches
Rim Elevation = 4674.60'
Inlet Pipe (S) is 18" at Invert Elevation 4668.27'
Outlet Pipe (E) is 18" at Invert Elevation 4668.27'
Sump Elevation = 4664.27' (4')
SAFL Baffle Bottom Elevation = 44667.27' (12" below outlet pipe Invert)
SAFL Baffle Width (W) = 48 inches
SAFL Baffle Height (H) = 36 inches

PROJECT NAME: 35th Avenue Widening in Greeley, Colorado.

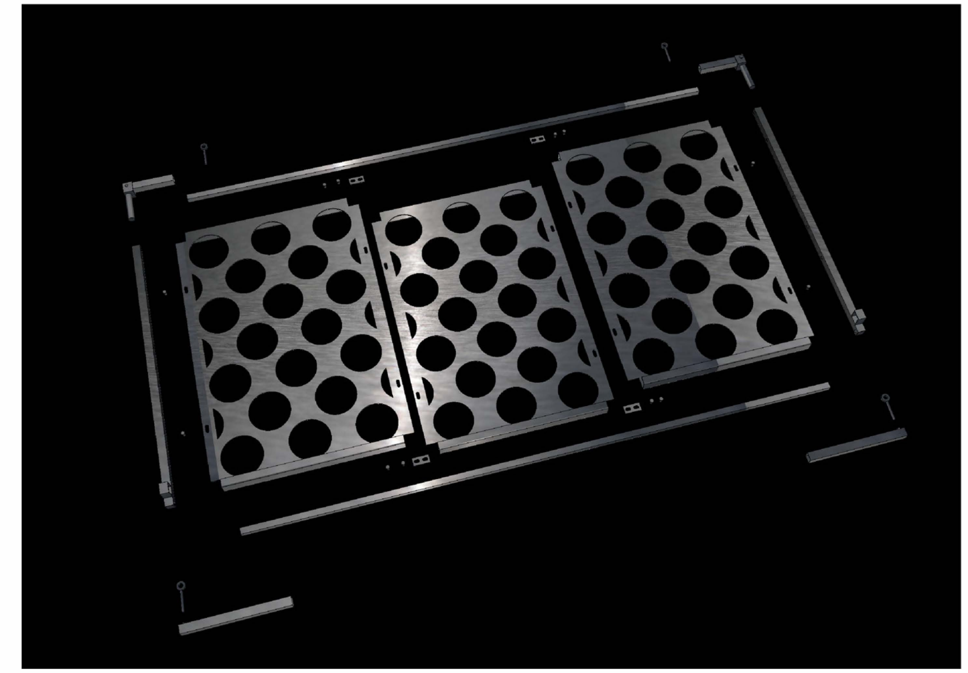
SAFL BAFFLE STANDARD DETAIL
UPSTREAM TECHNOLOGIES INC.
600 COUNTY ROAD D WEST, SUITE 14
NEW BRIGHTON, MN 55112
651.237.5123

SAFL BAFFLE

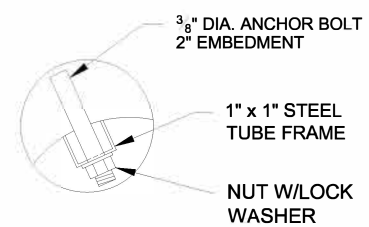




SAFL BAFFLE PANEL

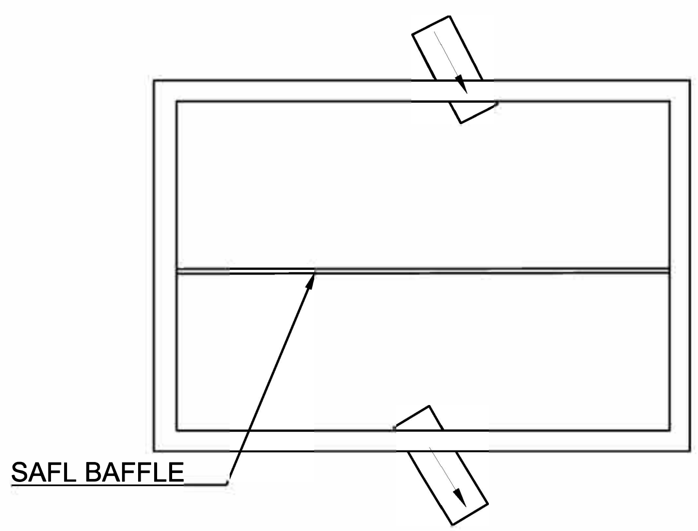


SAFL Baffle Structure 6



SAFL BAFFLE ATTACHMENT

BOLT DETAIL



SAFL BAFFLE INSTALLATION

DETAIL (TYP)

NOTES:

1) CONTRACTOR MUST VERIFY LOCATION OF CASTING AND STEPS PRIOR TO INSTALLATION OF STRUCTURE.
2) 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 THE UNIVERSITY OF MINNESOTA AND UPSTREAM TECHNOLOGIES, INC. NEITHER UPSTREAM TECHNOLOGIES NOR THE UNIVERSITY OF MINNESOTA APPROVES PLANS, SIZING, OR SYSTEM DESIGNS.

MAKE SURE TO LEAVE 2" CLEARANCE BETWEEN THE TOP OF THE BAFFLE AND THE TOP OF THE STRUCTURE TO ALLOW FOR MOUNTING OF THE PANELS.

Inlet and Outlet Pipe Diameter = 24"

Rim Elevation (B) = 4674.10'
Inlet Pipe Invert Elevation = 4668.04'
Outlet Pipe Invert Elevation = 4668.04'
Bottom of SAFL Baffle Eelvation = 4667.04'

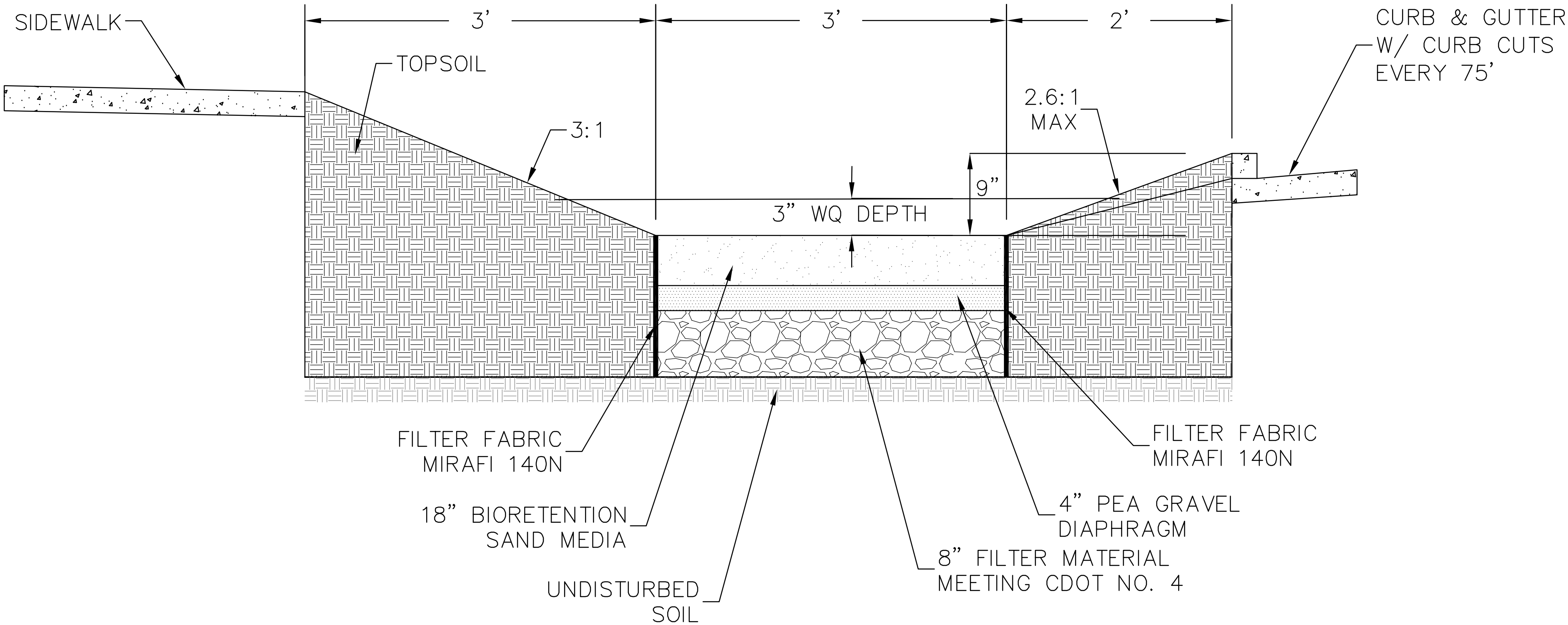
Structure Width (W) = 60 inches
SAFL Baffle Width (W) = 60 inches
SAFL Baffle Height (H) = 36 inches

Width of SAFL Baffle is adjustable from 56 inches to 60 inches

PROJECT NAME: 35th Avenue Widening in Greeley, Colorado

SAFL BAFFLE STANDARD DETAIL
UPSTREAM TECHNOLOGIES INC.
600 COUNTY ROAD D WEST, STE 14
NEW BRIGHTON, MN 55112
651.237.5123

SAFL BAFFLE



NOTE:
NO BIOSWALE MATERIAL OR FABRIC SHALL BE PLACED 3 FEET NORTH OR SOUTH OF TREE ROOT BALL.

WQ BIOSWALE CROSS-SECTION

N.T.S

Design Procedure Form: Rain Garden (RG)

UD-BMP (Version 3.07, March 2018)

Designer: es
Company: ICG
Date: May 19, 2020
Project: 35th Avenue
Location: Basin I

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of rain garden)	I_a = 80.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a/100$)	i = 0.800
C) Water Quality Capture Volume (WQCV) for a 12-hour Drain Time (WQCV= 0.8 * (0.91* i^3 - 1.19 * i^2 + 0.78 * i)	WQCV = 0.26 watershed inches
D) Contributing Watershed Area (including rain garden area)	Area = 39,349 sq ft
E) Water Quality Capture Volume (WQCV) Design Volume Vol = (WQCV / 12) * Area	V_{WQCV} = 861.3 cu ft
F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = in
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume	$V_{WQCV\ OTHER}$ = cu ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{WQCV\ USER}$ = cu ft
2. Basin Geometry	
A) WQCV Depth (12-inch maximum)	D_{WQCV} = 3.0 in
B) Rain Garden Side Slopes (Z = 4 min., horiz. dist per unit vertical) (Use "0" if rain garden has vertical walls)	Z = 3.00 ft / ft **Z < 4:1**
C) Mimimum Flat Surface Area	A_{Min} = 630.0 sq ft
D) Actual Flat Surface Area	A_{Actual} = 937 sq ft
E) Area at Design Depth (Top Surface Area)	A_{Top} = 1416.7 sq ft
F) Rain Garden Total Volume (V_T= ((A_{Top} + A_{Actual}) / 2) * Depth)	V_T= 294.2 cu ft **TOTAL VOLUME < DESIGN VOLUME**
3. Growing Media	Choose One ○ 18" Rain Garden Growing Media ○ Other (Explain):
4. Underdrain System	
A) Are underdrains provided?	Choose One ○ YES ○ NO
B) Underdrain system orifice diameter for 12 hour drain time	
i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice	y = ft
ii) Volume to Drain in 12 Hours	Vol_{12} = cu ft
iii) Orifice Diameter, 3/8" Minimum	D_O = in

Design Procedure Form: Rain Garden (RG)

UD-BMP (Version 3.07, March 2018)

Designer: es
Company: ICG
Date: May 19, 2020
Project: 35th Avenue
Location: Basin W

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of rain garden)	I_a = 77.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a/100$)	i = 0.770
C) Water Quality Capture Volume (WQCV) for a 12-hour Drain Time (WQCV= 0.8 * (0.91* i^3 - 1.19 * i^2 + 0.78 * i)	WQCV = 0.25 watershed inches
D) Contributing Watershed Area (including rain garden area)	Area = 46,698 sq ft
E) Water Quality Capture Volume (WQCV) Design Volume Vol = (WQCV / 12) * Area	V_{WQCV} = 966.6 cu ft
F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = in
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume	$V_{WQCV\ OTHER}$ = cu ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{WQCV\ USER}$ = cu ft
2. Basin Geometry	
A) WQCV Depth (12-inch maximum)	D_{WQCV} = 3.0 in
B) Rain Garden Side Slopes (Z = 4 min., horiz. dist per unit vertical) (Use "0" if rain garden has vertical walls)	Z = 3.00 ft / ft **Z < 4:1**
C) Mimimum Flat Surface Area	A_{Min} = 719.0 sq ft
D) Actual Flat Surface Area	A_{Actual} = 1581 sq ft
E) Area at Design Depth (Top Surface Area)	A_{Top} = 2386.4 sq ft
F) Rain Garden Total Volume (V_T= ((A_{Top} + A_{Actual}) / 2) * Depth)	V_T= 495.9 cu ft **TOTAL VOLUME < DESIGN VOLUME**
3. Growing Media	Choose One ○ 18" Rain Garden Growing Media ○ Other (Explain):
4. Underdrain System	
A) Are underdrains provided?	Choose One ○ YES ○ NO
B) Underdrain system orifice diameter for 12 hour drain time	
i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice	y = ft
ii) Volume to Drain in 12 Hours	Vol_{12} = cu ft
iii) Orifice Diameter, 3/8" Minimum	D_O = in

Design Procedure Form: Rain Garden (RG)

UD-BMP (Version 3.07, March 2018)

Designer: es
Company: ICG
Date: May 19, 2020
Project: 35th Avenue
Location: Basin X1

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of rain garden)	I_a = 74.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a/100$)	i = 0.740
C) Water Quality Capture Volume (WQCV) for a 12-hour Drain Time (WQCV= $0.8 * (0.91* i^3 - 1.19 * i^2 + 0.78 * i)$)	WQCV = 0.24 watershed inches
D) Contributing Watershed Area (including rain garden area)	Area = 14,020 sq ft
E) Water Quality Capture Volume (WQCV) Design Volume Vol = (WQCV / 12) * Area	V_{WQCV} = 275.1 cu ft
F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = in
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume	$V_{WQCV\ OTHER}$ = cu ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{WQCV\ USER}$ = cu ft
2. Basin Geometry	
A) WQCV Depth (12-inch maximum)	D_{WQCV} = 3.0 in
B) Rain Garden Side Slopes (Z = 4 min., horiz. dist per unit vertical) (Use "0" if rain garden has vertical walls)	Z = 3.00 ft / ft **Z < 4:1**
C) Mimimum Flat Surface Area	A_{Min} = 207.0 sq ft
D) Actual Flat Surface Area	A_{Actual} = 269 sq ft
E) Area at Design Depth (Top Surface Area)	A_{Top} = 411.2 sq ft
F) Rain Garden Total Volume ($V_T = ((A_{Top} + A_{Actual}) / 2) * \text{Depth}$)	V_T= 85.0 cu ft **TOTAL VOLUME < DESIGN VOLUME**
3. Growing Media	Choose One ◯ 18" Rain Garden Growing Media ◯ Other (Explain):
4. Underdrain System	
A) Are underdrains provided?	Choose One ◯ YES ◯ NO
B) Underdrain system orifice diameter for 12 hour drain time	
i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice	y = ft
ii) Volume to Drain in 12 Hours	Vol_{12} = cu ft
iii) Orifice Diameter, 3/8" Minimum	D_O = in

Description

A BMP that utilizes bioretention is an engineered, depressed landscape area designed to capture and filter or infiltrate the water quality capture volume (WQCV). BMPs that utilize bioretention are frequently referred to as rain gardens or porous landscape detention areas (PLDs). The term PLD is common in the Denver metropolitan area as this manual first published the BMP by this name in 1999. In an effort to be consistent with terms most prevalent in the stormwater industry, this document generally refers to the treatment process as *bioretention* and to the BMP as a *rain garden*.

Photograph B-1. This recently constructed rain garden provides bioretention of pollutants, as well as an attractive amenity for a residential building. Treatment should improve as vegetation matures.

The design of a rain garden may provide detention for events exceeding that of the WQCV. There are generally two ways to achieve this. The design can provide the flood control volume above the WQCV water surface elevation, with flows bypassing the filter usually by overtopping into an inlet designed to restrict the peak flow for a larger event (or events). Alternatively, the design can provide and slowly release the flood control volume in an area downstream of one or more rain gardens.

This infiltrating BMP requires consultation with a geotechnical engineer when proposed near a structure. A geotechnical engineer can assist with evaluating the suitability of soils, identifying potential impacts, and establishing minimum distances between the BMP and structures.

Bioretention (Rain Garden)	
Functions	
LID/Volume Red.	Yes
WQCV Capture	Yes
WQCV+Flood Control	Yes
Fact Sheet Includes EURV Guidance	No
Typical Effectiveness for Targeted Pollutants[3]	
Sediment/Solids	Very Good[1]
Nutrients	Moderate
Total Metals	Good
Bacteria	Moderate
Other Considerations	
Life-cycle Costs[4]	Moderate

[1] Not recommended for watersheds with high sediment yields (unless pretreatment is provided).

[3] Based primarily on data from the International Stormwater BMP Database (www.bmpdatabase.org).

[4] Based primarily on BMP-REALCOST available at www.udfcd.org. Analysis based on a single installation (not based on the maximum recommended watershed tributary to each BMP).

Terminology

The term *bioretention* refers to the treatment process although it is also frequently used to describe a BMP that provides biological uptake and retention of the pollutants found in stormwater runoff. This BMP is frequently referred to as a *porous landscape detention (PLD) area* or *rain garden*.

Site Selection

Bioretention can be provided in a variety of areas within new developments, or as a retrofit within an existing site. This BMP allows the WQCV to be treated within areas designated for landscape (see design step 7 for appropriate vegetation). In this way, it is an excellent alternative to extended detention basins for small sites. A typical rain garden serves a tributary area of one impervious acre or less, although they can be designed for larger tributary areas. Multiple installations can be used within larger sites. Rain gardens should not be used when a baseflow is anticipated. They are typically small and installed in locations such as:

- Parking lot islands
- Street medians
- Landscape areas between the road and a detached walk
- Planter boxes that collect roof drains

Bioretention requires a stable watershed. Retrofit applications are typically successful for this reason. When the watershed includes phased construction, sparsely vegetated areas, or steep slopes in sandy soils, consider another BMP or provide pretreatment before runoff from these areas reaches the rain garden. The surface of the rain garden should be flat. For this reason, rain gardens can be more difficult to incorporate into steeply sloping terrain; however, terraced applications of these facilities have been successful in other parts of the country.

When bioretention (and other BMPs used for infiltration) are located adjacent to buildings or pavement areas, protective measures should be implemented to avoid adverse impacts to these structures. Oversaturated subgrade soil underlying a structure can cause the structure to settle or result in moisture-related problems. Wetting of expansive soils or bedrock can cause swelling, resulting in structural movements. A geotechnical engineer should evaluate the potential impact of the BMP on adjacent structures based on an evaluation of the subgrade soil, groundwater, and bedrock conditions at the site. Additional minimum requirements include:

- In locations where subgrade soils do not allow infiltration, the growing medium should be underlain by an underdrain system.
- Where infiltration can adversely impact adjacent structures, the filter layer should be underlain by an underdrain system designed to divert water away from the structure.
- In locations where potentially expansive soils or bedrock exist, placement of a rain garden adjacent to structures and pavement should only be considered if the BMP includes an underdrain designed to divert water away from the structure and is lined with an essentially impermeable geomembrane liner designed to restrict seepage.

Benefits

- Bioretention uses multiple treatment processes to remove pollutants, including sedimentation, filtering, adsorption, evapotranspiration, and biological uptake of constituents.
- Volumetric stormwater treatment is provided within portions of a site that are already reserved for landscaping.
- There is a potential reduction of irrigation requirements by taking advantage of site runoff.

Limitations

- Additional design and construction steps are required for placement of any ponding or infiltration area near or upgradient from a building foundation and/or when expansive (low to high swell) soils exist. This is discussed in the design procedure section.
- In developing or otherwise erosive watersheds, high sediment loads can clog the facility.

Designing for Maintenance

Recommended maintenance practices for all BMPs are in Chapter 6 of this manual. During design, the following should be considered to ensure ease of maintenance over the long-term:

- Do not put a filter sock on the underdrain. This is not necessary and can cause the BMP to clog.
- The best surface cover for a rain garden is full vegetation. Do not use rock mulch within the rain garden because sediment build-up on rock mulch tends to inhibit infiltration and require frequent cleaning or removal and replacement. Wood mulch handles sediment build-up better than rock mulch; however, wood mulch floats and may clog the overflow depending on the configuration of the outlet, settle unevenly, or be transported downstream. Some municipalities may not allow wood mulch for this reason.
- Consider all potential maintenance requirements such as mowing (if applicable) and replacement of the growing medium. Consider the method and equipment for each task required. For example, in a large rain garden where the use of hand tools is not feasible, does the shape and configuration of the rain garden allow for removal of the growing medium using a backhoe?
- Provide pre-treatment when it will reduce the extent and frequency of maintenance necessary to maintain function over the life of the BMP. For example, if the site is larger than 2 impervious acres, prone to debris or the use of sand for ice control, consider a small forebay.
- Make the rain garden as shallow as possible. Increasing the depth unnecessarily can create erosive side slopes and complicate maintenance. Shallow rain gardens are also more attractive.
- Design and adjust the irrigation system (temporary or permanent) to provide appropriate water for the establishment and maintenance of selected vegetation.

Is Pretreatment Needed

Designing the inflow gutter to the rain garden at a minimal slope of 0.5% can facilitate sediment and debris deposition prior to flows entering the BMP. Be aware, this will reduce maintenance of the BMP, but may require more frequent sweeping of the gutter to ensure that the sediment does not impede flow into the rain garden.

Design Procedure and Criteria

The following steps outline the design procedure and criteria, with Figure B-1 providing a corresponding cross-section.

1. **Basin Storage Volume**: Provide a storage volume based on a 12-hour drain time.

   - Find the required WQCV (watershed inches of runoff). Using the imperviousness of the tributary area (or effective imperviousness where LID elements are used upstream), use Figure 3-2 located in Chapter 3 of this manual to determine the WQCV based on a 12-hour drain time.
   - Calculate the design volume as follows:

$$V = \left[\frac{\text{WQCV}}{12}\right] A \qquad \text{Equation B-1}$$

   Where:

   V= design volume (ft^3)

A = area of watershed tributary to the rain garden (ft^2)

2. **Basin Geometry:** A maximum WQCV ponding depth of 12 inches is recommended to maintain vegetation properly. Provide an inlet or other means of overflow at this elevation. Depending on the type of vegetation planted, a greater depth may be utilized to detain larger (more infrequent) events. The bottom surface of the rain garden, also referred to here as the filter area, should be flat. Sediment will reside on the filter area of the rain garden; therefore, if the filter area is too small, it may clog prematurely. Increasing the filter area will reduce clogging and decrease the frequency of maintenance. Equation B-2 provides a **minimum** filter area allowing for some of the volume to be stored beyond the area of the filter (i.e., above the sideslopes of the rain garden).

   Note that the total surcharge volume provided by the design must also equal or exceed the design volume. Use vertical walls or slope the sides of the basin to achieve the required volume. Use the rain garden growing medium described in design step 3 only on the filter area because this material is more erosive than typical site soils. Sideslopes should be no steeper than 4:1 (horizontal:vertical).

$$A \geq (2/3)\frac{\mathrm{V}}{1\ \mathrm{foot}} \qquad \text{Equation B-2}$$

   Where:

   V= design volume (ft^3)

   A = minimum filter area (flat surface area) (ft^2)

   The one-foot dimension in this equation represents the maximum recommended WQCV depth in the rain garden. The actual design depth may differ; however, it is still appropriate to use a value of one foot when calculating the minimum filter area.

3. **Growing Medium:** For partial and no infiltration sections, provide a minimum of 18 inches of growing medium to enable establishment of the roots of the vegetation (see Figure B-1). Previous versions of this manual recommended a mix of 85% sand and 15% peat (by volume). Peat is a material that typically requires import to Colorado and mining peat has detrimental impacts to the environment (Mazerolle 2002). UDFCD partnered with the University of Colorado to perform a study to find a sustainable material to replace peat. The study was successful in finding a replacement that performed well for filtering ability, clogging characteristics, as well as seed germination. This mixture consists of 85% coarse sand and a 15% compost/shredded paper mixture (by volume). The study used thin (approximately 1/4 inch) strips of loosely packed shredded paper mixed with an equal volume of compost. Based on conversations with local suppliers, compost

Benefits of Shredded Paper in Rain Garden Growing Media

- Shredded paper, similar to other woody materials, captures nutrients from the compost and slowly releases them as the paper decomposes. Compost alone will leach more nutrients than desired.
- As the paper decomposes, nutrients stored in the material are available to the vegetation.
- Paper temporarily slows the infiltration rate of the media and retains moisture, providing additional time for a young root system to benefit from moisture in the growing media.

containing shredded paper is not an uncommon request, although not typically provided in the proportions recommended in this BMP Fact Sheet. Compost suppliers have access to shredded paper through document destruction companies and can provide a mixture of Class 1 compost and shredded paper. The supplier should provide the rain garden compost mixture premixed with coarse sand. On-site mixing is not recommended.

Rain Garden Compost Mixture (by volume)

- 50% Class 1 STA registered compost (approximate bulk density 1000 lbs/CY)
- 50% loosely packed shredded paper (approximate bulk density 50 to 100 lbs/CY)

When using diamond cut shredded paper or tightly packed paper, use the bulk densities provided to mix by weight.

Rain Garden Growing Medium

The supplier should premix the rain garden compost mixture (above) with coarse sand, in the following proportions, prior to delivery to the site:

- 15% rain garden compost mixture described above (by volume)
- 85% coarse sand (either Class C Filter Material per Table B-2 or sand meeting ASTM C-33) (by volume)

Table B-1 provides detailed information on Class 1 compost. Be aware, regular testing is not required to allow a compost supplier to refer to a product as a specific STA class. However, regular testing is required and performed through the United States Compost Council (USCC) Seal of Testing Assurance (STA) Program to be a STA registered compost. To ensure Class 1 characteristics, look for a Class 1 STA registered compost.

Other Rain Garden Growing Medium Amendments

The growing medium described above is designed for filtration ability, clogging characteristics, and vegetative health. It is important to preserve the function provided by the rain garden growing medium when considering additional materials for incorporation into the growing medium or into the standard section shown in Figure B-1. When desired, amendments may be included to improve water quality or to benefit vegetative health as long as they do not add nutrients, pollutants, or modify the infiltration rate. For example, a number of products, including steel wool, capture and retain dissolved phosphorus (Erickson 2009). When phosphorus is a target pollutant, proprietary materials with similar characteristics may be considered. Do not include amendments such as top soil, sandy loam, and additional compost.

Full Infiltration Sections

A full infiltration section retains the WQCV onsite. For this section, it is not necessary to use the prescribed rain garden growing medium. Amend the soils to provide adequate nutrients to establish vegetation. Typically, 3 to 5 cubic yards of soil amendment (compost) per 1,000 square feet, tilled 6 inches into the soil, is required for vegetation to thrive. Additionally, inexpensive soil tests can be conducted to determine required soil amendments. (Some local governments may also require proof of soil amendment in landscaped areas for water conservation reasons.)

Table B-1. Class 1 Compost

Characteristic	**Criteria**
Minimum Stability Indicator (Respirometry)	Stable to Very Stable
Maturity Indicator Expressed as Ammonia N / Nitrate N Ratio	< 4
Maturity Indicator Expressed as Carbon to Nitrogen Ratio	< 12
Maturity Indicator Expressed as Percentage of Germination/Vigor	80+ / 80+
pH – Acceptable Range	6.0 – 8.4
Soluble Salts – Acceptable Range (1:5 by weight)	0 – 5 mmhos/cm
Testing and Test Report Submittal Requirement	Seal of Testing Assurance (STA)/Test Methods for the Examination of Composting and Compost (TMECC)
Chemical Contaminants	Equal or better than US EPA Class A Standard, 40 CFR 503.13, Tables 1 & 3 levels
Pathogens	Meet or exceed US EPA Class A standard, 40 CFR 503.32(a) levels

4. **Underdrain System**: Underdrains are often necessary and should be provided if infiltration tests show percolation drawdown rates slower than 2 times the rate needed to drain the WQCV over 12 hours, or where required to divert water away from structures as determined by a professional engineer. Percolation tests should be performed or supervised by a licensed professional engineer and conducted at a minimum depth equal to the bottom of the bioretention facility. Additionally, underdrains are required where impermeable membranes are used. Similar to the terminology used for permeable pavement sections, there are three basic sections for bioretention facilities:

   - **No-Infiltration Section:** This section includes an underdrain and an impermeable liner that does not allow for any infiltration of stormwater into the subgrade soils. It is appropriate to use a no-infiltration system when either of the following is true:

     - Land use or activities could contaminate groundwater when stormwater is allowed to infiltrate, or

     - The BMP is located over potentially expansive soils or bedrock and is adjacent (within 10 feet) to structures.

   - **Partial Infiltration Section:** This section does not include an impermeable liner and, therefore; allows for some infiltration. Stormwater that does not infiltrate will be collected and removed by an underdrain system.

- **Full Infiltration Section:** This section is designed to infiltrate all of the water stored into the subgrade below. Overflows are managed via perimeter drainage to a downstream conveyance element. UDFCD recommends a minimum infiltration rate of 2 times the rate needed to drain the WQCV over 12 hours.

When using an underdrain system, provide a control orifice sized to drain the design volume in 12 hours or more (see Equation B-3). Use a minimum orifice size of 3/8 inch to avoid clogging. This will provide detention and slow release of the WQCV, providing water quality benefits and reducing impacts to downstream channels. Space underdrain pipes a maximum of 20 feet on center. Provide cleanouts to enable maintenance of the underdrain. Cleanouts can also be used to conduct an inspection (by camera) of the underdrain system to

Important Design Considerations

The potential for impacts to adjacent buildings can be significantly reduced by locating the bioretention area at least 10 feet away from the building, beyond the limits of backfill placed against the building foundation walls, and by providing positive surface drainage away from the building.

The BMP should not restrict surface water from flowing away from the buildings. This can occur if the top of the perimeter wall for the BMP impedes flow away from the building.

Always adhere to the slope recommendations provided in the geotechnical report. In the absence of a geotechnical report, the following general recommendations should be followed for the first 10 feet from a building foundation.

1) Where feasible, provide a slope of 10% for a distance of 10 feet away from a building foundation.

2) In locations where non-expansive soil or bedrock conditions exist, the slope for the surface within 10 feet of the building should be at least 5% away from the building for unpaved (landscaped) surfaces.

3) In locations where potentially expansive soil or bedrock conditions exist, the design slope should be at least 10% away from the building for unpaved (landscaped) surfaces.

4) For paved surfaces, a slope of at least 2% away from the building is adequate. Where accessibility requirements or other design constraints do not apply, use an increased minimum design slope for paved areas (2.5% where non-expansive soil or bedrock conditions exist).

ensure that the pipe was not crushed or disconnected during construction.

Calculate the diameter of the orifice for a 12-hour drain time using Equation B-3 (Use a minimum orifice size of 3/8 inch to avoid clogging.):

$$D_{12\text{ hour drain time}} = \sqrt{\frac{V}{1414\, y^{0.41}}} \qquad \text{Equation B-3}$$

Where:

D = orifice diameter (in)

y = distance from the lowest elevation of the storage volume (i.e., surface of the filter) to the center of the orifice (ft)

V = volume (WQCV or the portion of the WQCV in the rain garden) to drain in 12 hours (ft^3)

In previous versions of this manual, UDFCD recommended that the underdrain be placed in an aggregate layer and that a geotextile (separator fabric) be placed between this aggregate and the growing medium. This version of the manual replaces that section with materials that, when used together, eliminate the need for a separator fabric.

The underdrain system should be placed within an 6-inch-thick section of CDOT Class C filter material meeting the gradation in Table B-2. Use slotted pipe that meets the slot dimensions provided in Table B-3.

Table B-2. Gradation Specifications for CDOT Class C Filter Material

(Source: CDOT Table 703-7)

Sieve Size	Mass Percent Passing Square Mesh Sieves
19.0 mm (3/4”)	100
4.75 mm (No. 4)	60 – 100
300 µm (No. 50)	10 – 30
150 µm (No. 100)	0 – 10
75 µm (No. 200)	0 - 3

Table B-3. Dimensions for Slotted Pipe

Pipe Diameter	Slot Length[1]	Maximum Slot Width	Slot Centers[1]	Open Area[1] (per foot)
4”	1-1/16”	0.032”	0.413”	1.90 in^2
6”	1-3/8”	0.032”	0.516”	1.98 in^2

[1] Some variation in these values is acceptable and is expected from various pipe manufacturers. Be aware that both increased slot length and decreased slot centers will be beneficial to hydraulics but detrimental to the structure of the pipe.

5. **Impermeable Geomembrane Liner and Geotextile Separator Fabric:** For no-infiltration sections, install a 30 mil (minimum) PVC geomembrane liner, per Table B-5, on the bottom and sides of the basin, extending up at least to the top of the underdrain layer. Provide at least 9 inches (12 inches if possible) of cover over the membrane where it is attached to the wall to protect the membrane from UV deterioration. The geomembrane should be field-seamed using a dual track welder, which allows for non-destructive testing of almost all field seams. A small amount of single track and/or adhesive seaming should be allowed in limited areas to seam around pipe perforations, to patch seams removed for destructive seam testing, and for limited repairs. The liner should be installed with slack to prevent tearing due to backfill, compaction, and settling. Place CDOT Class B geotextile separator fabric above the geomembrane to protect it from being punctured during the placement of the filter material above the liner. If the subgrade contains angular rocks or other material that could puncture the geomembrane, smooth-roll the surface to create a suitable surface. If smooth-rolling the surface does not provide a suitable surface, also place the separator fabric between the geomembrane and the underlying subgrade. This should only be done when necessary because fabric placed under the geomembrane can increase seepage losses through pinholes or other geomembrane defects. Connect the geomembrane to perimeter concrete walls around the basin perimeter, creating a watertight seal between the geomembrane and the walls using a continuous batten bar and anchor connection (see Figure B-3). Where the need for the impermeable membrane is not as critical, the membrane can be attached with a nitrile-based vinyl adhesive. Use watertight PVC boots for underdrain pipe penetrations through the liner (see Figure B-2).

Table B-4. Physical Requirements for Separator Fabric[1]

Property	Class B Elongation < 50%[2]	Class B Elongation > 50%[2]	Test Method
Grab Strength, N (lbs)	800 (180)	510 (115)	ASTM D 4632
Puncture Resistance, N (lbs)	310 (70)	180 (40)	ASTM D 4833
Trapezoidal Tear Strength, N (lbs)	310 (70)	180 (40)	ASTM D 4533
Apparent Opening Size, mm (US Sieve Size)	AOS < 0.3mm (US Sieve Size No. 50)		ASTM D 4751
Permittivity, sec^{-1}	0.02 default value, must also be greater than that of soil		ASTM D 4491
Permeability, cm/sec	k fabric > k soil for all classes		ASTM D 4491
Ultraviolet Degradation at 500 hours	50% strength retained for all classes		ASTM D 4355

[1] Strength values are in the weaker principle direction
[2] As measured in accordance with ASTM D 4632

Table B-5. Physical Requirements for Geomembrane

Property	Thickness 0.76 mm (30 mil)	Test Method
Thickness, % Tolerance	±5	ASTM D 1593
Tensile Strength, kN/m (lbs/in) width	12.25 (70)	ASTM D 882, Method B
Modulus at 100% Elongation, kN/m (lbs/in)	5.25 (30)	ASTM D 882, Method B
Ultimate Elongation, %	350	ASTM D 882, Method A
Tear Resistance, N (lbs)	38 (8.5)	ASTM D 1004
Low Temperature Impact, °C (°F)	-29 (-20)	ASTM D 1790
Volatile loss, % max.	0.7	ASTM D 1203, Method A
Pinholes, No. Per 8 m^2 (No. per 10 sq. yds.) max.	1	N/A
Bonded Seam Strength, % of tensile strength	80	N/A

6. **Inlet/Outlet Control:** In order to provide the proper drain time, the bioretention area can be designed without an underdrain (provided it meets the requirements in step 4) or the outlet can be controlled by an orifice plate. Equation B-3 is a simplified equation for sizing an orifice plate for a 12-hour drain time.

Photograph B-2. The curb cut shown allows flows to enter this rain garden while excess flows bypass the facility. Note: trees are not recommended inside a rain garden

7. How flow enters and exits the BMP is a function of the overall drainage concept for the site. Inlets at each rain garden may or may not be needed. Curb cuts can be designed to both allow stormwater into the rain garden as well as to provide release of stormwater in excess of the WQCV. Roadside rain gardens located on a steep site might pool and overflow into downstream cells with a single curb cut, level spreader, or outlet structure located at the most downstream cell. When selecting the type and location of the outlet structure, ensure that the runoff will not short-circuit the rain garden. This is a frequent problem when using a curb inlet located outside the rain garden for overflow.

   For rain gardens with concentrated points of inflow, provide for energy dissipation. When rock is used, provide separator fabric between the rock and growing medium to minimize subsidence.

8. **Vegetation:** UDFCD recommends that the filter area be vegetated with drought tolerant species that thrive in sandy soils. Table B-6 provides a suggested seed mix for sites that will not need to be irrigated after the grass has been established.

   All seed must be well mixed and broadcast, followed by hand raking to cover seed and then mulched. Hydromulching can be effective for large areas. Do not place seed when standing water or snow is present or if the ground is frozen. Weed control is critical in the first two to three years, especially when starting with seed.

   Do not use conventional sod. Conventional sod is grown in clay soil that will seal the filter area, greatly reducing overall function of the BMP. Several successful local installations have started with seed.

Designing for Flood Protection

Provide the WQCV in rain gardens that direct excess flow into to a landscaped area providing the flood control volume. Design the flood control outlet to meter the major event (100-year event) and slowly release the difference in volume between the EURV and the WQCV. (This assumes that the runoff treated by the rain gardens is routed directly into the outlet or infiltrates.) Providing treatment in this manner will reduce inundation in the landscaped area to a few times per year, resulting in an area better suited for multipurpose uses.

When using an impermeable liner, select plants with diffuse (or fibrous) root systems, not taproots. Taproots can damage the liner and/or underdrain pipe. Avoid trees and large shrubs that may interfere with restorative maintenance. Trees and shrubs can be planted outside of the area of growing medium. Use a cutoff wall to ensure that roots do not grow into the underdrain or place trees and shrubs a conservative distance from the underdrain.

9. **Irrigation:** Provide spray irrigation at or above the WQCV elevation or place temporary irrigation on top of the rain garden surface. Do not place sprinkler heads on the flat surface. Remove temporary irrigation when vegetation is established. If left in place this will become buried over time and will be damaged during maintenance operations.

   Irrigation schedules should be adjusted during the growing season to provide the minimum water necessary to maintain plant health and to maintain the available pore space for infiltration.

Table B-6. Native Seed Mix for Rain Gardens [2]

Common Name	Scientific Name	Variety	PLS[2] lbs per Acre	Ounces per Acre
Sand bluestem	Andropogon hallii	Garden	3.5	
Sideoats grama	Bouteloua curtipendula	Butte	3	
Prairie sandreed	Calamovilfa longifolia	Goshen	3	
Indian ricegrass	Oryzopsis hymenoides	Paloma	3	
Switchgrass	Panicum virgatum	Blackwell	4	
Western wheatgrass	Pascopyrum smithii	Ariba	3	
Little bluestem	Schizachyrium scoparium	Patura	3	
Alkali sacaton	Sporobolus airoides		3	
Sand dropseed	Sporobolus cryptandrus		3	
Pasture sage[1]	Artemisia frigida			2
Blue aster[1]	Aster laevis			4
Blanket flower[1]	Gaillardia aristata			8
Prairie coneflower[1]	Ratibida columnifera			4
Purple prairieclover[1]	Dalea (Petalostemum) purpurea			4
Sub-Totals:			27.5	22
Total lbs per acre:			**28.9**	

[1] Wildflower seed (optional) for a more diverse and natural look.
[2] PLS = Pure Live Seed.

Aesthetic Design

In addition to providing effective stormwater quality treatment, rain gardens can be attractively incorporated into a site within one or several landscape areas. Aesthetically designed rain gardens will typically either reflect the character of their surroundings or become distinct features within their surroundings. Guidelines for each approach are provided below.

Reflecting the Surrounding

- Determine design characteristics of the surrounding. This becomes the context for the drainage improvement. Use these characteristics in the structure.
- Create a shape or shapes that "fix" the forms surrounding the improvement. Make the improvement part of the existing surrounding.
- The use of material is essential in making any new improvement an integral part of the whole. Select materials that are as similar as possible to the surrounding architectural/engineering materials. Select materials from the same source if possible. Apply materials in the same quantity, manner, and method as original material.
- Size is an important feature in seamlessly blending the addition into its context. If possible, the overall size of the improvement should look very similar to the overall sizes of other similar objects in the improvement area.

Reflective Design

A reflective design borrows the characteristics, shapes, colors, materials, sizes and textures of the built surroundings. The result is a design that fits seamlessly and unobtrusively in its environment.

- The use of the word texture in terms of the structure applies predominantly to the selection of plant material. The materials used should as closely as possible, blend with the size and texture of other plant material used in the surrounding. The plants may or may not be the same, but should create a similar feel, either individually or as a mass.

Creating a Distinct Feature

Designing the rain garden as a distinct feature is limited only by budget, functionality, and client preference. There is far more latitude in designing a rain garden that serves as a distinct feature. If this is the intent, the main consideration beyond functionality is that the improvement create an attractive addition to its surroundings. The use of form, materials, color, and so forth focuses on the improvement itself and does not necessarily reflect the surroundings, depending on the choice of the client or designer.

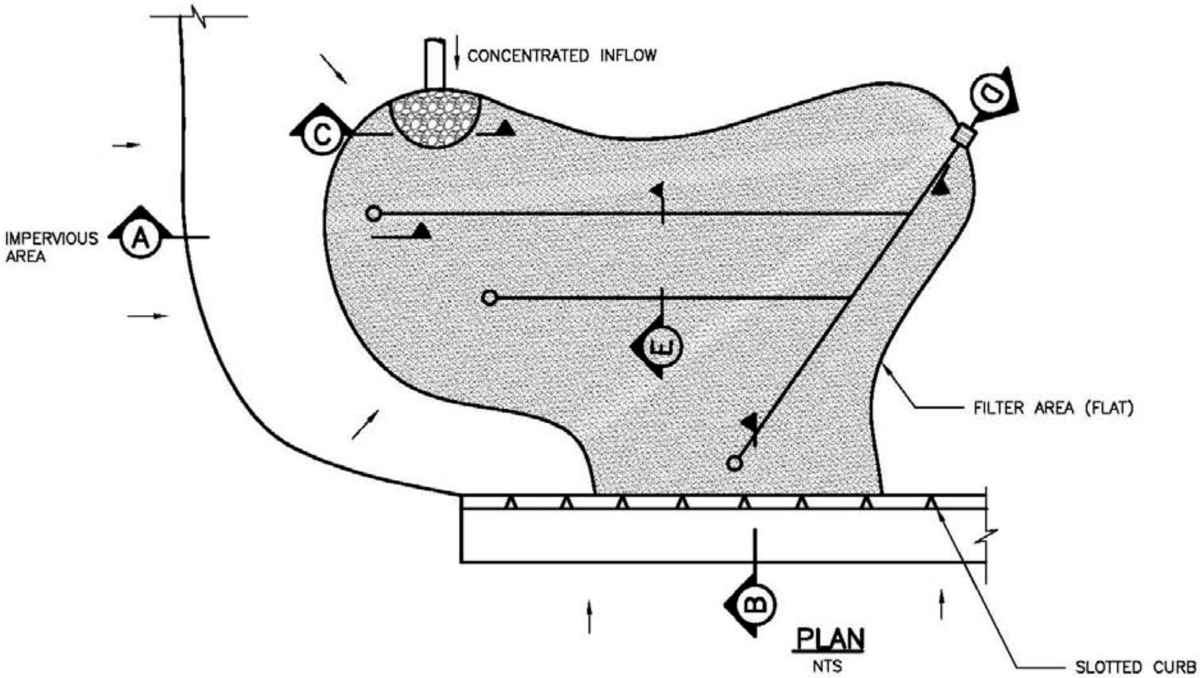
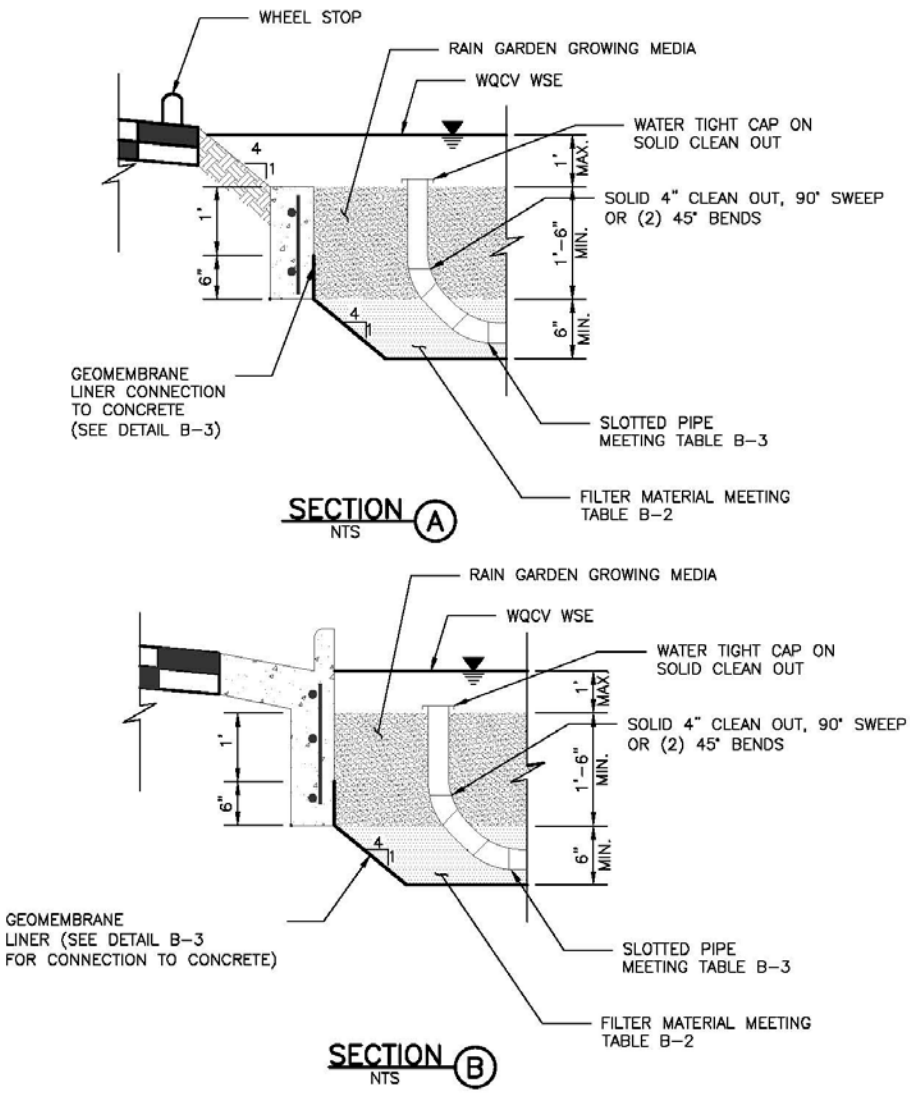
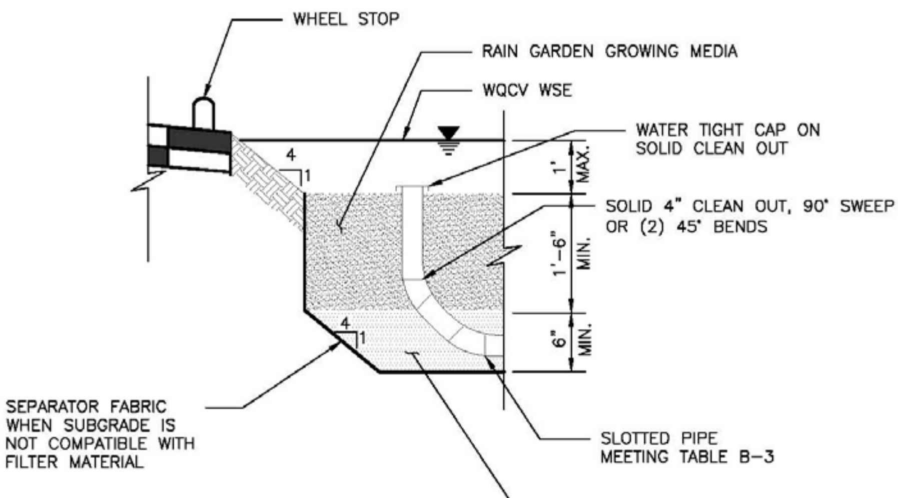


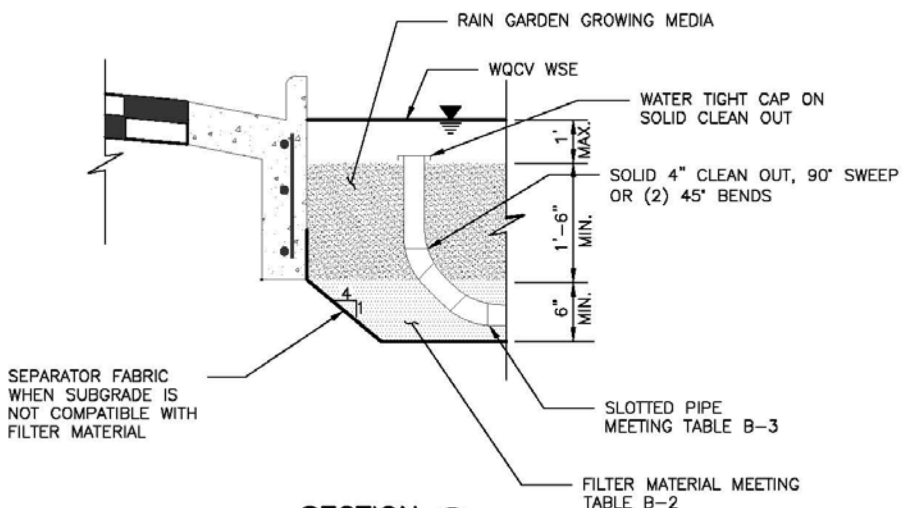
Figure B-1 – Typical Rain Garden Plan and Sections



NO-INFILTRATION SECTIONS

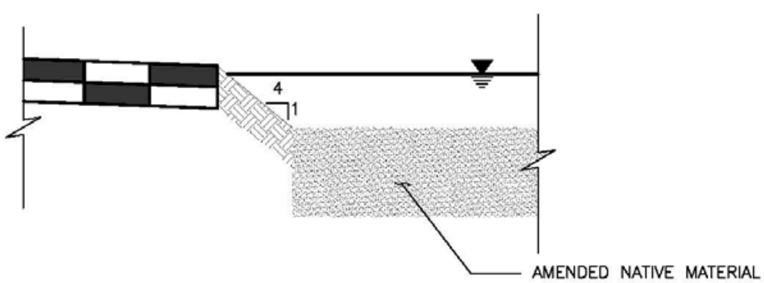


SECTION (A)
NTS



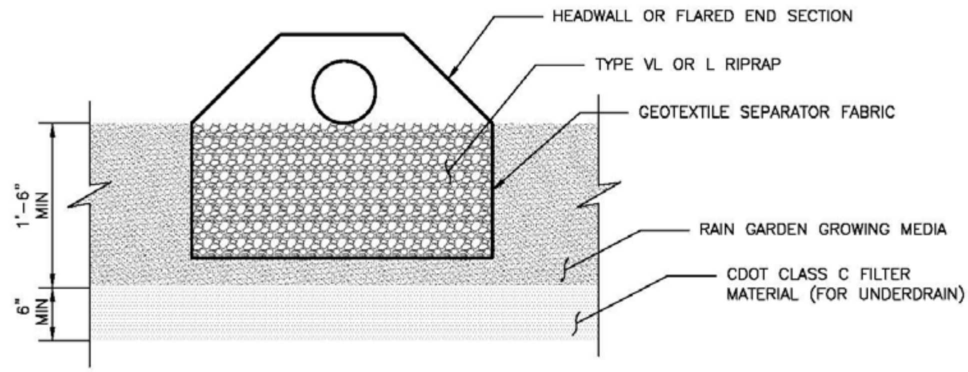
SECTION (B)
NTS

PARTIAL INFILTRATION SECTIONS

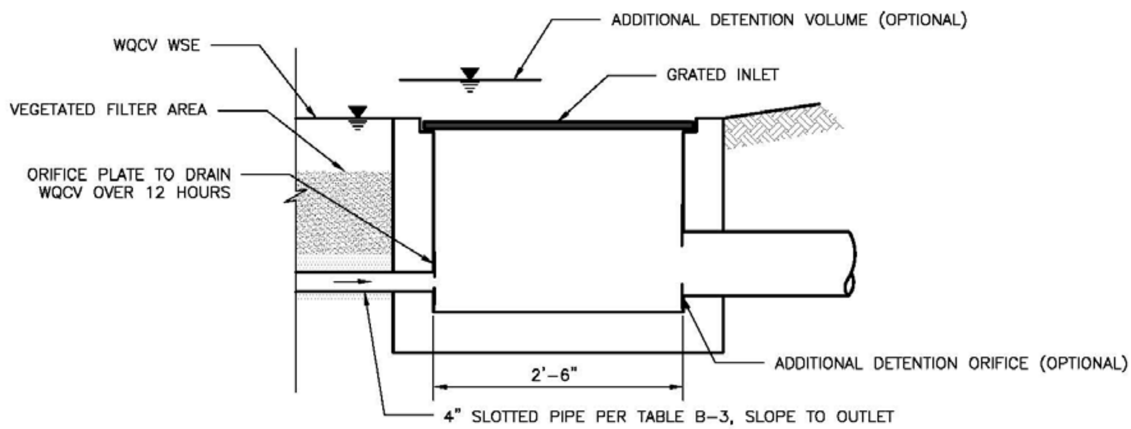


SECTION (A)
NTS

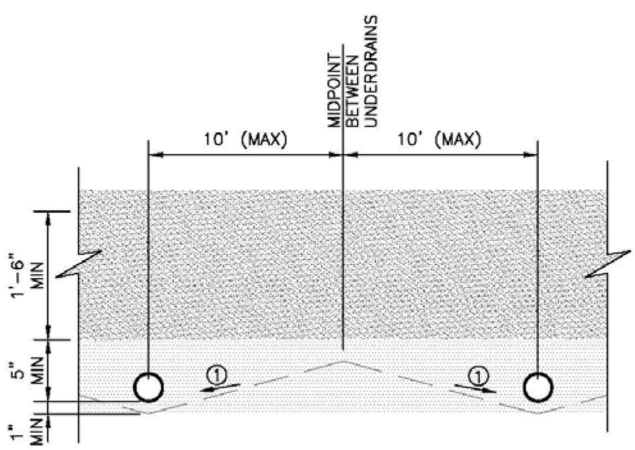
FULL INFILTRATION SECTION



SECTION C
NTS



SECTION D
NTS



① SLOPE (STRAIGHT GRADE) SUBGRADE (2–10%) TO UNDERDRAIN TO REDUCE SATURATED SOIL CONDITIONS BETWEEN STORM EVENTS (OPTIONAL)

SECTION E
NTS

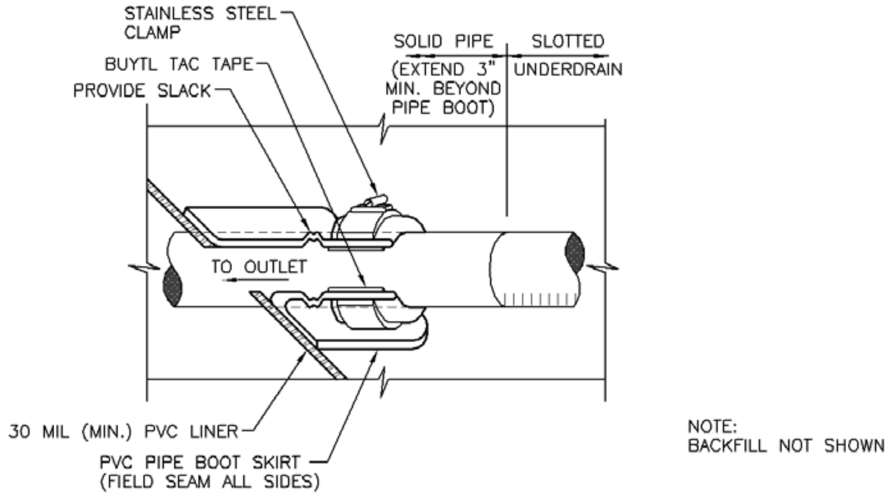


Figure B-2. Geomembrane Liner/Underdrain Penetration Detail

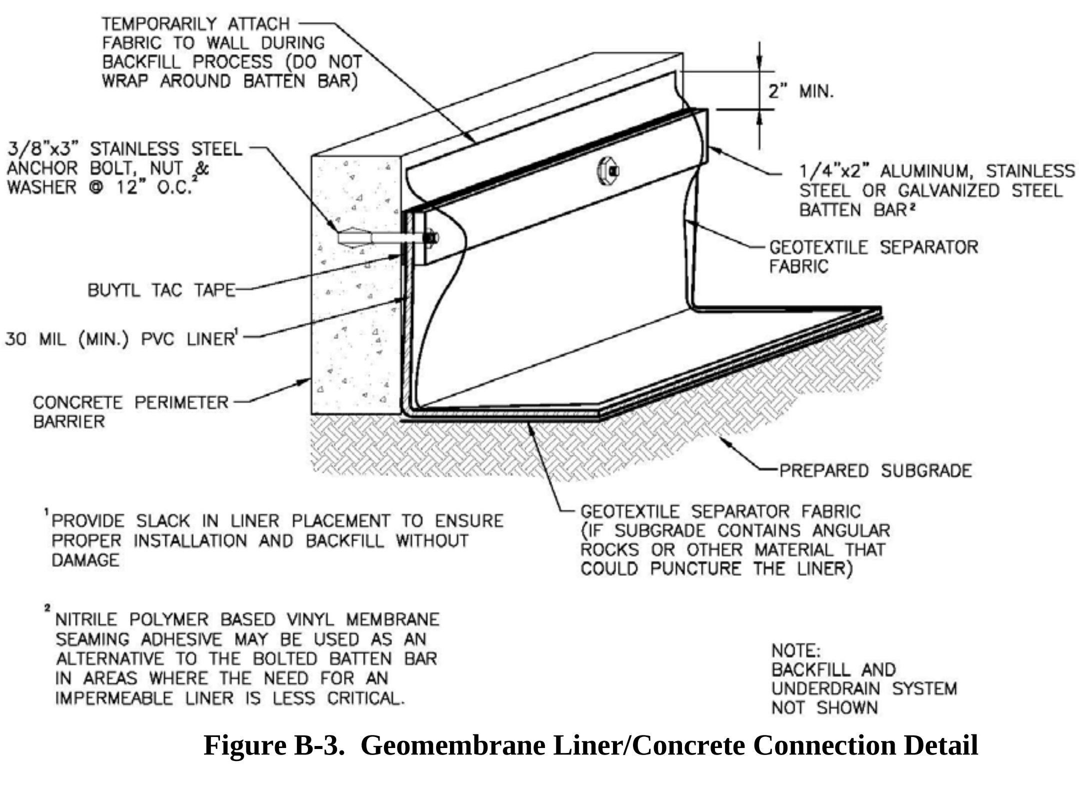


Figure B-3. Geomembrane Liner/Concrete Connection Detail

Construction Considerations

Proper construction of rain gardens involves careful attention to material specifications, final grades, and construction details. For a successful project, implement the following practices:

- Protect area from excessive sediment loading during construction. This is the most common cause of clogging of rain gardens. The portion of the site draining to the rain garden must be stabilized before allowing flow into the rain garden. This includes completion of paving operations.

- Avoid over compaction of the area to preserve infiltration rates (for partial and full infiltration sections).

- Provide construction observation to ensure compliance with design specifications. Improper installation, particularly related to facility dimensions and elevations and underdrain elevations, is a common problem with rain gardens.

Photograph B-3. Inadequate construction staking may have contributed to flows bypassing this rain garden.

- When using an impermeable liner, ensure enough slack in the liner to allow for backfill, compaction, and settling without tearing the liner.

- Provide necessary quality assurance and quality control (QA/QC) when constructing an impermeable geomembrane liner system, including but not limited to fabrication testing, destructive and non-destructive testing of field seams, observation of geomembrane material for tears or other defects, and air lace testing for leaks in all field seams and penetrations. QA/QC should be overseen by a professional engineer. Consider requiring field reports or other documentation from the engineer.

Photograph B-4. Runoff passed the upradient rain garden, shown in Photo B-3, and flooded this downstream rain garden.

- Provide adequate construction staking to ensure that the site properly drains into the facility, particularly with respect to surface drainage away from adjacent buildings. Photo B-3 and Photo B-4 illustrate a construction error for an otherwise correctly designed series of rain gardens.

Construction Example

Photograph B-5. Rain garden is staked out at the low point of the parking area prior to excavation.

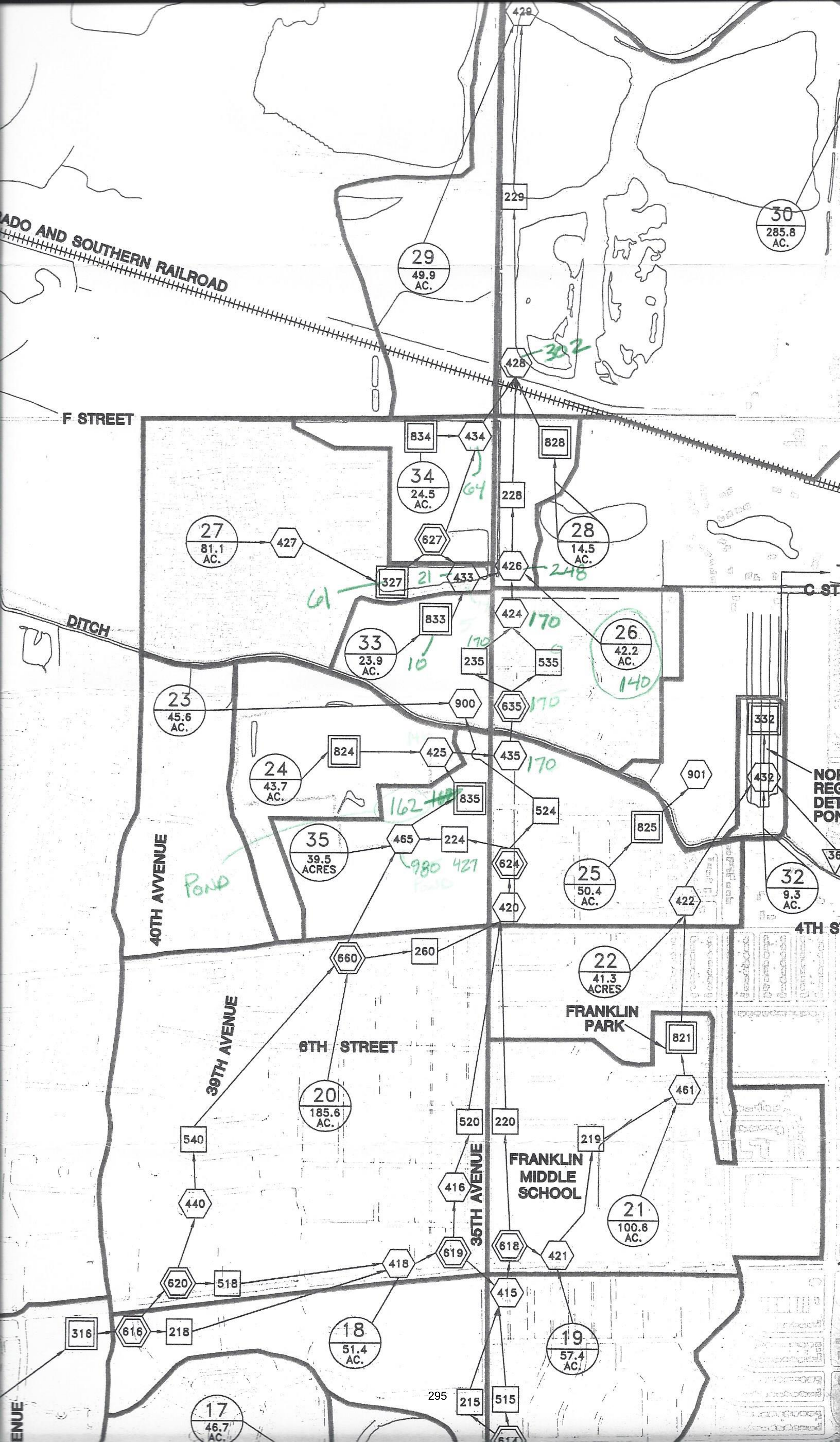
Photograph B-6. Curb and gutter is installed. Flush curbs with wheel stops or a slotted curb could have been used in lieu of the solid raised curb with concentrated inflow.

Photograph B-7. The aggregate layer is covered with a geotextile and growing media. This photo shows installation of the geotextile to separate the growing media from the aggregate layer below. Cleanouts for the underdrain system are also shown. Note: The current design section does not require this geotextile.

Photograph B-8. Shrubs and trees are placed outside of the ponding area and away from geotextiles.

Photograph B-9. This photo was taken during the first growing season of this rain garden. Better weed control in the first two to three years will help the desired vegetation to become established.

MASTER PLAN
FLOW INFORMATION


ADO AND SOUTHERN RAILROAD
F STREET
DITCH
C ST
40TH AVVENUE
39TH AVENUE
6TH STREET
36TH AVENUE
4TH ST
FRANKLIN PARK
FRANKLIN MIDDLE SCHOOL
NOR REG DET POND
ENUE
29 49.9 AC.
30 285.8 AC.
34 24.5 AC.
28 14.5 AC.
27 81.1 AC.
26 42.2 AC.
33 23.9 AC.
23 45.6 AC.
24 43.7 AC.
35 39.5 ACRES
25 50.4 AC.
32 9.3 AC.
22 41.3 ACRES
20 185.6 AC.
21 100.6 AC.
18 51.4 AC.
19 57.4 AC.
17 46.7 AC.
429
229
428
302
834
434
828
64
228
627
427
327
21
433
426
248
61
424
170
833
10
235
535
140
900
635
824
425
435
332
901
432
162
835
524
224
465
825
36
624
980
427
POND
420
422
660
260
821
461
219
540
520
220
440
416
619
618
421
620
518
418
415
316
616
218
215
515
614

8/ 2/41	8	30	0	102	0.000	93.326	93.326	93.326	0.000	93.461	0.000	93.461	138.572	4.278
8/ 2/41	8	35	0	103	0.000	92.571	92.571	92.571	0.000	92.706	0.000	92.706	138.069	4.243
8/ 2/41	8	40	0	104	0.000	91.832	91.832	91.832	0.000	91.963	0.000	91.963	137.564	4.208
8/ 2/41	8	45	0	105	0.000	91.099	91.099	91.099	0.000	91.230	0.000	91.230	137.057	4.174
8/ 2/41	8	50	0	106	0.000	90.369	90.369	90.369	0.000	90.500	0.000	90.500	136.547	4.139
8/ 2/41	8	55	0	107	0.000	89.623	89.623	89.623	0.000	89.758	0.000	89.758	136.034	4.105
8/ 2/41	9	0	0	108	0.000	88.898	88.898	88.898	0.000	89.032	0.000	89.032	135.519	4.071
8/ 2/41	9	5	0	109	0.000	88.184	88.184	88.184	0.000	88.341	0.000	88.341	135.002	4.038
8/ 2/41	9	10	0	110	0.000	87.471	87.471	87.471	0.000	87.639	0.000	87.639	134.483	4.005
8/ 2/41	9	15	0	111	0.000	86.765	86.765	86.765	0.000	86.881	0.000	86.881	133.961	3.972
8/ 2/41	9	20	0	112	0.000	86.067	86.067	86.067	0.000	86.201	0.000	86.201	133.437	3.939
8/ 2/41	9	25	0	113	0.000	85.380	85.380	85.380	0.000	85.504	0.000	85.504	132.912	3.907
8/ 2/41	9	30	0	114	0.000	84.694	84.694	84.694	0.000	84.822	0.000	84.822	132.385	3.874
8/ 2/41	9	35	0	115	0.000	83.994	83.994	83.994	0.000	84.124	0.000	84.124	131.856	3.843
8/ 2/41	9	40	0	116	0.000	83.315	83.315	83.315	0.000	83.439	0.000	83.439	131.325	3.811
8/ 2/41	9	45	0	117	0.000	82.642	82.642	82.642	0.000	82.766	0.000	82.766	130.792	3.780
8/ 2/41	9	50	0	118	0.000	81.974	81.974	81.974	0.000	82.097	0.000	82.097	130.258	3.748
8/ 2/41	9	55	0	119	0.000	81.310	81.310	81.310	0.000	81.432	0.000	81.432	129.723	3.718

AVERAGE FLOW....................	20.904	145.765	145.765	145.765	0.000	145.589	0.000	175.637	140.886	5.466
STANDARD DEVIATION OF FLOW......	4.533	8.530	8.530	8.530	0.000	8.542	0.000	17.116	3.096	0.172
MAXIMUM FLOW....................	168.351	427.950	427.950	427.950	0.000	427.972	0.000	979.989	162.340	7.999
MINIMUM FLOW....................	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000
FLOW VOLUME (CUBIC FEET)........	7.46E+05	5.20E+06	5.20E+06	5.20E+06	1.60E-02	5.20E+06	1.15E-02	6.27E+06	5.03E+06	1.95E+05

1

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*******************************************************
*     SELECTED OUTFLOW HYDROGRAPHS AND POLLUTOGRAPHS  *
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City of Greeley Comprehensive Drainage Plan Update - ACE Inc.
Grapevine Basin - Proposed Conditions - 100-Year Storm

ALL FLOW RATES ARE IN UNITS OF CFS.

DATE MO/DA/YR	TIME HR	MIN	SEC	TIME STEP	OUTFLOW 425	OUTFLOW 435	OUTFLOW 635	OUTFLOW 726	OUTFLOW 727	OUTFLOW 235	OUTFLOW 535	OUTFLOW 424	OUTFLOW 421	OUTFLOW 219
8/ 2/41	0	5	0	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.020	0.000
8/ 2/41	0	10	0	2	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.520	0.000
8/ 2/41	0	15	0	3	0.017	0.017	0.017	0.017	0.000	0.000	0.000	0.000	7.140	0.000
8/ 2/41	0	20	0	4	0.148	0.148	0.148	0.148	0.000	0.000	0.000	0.000	23.223	2.715
8/ 2/41	0	25	0	5	8.878	8.878	8.878	8.878	0.000	1.896	0.000	1.896	52.307	20.286
8/ 2/41	0	30	0	6	42.628	42.628	42.628	42.628	0.000	25.438	0.000	25.438	146.450	73.583
8/ 2/41	0	35	0	7	73.619	73.619	73.619	73.619	0.000	64.456	0.000	64.456	289.579	200.675
8/ 2/41	0	40	0	8	98.973	98.973	98.973	98.973	0.000	90.710	0.000	90.710	318.956	309.093
8/ 2/41	0	45	0	9	112.723	112.723	112.723	112.723	0.000	110.040	0.000	110.040	287.824	304.930
8/ 2/41	0	50	0	10	124.955	124.955	124.955	124.955	0.000	120.980	0.000	120.980	254.553	272.299
8/ 2/41	0	55	0	11	134.589	134.589	134.589	134.589	0.000	132.342	0.000	132.342	228.798	242.647
8/ 2/41	1	0	0	12	142.300	142.300	142.300	142.300	0.000	140.123	0.000	140.123	206.820	219.145
8/ 2/41	1	5	0	13	148.929	148.929	148.929	148.929	0.000	147.307	0.000	147.307	192.573	200.601
8/ 2/41	1	10	0	14	154.341	154.341	154.341	154.341	0.000	152.906	0.000	152.906	166.097	182.235
8/ 2/41	1	15	0	15	158.022	158.022	158.022	158.022	0.000	157.213	0.000	157.213	121.724	149.871
8/ 2/41	1	20	0	16	160.949	160.949	160.949	160.949	0.000	160.151	0.000	160.151	72.407	106.277
8/ 2/41	1	25	0	17	163.363	163.363	163.363	163.363	0.000	162.786	0.000	162.786	31.077	64.257
8/ 2/41	1	30	0	18	165.308	165.308	165.308	165.308	0.000	164.802	0.000	164.802	16.780	33.178
8/ 2/41	1	35	0	19	166.773	166.773	166.773	166.773	0.000	166.429	0.000	166.429	13.428	19.881
8/ 2/41	1	40	0	20	167.824	167.824	167.824	167.824	0.000	167.562	0.000	167.562	11.622	15.048
8/ 2/41	1	45	0	21	168.571	168.571	168.571	168.571	0.000	168.416	0.000	168.416	10.310	12.597
8/ 2/41	1	50	0	22	169.105	169.105	169.105	169.105	0.000	168.991	0.000	168.991	9.513	11.022
8/ 2/41	1	55	0	23	169.489	169.489	169.489	169.489	0.000	169.418	0.000	169.418	9.327	10.008
8/ 2/41	2	0	0	24	169.785	169.785	169.785	169.785	0.000	169.735	0.000	169.735	9.190	9.556
8/ 2/41	2	5	0	25	170.026	170.026	170.026	170.026	0.000	169.992	0.000	169.992	7.392	9.372
8/ 2/41	2	10	0	26	170.193	170.193	170.193	170.193	0.000	170.145	0.000	170.145	4.688	8.320
8/ 2/41	2	15	0	27	170.250	170.250	170.250	170.250	0.000	170.246	0.000	170.246	2.820	6.400
8/ 2/41	2	20	0	28	170.196	170.196	170.196	170.196	0.000	170.214	0.000	170.214	1.656	4.658
8/ 2/41	2	25	0	29	170.060	170.060	170.060	170.060	0.000	170.099	0.000	170.099	0.064	4.017
8/ 2/41	2	30	0	30	169.864	169.864	169.864	169.864	0.000	169.917	0.000	169.917	0.000	2.249
8/ 2/41	2	35	0	31	169.627	169.627	169.627	169.627	0.000	169.690	0.000	169.690	0.000	1.291
8/ 2/41	2	40	0	32	169.364	169.364	169.364	169.364	0.000	169.434	0.000	169.434	0.000	0.824
8/ 2/41	2	45	0	33	169.084	169.084	169.084	169.084	0.000	169.157	0.000	169.157	0.000	0.562
8/ 2/41	2	50	0	34	168.792	168.792	168.792	168.792	0.000	168.868	0.000	168.868	0.000	0.402
8/ 2/41	2	55	0	35	168.490	168.490	168.490	168.490	0.000	168.569	0.000	168.569	0.000	0.299
8/ 2/41	3	0	0	36	168.183	168.183	168.183	168.183	0.000	168.262	0.000	168.262	0.000	0.229
8/ 2/41	3	5	0	37	167.874	167.874	167.874	167.874	0.000	167.953	0.000	167.953	0.000	0.180
8/ 2/41	3	10	0	38	167.562	167.562	167.562	167.562	0.000	167.642	0.000	167.642	0.000	0.144
8/ 2/41	3	15	0	39	167.249	167.249	167.249	167.249	0.000	167.330	0.000	167.330	0.000	0.118
8/ 2/41	3	20	0	40	166.935	166.935	166.935	166.935	0.000	167.017	0.000	167.017	0.000	0.098
8/ 2/41	3	25	0	41	166.619	166.619	166.619	166.619	0.000	166.706	0.000	166.706	0.000	0.082
8/ 2/41	3	30	0	42	166.302	166.302	166.302	166.302	0.000	166.392	0.000	166.392	0.000	0.069
8/ 2/41	3	35	0	43	165.983	165.983	165.983	165.983	0.000	166.077	0.000	166.077	0.000	0.060
8/ 2/41	3	40	0	44	165.663	165.663	165.663	165.663	0.000	165.760	0.000	165.760	0.000	0.051
8/ 2/41	3	45	0	45	165.341	165.341	165.341	165.341	0.000	165.441	0.000	165.441	0.000	0.045
8/ 2/41	3	50	0	46	165.018	165.018	165.018	165.018	0.000	165.121	0.000	165.121	0.000	0.039
8/ 2/41	3	55	0	47	164.694	164.694	164.694	164.694	0.000	164.800	0.000	164.800	0.000	0.035
8/ 2/41	4	0	0	48	164.368	164.368	164.368	164.368	0.000	164.477	0.000	164.477	0.000	0.031
8/ 2/41	4	5	0	49	164.040	164.040	164.040	164.040	0.000	164.153	0.000	164.153	0.000	0.028

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City of Greeley Comprehensive Drainage Plan Update - ACE Inc.
Grapevine Basin - Proposed Conditions - 100-Year Storm

ALL FLOW RATES ARE IN UNITS OF CFS.

DATE MO/DA/YR	TIME HR	MIN	SEC	TIME STEP	OUTFLOW 425	OUTFLOW 435	OUTFLOW 635	OUTFLOW 726	OUTFLOW 727	OUTFLOW 235	OUTFLOW 535	OUTFLOW 424	OUTFLOW 421	OUTFLOW 219
8/ 2/41	4	10	0	50	163.712	163.712	163.712	163.712	0.000	163.789	0.000	163.789	0.000	0.025
8/ 2/41	4	15	0	51	163.382	163.382	163.382	163.382	0.000	163.471	0.000	163.471	0.000	0.022
8/ 2/41	4	20	0	52	163.052	163.052	163.052	163.052	0.000	163.137	0.000	163.137	0.000	0.020
8/ 2/41	4	25	0	53	162.720	162.720	162.720	162.720	0.000	162.807	0.000	162.807	0.000	0.018
8/ 2/41	4	30	0	54	162.388	162.388	162.388	162.388	0.000	162.475	0.000	162.475	0.000	0.017
8/ 2/41	4	35	0	55	162.055	162.055	162.055	162.055	0.000	162.142	0.000	162.142	0.000	0.015
8/ 2/41	4	40	0	56	161.721	161.721	161.721	161.721	0.000	161.808	0.000	161.808	0.000	0.015
8/ 2/41	4	45	0	57	161.386	161.386	161.386	161.386	0.000	161.474	0.000	161.474	0.000	0.015

MO/DA/YR	HR:MIN:SEC	STEP	725	833	433	426	228	834	434	828	428	229
8/ 2/41	0 5 0	1	0.000	0.000	0.000	0.011	0.000	0.000	0.000	0.000	0.000	0.000
8/ 2/41	0 10 0	2	0.000	0.003	0.006	0.276	0.000	0.005	0.005	0.002	0.007	0.000
8/ 2/41	0 15 0	3	0.000	0.048	0.091	3.851	0.000	0.071	0.071	0.026	0.097	0.000
8/ 2/41	0 20 0	4	0.000	0.229	0.430	13.297	0.366	0.350	0.350	0.112	0.828	0.000
8/ 2/41	0 25 0	5	0.000	0.644	1.265	32.723	6.331	0.995	0.995	0.350	7.676	0.000
8/ 2/41	0 30 0	6	0.000	1.532	3.319	111.597	30.962	2.325	2.325	1.032	34.319	0.000
8/ 2/41	0 35 0	7	0.000	3.025	6.934	207.355	117.842	4.523	4.523	2.203	124.568	0.000
8/ 2/41	0 40 0	8	0.000	4.696	10.856	240.651	190.917	6.987	6.987	3.473	201.377	22.062
8/ 2/41	0 45 0	9	0.000	6.109	13.973	247.764	238.402	9.062	9.062	4.602	252.067	79.298
8/ 2/41	0 50 0	10	0.000	7.213	16.008	243.899	234.163	10.661	10.661	5.570	250.394	128.501
8/ 2/41	0 55 0	11	0.000	8.063	17.603	242.384	242.702	11.870	11.870	6.392	260.964	178.694
8/ 2/41	1 0 0	12	0.000	8.705	18.795	237.388	238.261	12.760	12.760	7.080	258.101	195.009
8/ 2/41	1 5 0	13	0.000	9.172	19.682	235.151	236.904	13.383	13.383	7.637	257.925	222.825
8/ 2/41	1 10 0	14	10.131	9.509	20.309	231.183	234.328	13.816	23.947	8.021	266.296	227.085
8/ 2/41	1 15 0	15	50.052	9.732	20.532	221.945	229.442	14.082	64.134	8.222	301.798	234.848
8/ 2/41	1 20 0	16	45.123	9.851	20.651	210.912	220.367	14.195	59.318	8.299	287.985	261.114
8/ 2/41	1 25 0	17	32.615	9.898	20.698	205.335	210.757	14.200	46.814	8.298	265.869	277.797
8/ 2/41	1 30 0	18	21.486	9.896	20.696	201.668	205.143	14.127	35.613	8.243	248.999	264.666
8/ 2/41	1 35 0	19	13.495	9.862	20.662	199.666	201.622	14.007	27.502	8.151	237.275	261.497
8/ 2/41	1 40 0	20	8.519	9.811	20.611	198.599	199.653	13.862	22.381	8.036	230.070	253.579
8/ 2/41	1 45 0	21	5.493	9.753	20.553	197.808	198.545	13.706	19.199	7.903	225.648	245.230
8/ 2/41	1 50 0	22	3.560	9.691	20.491	197.193	197.756	13.549	17.109	7.762	222.627	238.118
8/ 2/41	1 55 0	23	2.498	9.629	20.429	196.817	197.174	13.393	15.890	7.619	220.684	232.233
8/ 2/41	2 0 0	24	2.009	9.569	20.369	196.843	196.863	13.240	15.250	7.478	219.592	227.696
8/ 2/41	2 5 0	25	0.864	9.499	20.299	195.959	196.651	13.077	13.940	7.334	217.926	224.738
8/ 2/41	2 10 0	26	0.000	9.404	20.195	194.433	195.702	12.875	12.875	7.166	215.743	222.447
8/ 2/41	2 15 0	27	0.000	9.284	20.053	193.089	194.281	12.633	12.633	6.981	213.896	220.118
8/ 2/41	2 20 0	28	0.000	9.140	19.880	191.962	192.976	12.355	12.355	6.800	212.131	217.968
8/ 2/41	2 25 0	29	0.000	8.986	19.689	189.860	191.615	12.061	12.061	6.624	210.299	215.996
8/ 2/41	2 30 0	30	0.000	8.834	19.497	189.415	189.961	11.773	11.773	6.452	208.186	214.152
8/ 2/41	2 35 0	31	0.000	8.684	19.308	188.998	189.385	11.492	11.492	6.285	207.162	211.924
8/ 2/41	2 40 0	32	0.000	8.537	19.121	188.555	188.945	11.218	11.218	6.122	206.285	210.161
8/ 2/41	2 45 0	33	0.000	8.392	18.937	188.094	188.498	10.951	10.951	5.963	205.412	208.765
8/ 2/41	2 50 0	34	0.000	8.250	18.756	187.624	188.037	10.690	10.690	5.808	204.535	207.588
8/ 2/41	2 55 0	35	0.000	8.110	18.577	187.145	187.565	10.435	10.435	5.657	203.658	206.536
8/ 2/41	3 0 0	36	0.000	7.973	18.400	186.663	187.087	10.187	10.187	5.511	202.784	205.556
8/ 2/41	3 5 0	37	0.000	7.838	18.227	186.180	186.605	9.944	9.944	5.368	201.916	204.619
8/ 2/41	3 10 0	38	0.000	7.705	18.055	185.697	186.122	9.707	9.707	5.229	201.057	203.709
8/ 2/41	3 15 0	39	0.000	7.575	17.886	185.216	185.640	9.475	9.475	5.093	200.208	202.817
8/ 2/41	3 20 0	40	0.000	7.447	17.719	184.736	185.158	9.249	9.249	4.961	199.368	201.940
8/ 2/41	3 25 0	41	0.000	7.320	17.555	184.261	184.680	9.029	9.029	4.832	198.541	201.077
8/ 2/41	3 30 0	42	0.000	7.196	17.393	183.784	184.204	8.814	8.814	4.707	197.724	200.225
8/ 2/41	3 35 0	43	0.000	7.075	17.233	183.309	183.727	8.604	8.604	4.585	196.916	199.386
8/ 2/41	3 40 0	44	0.000	6.955	17.075	182.835	183.252	8.399	8.399	4.466	196.117	198.557
8/ 2/41	3 45 0	45	0.000	6.837	16.921	182.362	182.778	8.198	8.198	4.350	195.326	197.739
8/ 2/41	3 50 0	46	0.000	6.721	16.770	181.891	182.306	8.003	8.003	4.237	194.546	196.929
8/ 2/41	3 55 0	47	0.000	6.607	16.621	181.421	181.835	7.812	7.812	4.127	193.774	196.130
8/ 2/41	4 0 0	48	0.000	6.496	16.475	180.952	181.365	7.626	7.626	4.020	193.011	195.340
8/ 2/41	4 5 0	49	0.000	6.386	16.330	180.484	180.896	7.444	7.444	3.916	192.256	194.559

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City of Greeley Comprehensive Drainage Plan Update - ACE Inc.
Grapevine Basin - Proposed Conditions - 100-Year Storm

ALL FLOW RATES ARE IN UNITS OF CFS.

DATE MO/DA/YR	TIME HR:MIN:SEC	TIME STEP	OUTFLOW 725	OUTFLOW 833	OUTFLOW 433	OUTFLOW 426	OUTFLOW 228	OUTFLOW 834	OUTFLOW 434	OUTFLOW 828	OUTFLOW 428	OUTFLOW 229
8/ 2/41	4 10 0	50	0.000	6.277	16.188	179.977	180.419	7.267	7.267	3.814	191.500	193.789
8/ 2/41	4 15 0	51	0.000	6.171	16.042	179.513	179.925	7.094	7.094	3.715	190.734	193.028
8/ 2/41	4 20 0	52	0.000	6.067	15.895	179.032	179.454	6.925	6.925	3.619	189.997	192.257
8/ 2/41	4 25 0	53	0.000	5.964	15.750	178.557	178.975	6.759	6.759	3.525	189.260	191.500
8/ 2/41	4 30 0	54	0.000	5.863	15.607	178.082	178.501	6.598	6.598	3.434	188.533	190.749
8/ 2/41	4 35 0	55	0.000	5.764	15.466	177.608	178.043	6.441	6.441	3.344	187.828	190.002
8/ 2/41	4 40 0	56	0.000	5.666	15.326	177.134	177.605	6.288	6.288	3.258	187.150	189.267
8/ 2/41	4 45 0	57	0.000	5.570	15.189	176.663	177.156	6.138	6.138	3.173	186.467	188.556
8/ 2/41	4 50 0	58	0.000	5.476	15.053	176.192	176.707	5.991	5.991	3.091	185.789	187.856
8/ 2/41	4 55 0	59	0.000	5.383	14.919	175.721	176.258	5.849	5.849	3.011	185.118	187.163
8/ 2/41	5 0 0	60	0.000	5.292	14.787	175.252	175.713	5.709	5.709	2.933	184.354	186.502
8/ 2/41	5 5 0	61	0.000	5.202	14.657	174.784	175.232	5.573	5.573	2.857	183.662	185.781
8/ 2/41	5 10 0	62	0.000	5.114	14.528	174.317	174.763	5.440	5.440	2.782	182.985	185.068
8/ 2/41	5 15 0	63	0.000	5.027	14.401	173.850	174.295	5.311	5.311	2.710	182.316	184.368
8/ 2/41	5 20 0	64	0.000	4.942	14.276	173.385	173.829	5.184	5.184	2.640	181.653	183.702
8/ 2/41	5 25 0	65	0.000	4.859	14.152	172.920	173.363	5.060	5.060	2.571	180.995	183.037
8/ 2/41	5 30 0	66	0.000	4.776	14.030	172.456	172.898	4.940	4.940	2.505	180.343	182.374
8/ 2/41	5 35 0	67	0.000	4.695	13.909	171.992	172.434	4.822	4.822	2.440	179.696	181.752
8/ 2/41	5 40 0	68	0.000	4.616	13.790	171.529	171.970	4.707	4.707	2.377	179.054	181.134
8/ 2/41	5 45 0	69	0.000	4.538	13.673	171.066	171.507	4.595	4.595	2.315	178.417	180.516
8/ 2/41	5 50 0	70	0.000	4.461	13.557	170.604	171.045	4.485	4.485	2.255	177.785	179.899
8/ 2/41	5 55 0	71	0.000	4.385	13.442	170.142	170.582	4.378	4.378	2.196	177.157	179.235
8/ 2/41	6 0 0	72	0.000	4.311	13.329	169.680	170.120	4.274	4.274	2.139	176.533	178.583
8/ 2/41	6 5 0	73	0.000	4.238	13.217	169.218	169.658	4.172	4.172	2.084	175.914	177.942
8/ 2/41	6 10 0	74	0.000	4.166	13.107	168.758	169.196	4.073	4.073	2.030	175.299	177.308
8/ 2/41	6 15 0	75	0.000	4.096	12.998	168.301	168.737	3.976	3.976	1.977	174.690	176.680
8/ 2/41	6 20 0	76	0.000	4.026	12.890	167.842	168.280	3.881	3.881	1.926	174.086	176.058
8/ 2/41	6 25 0	77	0.000	3.958	12.784	167.382	167.820	3.788	3.788	1.876	173.485	175.443
8/ 2/41	6 30 0	78	0.000	3.891	12.679	166.921	167.360	3.698	3.698	1.827	172.886	174.832
8/ 2/41	6 35 0	79	0.000	3.825	12.576	166.460	166.900	3.610	3.610	1.780	172.289	174.225
8/ 2/41	6 40 0	80	0.000	3.761	12.473	165.997	166.438	3.524	3.524	1.734	171.695	173.622
8/ 2/41	6 45 0	81	0.000	3.697	12.372	165.493	165.967	3.440	3.440	1.689	171.096	173.024
8/ 2/41	6 50 0	82	0.000	3.634	12.272	165.033	165.477	3.358	3.358	1.645	170.480	172.430
8/ 2/41	6 55 0	83	0.000	3.573	12.174	164.556	165.009	3.278	3.278	1.602	169.889	171.820
8/ 2/41	7 0 0	84	0.000	3.512	12.076	164.079	164.533	3.200	3.200	1.561	169.294	171.219
8/ 2/41	7 5 0	85	0.000	3.453	11.980	163.597	164.056	3.124	3.124	1.520	168.700	170.620
8/ 2/41	7 10 0	86	0.000	3.394	11.885	163.054	163.563	3.049	3.049	1.481	168.093	170.026
8/ 2/41	7 15 0	87	0.000	3.337	11.791	162.467	163.019	2.976	2.976	1.442	167.438	169.440
8/ 2/41	7 20 0	88	0.000	3.280	11.698	161.890	162.440	2.905	2.905	1.405	166.751	168.836
8/ 2/41	7 25 0	89	0.000	3.225	11.607	161.306	161.862	2.836	2.836	1.368	166.067	168.198
8/ 2/41	7 30 0	90	0.000	3.170	11.516	160.721	161.278	2.769	2.769	1.333	165.380	167.543
8/ 2/41	7 35 0	91	0.000	3.116	11.426	160.132	160.693	2.703	2.703	1.298	164.694	166.875
8/ 2/41	7 40 0	92	0.000	3.064	11.338	159.541	160.104	2.638	2.638	1.265	164.007	166.200
8/ 2/41	7 45 0	93	0.000	3.012	11.251	158.947	159.512	2.575	2.575	1.232	163.320	165.520
8/ 2/41	7 50 0	94	0.000	2.961	11.164	158.350	158.918	2.514	2.514	1.200	162.632	164.838
8/ 2/41	7 55 0	95	0.000	2.911	11.079	157.752	158.322	2.454	2.454	1.169	161.945	164.153
8/ 2/41	8 0 0	96	0.000	2.861	10.995	157.151	157.723	2.395	2.395	1.138	161.257	163.468
8/ 2/41	8 5 0	97	0.000	2.813	10.911	156.547	157.122	2.338	2.338	1.109	160.569	162.781
8/ 2/41	8 10 0	98	0.000	2.765	10.829	155.942	156.518	2.283	2.283	1.080	159.881	162.094
8/ 2/41	8 15 0	99	0.000	2.718	10.747	155.337	155.913	2.228	2.228	1.052	159.194	161.407

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DATE MO/DA/YR	TIME HR:MIN:SEC	TIME STEP	OUTFLOW 725	OUTFLOW 833	OUTFLOW 433	OUTFLOW 426	OUTFLOW 228	OUTFLOW 834	OUTFLOW 434	OUTFLOW 828	OUTFLOW 428	OUTFLOW 229
8/ 2/41	8 20 0	100	0.000	2.672	10.667	154.737	155.309	2.175	2.175	1.025	158.509	160.719
8/ 2/41	8 25 0	101	0.000	2.627	10.587	154.130	154.708	2.123	2.123	0.998	157.829	160.031
8/ 2/41	8 30 0	102	0.000	2.583	10.509	153.524	154.102	2.073	2.073	0.972	157.147	159.346
8/ 2/41	8 35 0	103	0.000	2.539	10.431	152.915	153.495	2.023	2.023	0.947	156.465	158.663
8/ 2/41	8 40 0	104	0.000	2.496	10.354	152.265	152.879	1.975	1.975	0.923	155.776	157.982
8/ 2/41	8 45 0	105	0.000	2.454	10.278	151.658	152.242	1.928	1.928	0.899	155.068	157.303
8/ 2/41	8 50 0	106	0.000	2.412	10.203	151.035	151.627	1.882	1.882	0.875	154.385	156.606
8/ 2/41	8 55 0	107	0.000	2.371	10.129	150.416	151.007	1.837	1.837	0.853	153.696	155.915
8/ 2/41	9 0 0	108	0.000	2.331	10.055	149.794	150.387	1.793	1.793	0.831	153.011	155.225
8/ 2/41	9 5 0	109	0.000	2.292	9.982	149.171	149.765	1.751	1.751	0.809	152.324	154.537

CITY OF GREELEY
COMPREHENSIVE DRAINAGE PLAN

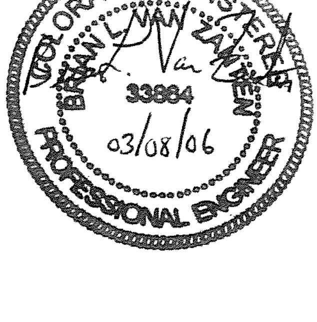
GRAPEVINE BASIN
FINAL REPORT

Prepared for:

City of Greeley
Public Works Department
1001 Ninth Avenue
Greeley, CO 80631

Prepared by:

Anderson Consulting Engineers, Inc.
772 Whalers Way, Suite 200
Fort Collins, CO 80525
(ACE Project No. COCOG05)



March 8, 2006

cfs. The 100-year existing condition discharge in the channel at the Greeley No. 3 Ditch is approximately 724 cfs.

3.3 Storm Sewers

The principal storm sewers as inventoried in the 1997 Grapevine Basin Comp Plan included the following: (a) 47th Avenue Storm Sewer; (b) 16th Street Storm Sewer; (c) 35th Avenue Storm Sewer; (d) 10th Street Storm Sewer; (e) 4th Street Storm Sewer; and (f) Franklin Park Storm Sewer. Table 3.1 summarizes the location, condition, and hydraulic capacity of each storm sewer.

47th Avenue Storm Sewer. This storm sewer originates in the vicinity of Monfort Elementary School and extends north along 47th Avenue to 20th Street. Recent improvements associated with the Monfort Park Regional Detention Pond have extended the storm sewer farther south along 47th Avenue to the pond outlet. At the intersection of 47th Avenue and 20th Street, the storm sewer crosses 47th Avenue and continues east along 20th Street to 46th Avenue. With the exception of two small sections of 42-inch reinforced concrete pipe and 42-inch ductile iron pipe, the storm sewer consists of a 36-inch RCP with a maximum capacity estimated to be 73 cfs.

16th Street Storm Sewer. The intersection of 46th Avenue and 20th Street marks the beginning of the 16th Street Storm Sewer. At this point, the 42-inch ductile iron pipe (47th Avenue Storm Sewer) transitions to a 60-inch CMP that continues north along 46th Avenue to 16th Street. The maximum capacity of the 60-inch CMP in this section of storm sewer is approximately 155 cfs. At the intersection of 16th Street and 46th Avenue, stormwater runoff conveyed in the 60-inch CMP is commingled with flows collected by a 42-inch CMP adjacent to 16th Street and extending west to 47th Avenue. The 42-inch CMP has a maximum capacity estimated to be 84 cfs. From the 16th Street intersection with 46th Avenue to 40th Avenue, the 60-inch CMP continues east along the south side of 16th Street with a maximum capacity of 134 cfs; from 40th Avenue to the upstream end of 16th Street, the culvert has a maximum capacity of approximately 118 cfs. The 60-inch CMP ultimately conveys stormwater runoff to the grass-lined channel within Bittersweet Park.

35th Avenue Storm Sewer. The 35th Avenue Storm Sewer extends from 16th Street to C Street, ranging in size from an 18-inch RCP to a 68"H x 106"W HERCP. The 18-inch RCP, which increases in size to a 30-inch RCP, extends from 16th Street to the outlet pipe from the Bittersweet Park Detention Pond, and has a maximum capacity of approximately 16 cfs. Downstream of Bittersweet Park Detention Pond, the storm sewer transitions to a 48-inch RCP with a maximum capacity estimated to be 120 cfs. Between 10th Street and 8th Street, the storm sewer is a 54-inch RCP with a maximum capacity of 165 cfs; between 8th Street and 4th Street, the storm sewer increases in size to a 60-inch RCP with a maximum capacity of 233 cfs. The storm sewer from 4th Street to the Greeley No. 3 Ditch transitions to a 66-inch RCP with a maximum capacity of 498 cfs. Downstream of the Greeley No. 3 Ditch to Village Drive, the storm sewer increases in size to a 72-inch RCP with a capacity of 483 cfs; from Village Drive to C Street, the storm sewer transitions to a 68"H x 106"W HERCP with a capacity of approximately 452 cfs. The 35th Avenue Storm Sewer terminates immediately downstream of C Street where stormwater runoff is conveyed from the HERCP to the 35th Avenue Outfall Channel.

10th Street Storm Sewer. The 10th Street Storm Sewer originates near 43rd Avenue and Ward Drive south of 10th Street, and extends eastward along 10th Street ultimately connecting with the 35th Avenue Storm Sewer. The storm sewer consists of a 15-inch RCP that increases to a 24-inch RCP, with a maximum capacity of approximately 29 cfs.

4th Street Storm Sewer. The 4th Street Storm Sewer originates near 40th Avenue and extends eastward along 4th Street, also connecting with the 35th Avenue Storm Sewer. The storm sewer ranges in diameter from an 18-inch RCP to a 54-inch RCP, with a maximum capacity of 165 cfs.

32nd Avenue Storm Sewer. The 32nd Avenue Storm Sewer crosses 10th Street at 32nd Avenue, with several laterals that route runoff from the south to this intersection. The storm sewer extends to the north between two storage buildings and daylights into the Franklin Middle School Channel (described in Section 3.4). The storm sewer is a 36-inch RCP as it crosses 10th Street and has a maximum capacity of approximately 66 cfs.

Franklin Park Storm Sewer. This storm sewer consists of a 48-inch RCP located along the secondary drainageway immediately south of Franklin Park, with the inlet at the upstream face of 30th Avenue Place. The storm sewer receives flow from the Franklin Middle School Channel. The maximum capacity of the storm sewer is estimated to be 170 cfs.

3.4 Open Channels

Three open channels are found in the Grapevine Basin as inventoried for the 1997 Comp Plan; one additional channel has been constructed since the completion of that plan. A description of each is presented below. In addition, the location, condition, and hydraulic capacity of each channel are summarized in Table 3.1.

16th Street Channel. This channel is located along the south side of 16th Street and extends from 46th Avenue to Bittersweet Park. Near 46th Avenue, the channel has a trapezoidal shape with an 8-foot bottom width, average depth of 1.8 feet, sideslopes of 7H:1V and an average longitudinal slope of 1.4 percent. In the vicinity of Bittersweet Park, the channel transitions to a 20-foot bottom width, average depth of 4.2 feet, sideslopes of 4H:1V, and a longitudinal slope of 1.5 percent. The bankfull capacity of the 16th Street Channel ranges from approximately 170 cfs near 46th Avenue to 1,500 cfs in the vicinity of Bittersweet Park.

35th Avenue Outfall Channel. Stormwater runoff captured along the major drainageway and conveyed by the 35th Avenue Storm Sewer is ultimately released into the 35th Avenue Outfall Channel. This channel originates immediately downstream of C Street and extends northward to the Cache La Poudre River. The typical configuration of the outfall channel includes a bottom width of 15 feet, sideslopes ranging from 1H:1V to 2H:1V, and an average depth of 5.4 feet. The channel slope varies from 0.2 percent in the reach from C Street to F Street to 0.12 percent from F Street to the river. The bankfull capacity of the outfall channel ranges from 470 cfs upstream (south) of F Street to approximately 300 cfs downstream (north) of F Street.

Franklin Middle School Channel. This channel is located along the secondary drainageway immediately east of Franklin Middle School. The channel is trapezoidal in shape with an average bottom width of 9 feet, sideslopes between 1H:1V and 2H:1V, average depth of 2.3 feet, and a longitudinal slope of 1.8 percent. The bankfull capacity of the Franklin Middle School Channel was estimated to be 147 cfs.

Northview Subdivision Bypass Channel. This channel was built in conjunction with the Northview Subdivision, located at the northeast corner of 35th Avenue and 4th Street. The channel is located along the secondary drainageway, immediately east of 30th Avenue and extending north from 4th Street to the Greeley No. 3 Ditch, where flows are directed beneath the ditch via the Greeley No. 3 Ditch Underchute. The channel is trapezoidal in shape with a bottom width of approximately 15 feet, average depth of 5.8 feet, side slopes of 3H:1V, and a longitudinal slope of 0.5 percent. The bankfull capacity of the Northview Subdivision Bypass Channel is estimated to be 1,360 cfs.

3.5 Overflow Weirs

One overflow (side channel) weir is found in the Grapevine Basin; it has been constructed along the left bank of the Greeley No. 3 Ditch as recommended from the 1997 Comp Plan. A description is provided below. In addition, the location, condition, and hydraulic capacity of the overflow weir is summarized in Table 3.1.

Northview Side Channel Weir. This overflow weir was constructed in conjunction with the Northview Regional Detention Pond improvements. It is located along the left bank of the Greeley No. 3 Ditch directly above the Greeley No. 3 Ditch Underchute Culvert. The weir is

16th Street at Bittersweet Park. During the 100-year storm event, 16th Street near Bittersweet Park would overtop by approximately 1.7 feet at the channel crossing, with a discharge of 1,690 cfs. The structure has a maximum capacity of 566 cfs prior to overtopping the roadway, and is capable of passing a discharge up to that associated with a 5-year event. Improvements upstream of the 16th Street crossing have included the realignment of the 16th Street Channel along with the installation of three drop structures.

35th Avenue Storm Sewer. The 35th Avenue Storm Sewer ranges in diameter from a 48-inch RCP at Bittersweet Park to a 68"H x 106"W HERCP at C Street. Per the 1974 Comprehensive Drainage Plan, this storm sewer was designed to convey the storm runoff from the 50-year event as determined from the 1974 rainfall intensity-duration-frequency curves. Consequently, given the revised rainfall curves and a 100-year design event, the capacity of the existing storm sewer is exceeded for each pipe segment along its entire length. For that portion of the storm sewer located south of 4th Street, the street section of 35th Avenue has adequate capacity to convey the excess 100-year storm flows within the limits of the current storm drainage criteria. North of 4th Street to the Greeley No. 3 Ditch, the 100-year peak discharge greatly exceeds the capacity of the storm sewer and cannot be conveyed within the street section of 35th Avenue without exceeding drainage criteria. A majority, if not all, of the 100-year flow conveyed within the street section north of 4th Street is likely to be intercepted by the Greeley No. 3 Ditch. Due to limited capacity within the ditch, the additional inflows have the potential to overtop the northern ditch bank and flood the properties immediately north of the Greeley No. 3 Ditch.

Greeley No. 3 Ditch. The capacity of the Greeley No. 3 Ditch is limited to less than 200 cfs at several locations through the Grapevine Basin. The ditch capacity is potentially exceeded at these locations by stormwater contributed from local runoff west of 35th Avenue and from flows along 35th Avenue. Stormwater captured by the ditch tends to overtop the northern ditch bank at those locations where the capacity is exceeded. Consequently, property located immediately north of the ditch has the potential to incur flooding damage at several locations within the Grapevine Basin.

35th Avenue Outfall Channel. The 35th Avenue Storm Sewer discharges stormwater runoff into the outfall channel, located immediately east of 35th Avenue and directly north of C Street. The outfall channel conveys flow north from this location to the Cache La Poudre River. From C Street to F Street, the bankfull capacity of the outfall channel is approximately 470 cfs; from F Street to the Cache la Poudre River, the bankfull capacity is reduced to 300 cfs as the channel slope decreases. The 100-year discharge at C Street is estimated to be 647 cfs; the 100-year discharge at F Street was determined to be approximately 867 cfs.

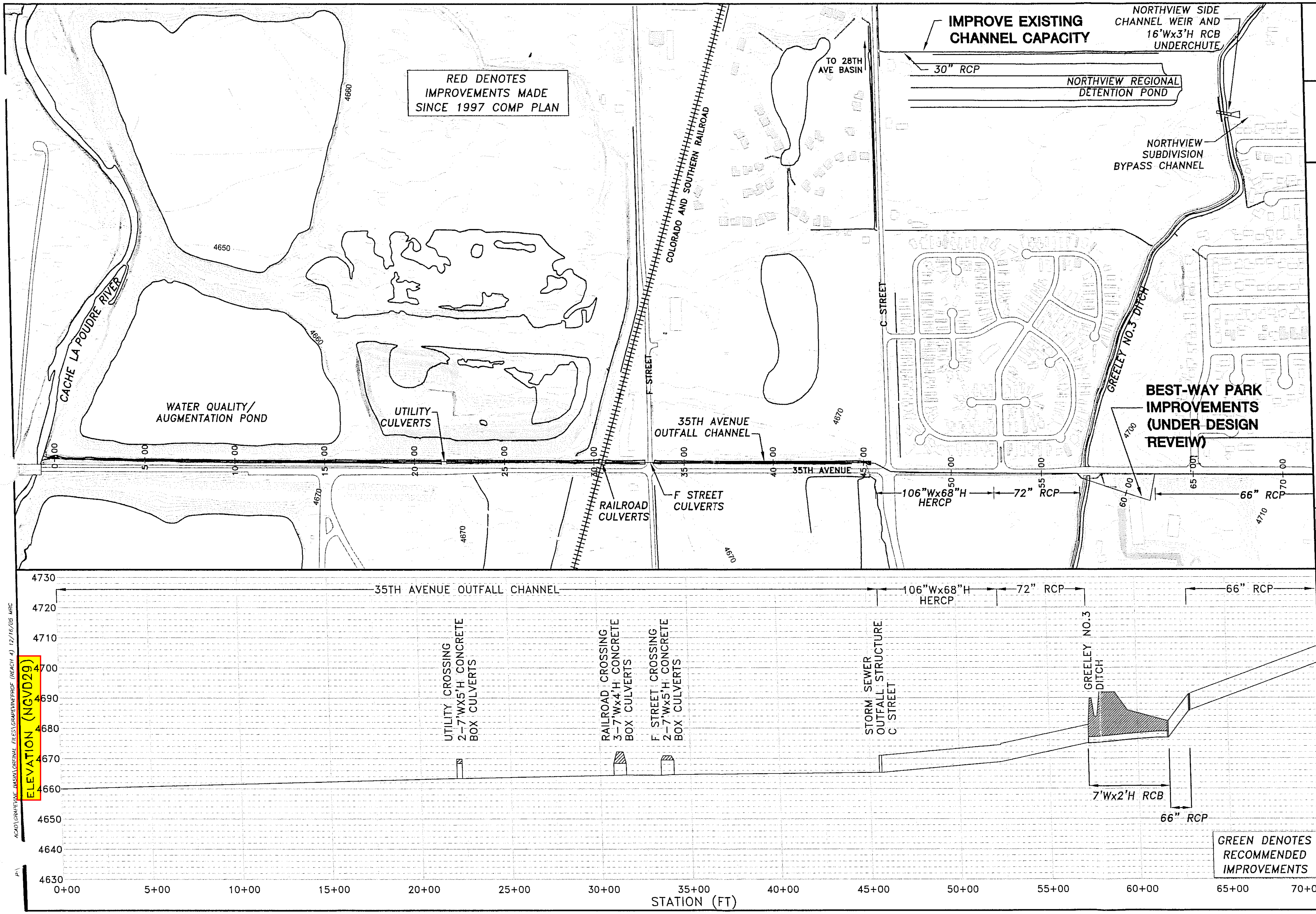
35th Avenue Outfall Channel Crossings. The 35th Avenue Outfall Channel crosses F Street, the Colorado and Southern Railroad, and a small county access road. The F Street crossing has a maximum capacity of approximately 499 cfs prior to overtopping. The crossing at the Colorado and Southern Railroad has a maximum capacity of 772 cfs prior to overtopping the embankment. The county access road crossing can pass approximately 600 cfs prior to overtopping the road. Under the Existing Condition, stormwater flows overtop the F Street crossing during all events greater than the 10-year storm; the Colorado and Southern Railroad and county access road crossings are overtopped by events that exceed the 50-year storm.

Intersection of 10th Street and 32nd Avenue. Potential flooding problems currently exist at a sump area located immediately south of the intersection of 10th Street and 32nd Avenue, which is roughly the beginning of the secondary drainageway. In the Existing Condition, a single 36-inch RCP conveys stormwater northward beneath 10th Street approximately 630 feet to the Franklin Middle School Channel. The capacity of the existing storm sewer is exceeded during storms greater than the 2-year event. Stormwater runoff ponds at the intersection until 10th Street is overtopped. As ponding occurs at the intersection, flooding of several residences and businesses south of 10th Street can occur. First floor elevations of these buildings often lie below the gutter flowline, further exacerbating the magnitude of the flooding potential in this area.

Franklin Middle School Channel and Franklin Park Storm Sewer. The Franklin Middle School Channel and Franklin Park Storm Sewer convey runoff along the eastern edge of Franklin Middle School, and then north into the Franklin Park Detention Pond. The channel has a maximum capacity of approximately 147 cfs, while the storm sewer has a maximum full-flow capacity estimated to be 170 cfs. The channel and storm sewer currently have the capacity to safely pass flows up to that associated with a 10-year event. Discharges in excess of this return period have the potential to inundate local residences along this corridor. The 100-year discharge at 10th Street and 32nd Avenue is approximately 319 cfs.

Franklin Park Detention Pond. The Franklin Park Detention Pond was originally designed to detain the runoff generated by the 25-year storm event. Stormwater runoff is released from the pond via a 24-inch RCP outlet pipe, and a lowered section of the western pond embankment serves as an emergency spillway. Presently, flows in excess of that associated with the 5-year event exceed the storage and discharge capacity of the pond. As the capacity of the outlet facilities is exceeded, stormwater runoff overtops the northern and eastern embankments and creates a potential flooding problem for adjacent residences. Stormwater that is released from the emergency spillway onto 31st Avenue, 5th Street, and 30th Avenue Court exceeds the street capacity; flooding of residences adjacent to these streets is likely to occur for storms greater than that associated with the 10-year event.

30th Avenue at 4th Street. The existing crossing structure at 30th Avenue north of 4th Street incorporates two 54-inch RCPs. The structures have a maximum combined capacity of 299 cfs prior to overtopping the roadway, and can pass flows up to and including that associated



GRAPEVINE BASIN PROPOSED DRAINAGE IMPROVEMENTS REACH 4

Anderson Consulting Engineers, Inc
Civil · Water Resources · Environmental
772 Whalers Way, Suite 200, Fort Collins, CO 80525
Phone (970) 226-0120 / Fax (970) 226-0121

Project No.	COCOG05
Date:	11/23/05
Design:	BLV\BAS
Drawn:	TAW\BAS
Revisions:	
ACADFILE:	GRAPEVINEPROF

FIGURE 5.5

potential flooding at this crossing to within drainage criteria limits. The required structure size would need to be confirmed by a detailed analysis completed as part of final design of this crossing. The structure would minimize roadway overtopping at the flowline to approximately 1.3 feet during a 100-year storm, which is the maximum depth at the flow line for a local street crossing by City of Greeley storm drainage criteria.

5. ***42nd Avenue Court.*** The 42nd Avenue Court crossing of the 16th Street Channel currently has a capacity of approximately 515 cfs, which is less than the flow associated with a 50-year Proposed Condition storm event. The 1997 Comp Plan did not call for any improvements as this crossing; however, as the crossing lies along the major drainageway, it was considered for potential improvements as part of the current study. The addition of a 4'W x 3'H RCB to the existing double 10'W x 3'H RCB would reduce potential flooding at this crossing to within drainage criteria limits. The required structure size would need to be confirmed by a detailed analysis completed as part of final design of this crossing. The structure would minimize roadway overtopping at the flowline to approximately 1.1 feet during a 100-year storm, which is less than the maximum of 1.5 feet for a local street crossing by City of Greeley drainage criteria.

6. ***16th Street.*** The 16th Street crossing of the 16th Street Channel currently has a capacity of approximately 566 cfs, which is less than the flow associated with a 10-year Proposed Condition event. The 1997 Comp Plan called for replacement of the existing culvert with a 16'W x 6'H RCB. Due to generally increased discharges as compared to the 1997 Comp Plan along 16th Street for the updated Comp Plan, the current study calls for an additional 12'W x 6'H RCB to supplement the existing 12'W x 6'H RCB. The required structure size would need to be confirmed by a detailed analysis completed as part of final design of this crossing. The structure would minimize roadway overtopping at the street crown to approximately 0.3 feet during a 100-year storm, which is less than the maximum of 0.5 feet for a minor arterial crossing by City of Greeley drainage criteria.

7. ***4th Street and 35th Avenue.*** The 1997 Comp Plan called for improvements along 4th Street west of 35th Avenue to divert 100-year discharges into a proposed gravel pit detention pond northwest of 4th Street and 35th Avenue. That project, now known as Best-Way Park, has been designed and is under review by the City of Greeley ("Final Drainage Report, Best-Way Park," Civil Design Group, Inc., October 2004). The previous Comp Plan assumed approximately 530 cfs would be diverted off of 4th Street west of 35th Avenue into the regional detention pond during the 100-year event; the updated Comp Plan hydrologic model indicates 428 cfs being diverted into the pond.

REFER TO "As-Built Bestway Regional Detention Pond (24x36)" FOR WHAT WAS ACTUALLY CONSTRUCTED

The previous Comp Plan also recommended 60 acre-feet of detention for the pond, along with a 54-inch RCP outlet designed to release a maximum 100-year discharge of 189 cfs. The final design provides approximately 69.2 acre-feet of detention (6.4 acre-feet of on-site detention for the Best-Way Park development, and 62.8 acre-feet of on-line regional detention for the major drainageway) along with an 18-inch RCP outlet (reduced down via a 9.5-inch orifice plate) for the Best-Way Park development pond and a single 7'W x 2'H RCB outlet (as cited by City staff; reduced down via an orifice plate, size unknown) for the on-line regional pond. Both ponds were modeled using storage volumes and release rates from the preliminary design of the Best-Way Park development ("Preliminary Design Report, Best-Way Park," Civil Design Group, Inc., February 2004). However, based on uncertainty if the project will be constructed and discussions with City staff, the preliminary design values were retained in all hydrologic models. The maximum combined release rate during the 100-year Proposed Condition event for the two ponds is approximately 170 cfs, all of which is released into the 35th Avenue Storm Sewer.

REFER TO "As-Built Bestway Regional Detention Pond (24x36)" FOR WHAT WAS ACTUALLY CONSTRUCTED

8. ***10th Street and 32nd Avenue.*** The 1997 Comp Plan called for the replacement of the existing 36-inch RCP crossing 10th Street at 32nd Avenue with two 54-inch RCPs. It also called for the construction of a grated collection gallery across 32nd Avenue south of 10th Street in order to reduce ponding at the intersection and meet the overtopping drainage criteria. Due to the virtually identical discharges at this location determined by both the 1997 Comp Plan and this study, no changes were made to the previously recommended improvements. Construction of the improvements would eliminate overtopping of 10th Street for all events including the 100-year storm (estimated to be a maximum of approximately 319 cfs for the Proposed Condition). According to City of Greeley drainage criteria, the elimination of street overtopping at this crossing for the 100-year event is necessary as 10th Street is considered a major arterial. The grated collection gallery should be designed to remove approximately 319 cfs from the intersection in order to eliminate overtopping of the roadway and reduce the potential flooding of adjacent residences and businesses.

9. ***Franklin Middle School Channel and 7th Street.*** Proposed improvements as outlined in the 1997 Comp Plan included enlargement of the channel section to a 12-foot bottom width, design depth of 3 feet, and side slopes of 2H:1V. Curb cuts were also recommended along 7th Street near the beginning of the Franklin Park Storm Sewer to allow flows greater than the capacity of the storm sewer to spill onto 7th Street and be conveyed north. Only minimal changes were made to the proposed channel as 100-year

EXISTING CULVERT ANALYSIS

Culvert Calculator Report
C Street 24-Inch Culvert (DP J)

Solve For: Discharge

Culvert Summary

Allowable HW Elevation	77.00	ft	Headwater Depth/Height	1.80	
Computed Headwater Eleva	77.00	ft	Discharge	19.26	cfs
Inlet Control HW Elev.	76.54	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	77.00	ft	Control Type	Outlet Control	

Grades

Upstream Invert	73.40	ft	Downstream Invert	69.68	ft
Length	186.50	ft	Constructed Slope	0.019946	ft/ft

Hydraulic Profile

Profile	CompositeM2PressureProfile		Depth, Downstream	1.58	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.58	ft
Velocity Downstream	7.24	ft/s	Critical Slope	0.026564	ft/ft

Section

Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties

Outlet Control HW Elev.	77.00	ft	Upstream Velocity Head	0.58	ft
Ke	0.90		Entrance Loss	0.53	ft

Inlet Control Properties

Inlet Control HW Elev.	76.54	ft	Flow Control	Submerged	
Inlet Type	Projecting		Area Full	3.1	ft^2
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Culvert Calculator Report
F Street 24-Inch Culvert (DP X2)

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	74.00	ft	Headwater Depth/Height	2.09	
Computed Headwater Eleva	74.00	ft	Discharge	20.94	cfs
Inlet Control HW Elev.	73.33	ft	Tailwater Elevation	0.00	ft
Outlet Control HW Elev.	74.00	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	69.81	ft	Downstream Invert	68.69	ft
Length	75.00	ft	Constructed Slope	0.014933	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	1.64	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.64	ft
Velocity Downstream	7.60	ft/s	Critical Slope	0.029189	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	74.00	ft	Upstream Velocity Head	0.69	ft
Ke	0.90		Entrance Loss	0.62	ft

Inlet Control Properties					
Inlet Control HW Elev.	73.33	ft	Flow Control	Submerged	
Inlet Type	Projecting		Area Full	3.1	ft²
K	0.03400		HDS 5 Chart	2	
M	1.50000		HDS 5 Scale	3	
C	0.05530		Equation Form	1	
Y	0.54000				

Culvert Calculator Report
Double 5x7 Culverts

Solve For: Headwater Elevation

Culvert Summary

Allowable HW Elevation	74.40	ft	Headwater Depth/Height	1.24	
Computed Headwater Eleva	73.60	ft	Discharge	511.00	cfs
Inlet Control HW Elev.	73.03	ft	Tailwater Elevation	71.94	ft
Outlet Control HW Elev.	73.60	ft	Control Type	Outlet Control	

Grades

Upstream Invert	67.42	ft	Downstream Invert	67.11	ft
Length	168.00	ft	Constructed Slope	0.001845	ft/ft

Hydraulic Profile

Profile	M2		Depth, Downstream	4.83	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	3.46	ft
Velocity Downstream	7.56	ft/s	Critical Slope	0.004071	ft/ft

Section

Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	7.00	ft
Section Size	7 x 5 ft		Rise	5.00	ft
Number Sections	2				

Outlet Control Properties

Outlet Control HW Elev.	73.60	ft	Upstream Velocity Head	0.87	ft
Ke	0.50		Entrance Loss	0.44	ft

Inlet Control Properties

Inlet Control HW Elev.	73.03	ft	Flow Control	Unsubmerged	
Inlet Type	30 to 75° wingwall flares		Area Full	70.0	ft^2
K	0.02600		HDS 5 Chart	8	
M	1.00000		HDS 5 Scale	1	
C	0.03470		Equation Form	1	
Y	0.86000				

Culvert Calculator Report
Triple 4x7 Culverts @ RR

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	75.00	ft	Headwater Depth/Height	1.45	
Computed Headwater Eleva	74.81	ft	Discharge	516.00	cfs
Inlet Control HW Elev.	73.85	ft	Tailwater Elevation	73.85	ft
Outlet Control HW Elev.	74.81	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	69.00	ft	Downstream Invert	69.00	ft
Length	40.00	ft	Constructed Slope	0.000000	ft/ft

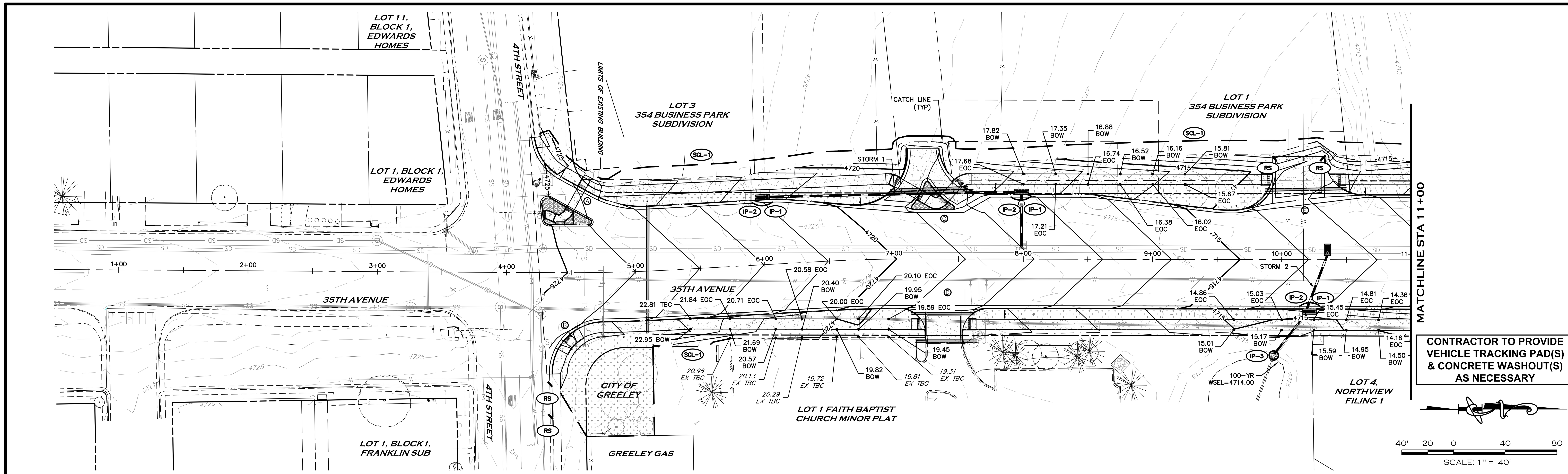
Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	4.85	ft
Slope Type	N/A		Normal Depth	N/A	ft
Flow Regime	N/A		Critical Depth	2.66	ft
Velocity Downstream	6.14	ft/s	Critical Slope	0.003776	ft/ft

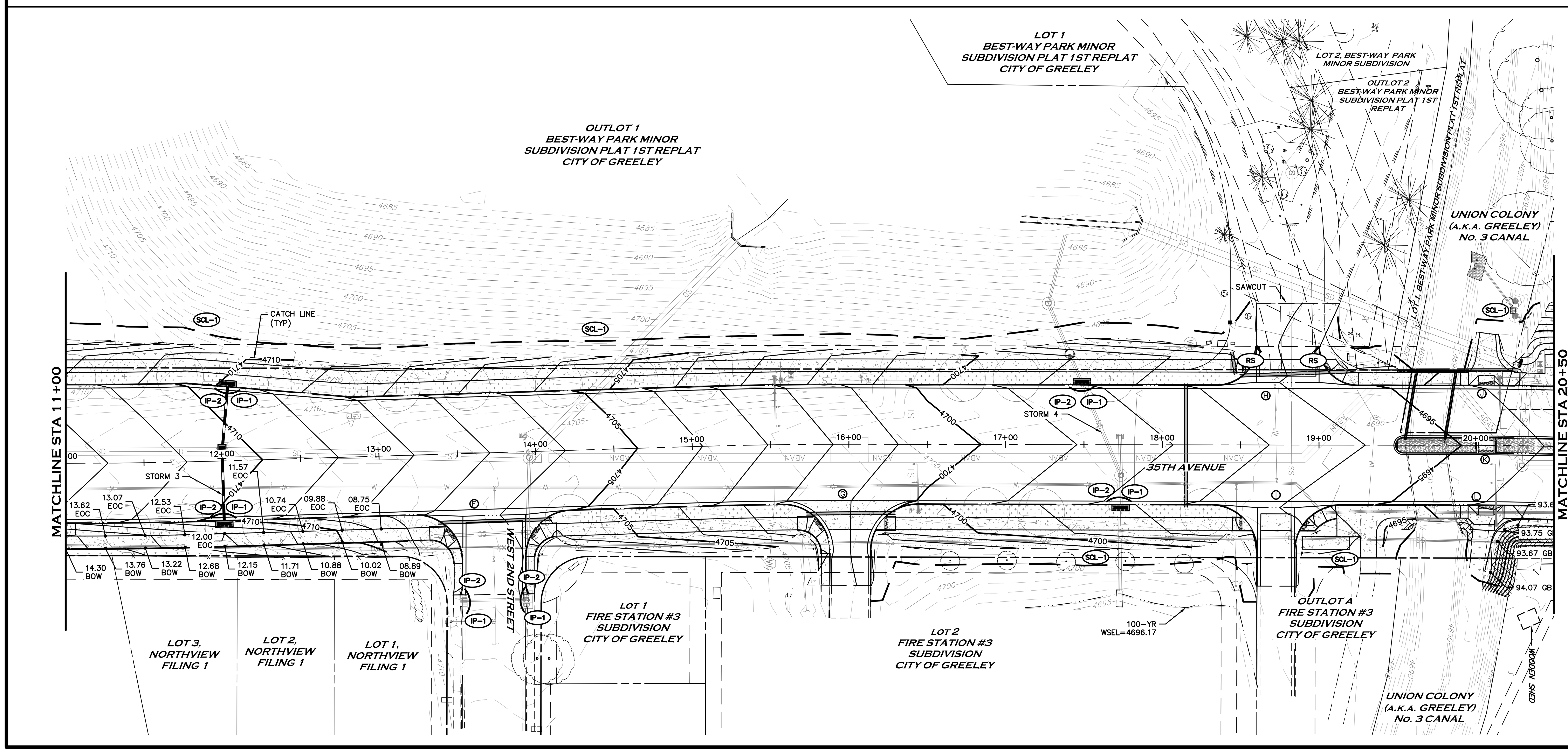
Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	7.00	ft
Section Size	7 x 4 ft		Rise	4.00	ft
Number Sections	3				

Outlet Control Properties					
Outlet Control HW Elev.	74.81	ft	Upstream Velocity Head	0.59	ft
Ke	0.50		Entrance Loss	0.29	ft

Inlet Control Properties					
Inlet Control HW Elev.	73.85	ft	Flow Control	Unsubmerged	
Inlet Type	30 to 75° wingwall flares		Area Full	84.0	ft²
K	0.02600		HDS 5 Chart	8	
M	1.00000		HDS 5 Scale	1	
C	0.03470		Equation Form	1	
Y	0.86000				

GRADING AND EROSION CONTROL PLAN, EROSION CONTROL DETAILS AND CONSTRUCTION SQUENCE





NOTES:

1. INSPECTION OF ALL EROSION AND SEDIMENT CONTROL BMP'S SHALL BE REQUIRED AT THE END OF EACH DAY'S WORK, WITH NECESSARY MAINTENANCE AND REPAIRS PROVIDED IMMEDIATELY.
2. STORM DRAIN INLETS SHALL BE PROTECTED FROM THE ENTRY OF SEDIMENT-LADEN WATER UNTIL FINAL STABILIZATION IS COMPLETE.

LEGEND

- EXISTING 1' CONTOUR
- 4810 EXISTING 5' CONTOUR
- PROPOSED 1' CONTOUR
- 4810 PROPOSED 5' CONTOUR
- LANDSCAPED AREAS
- SOIL RETENTION BLANKET (ALL SLOPES 4:1 OR GREATER)
- PROPOSED STORM PIPE
- PROPOSED INLET
- RS ROCK SOCK (CURB ROCK SOCKS)
- CD-1 CHECK DAM
- CIP-1 CULVERT INLET PROTECTION
- SCL-1 SEDIMENT CONTROL LOG (TOE OF SLOPE PROTECTION)
- IP-# INLET PROTECTION (# CORRELATES TO DETAIL)
- VTC CWA VEHICLE TRACKING CONTROL AND CONCRETE WASHOUT AREA
- SEE "INTERSECTION GRADING DETAIL" SHEETS FOR DRIVEWAY AND RAMP GRADING

CALL UTILITY NOTIFICATION CENTER OF COLORADO
811
CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

BID SET
NOT FOR CONSTRUCTION

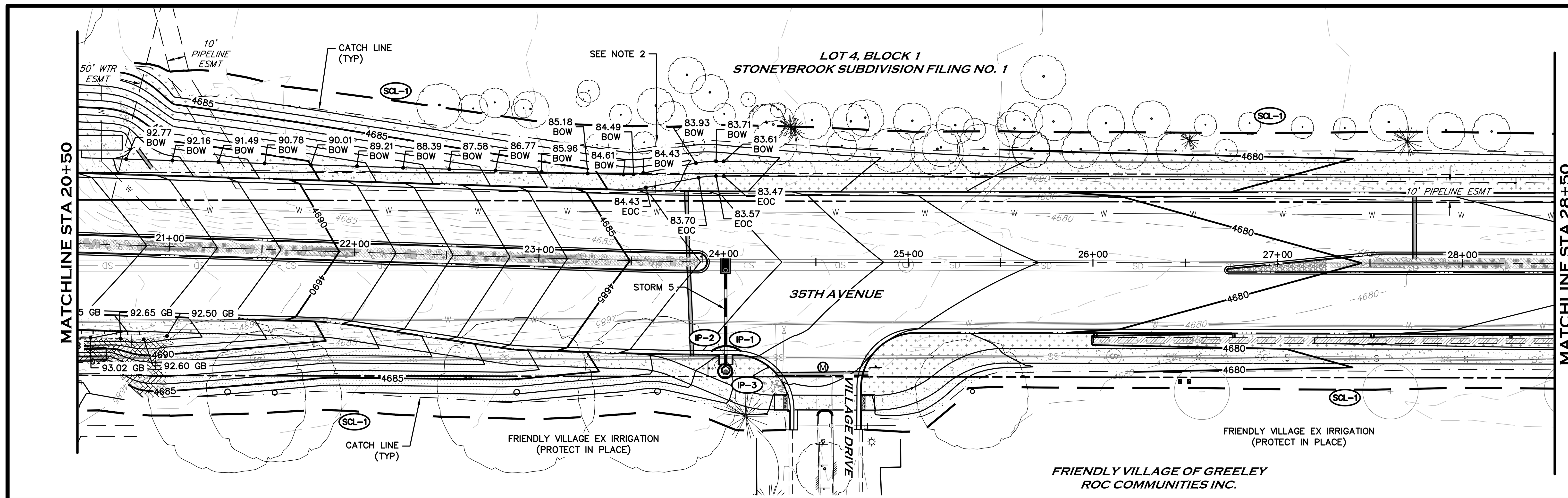
INTERWEST CONSULTING GROUP
1218 W. Ash, Suite A
Windsor, Colorado 80550
Phone: (970) 674-3300
Fax: (970) 674-3303

City of Greeley Colorado

35TH AVENUE WIDENING
GRADING & EROSION CONTROL PLAN

DATE: 10/30/20
SCALE (H): 1"=40'
SCALE (V): N/A
DESIGNED BY: LAJ
CHECKED BY: MPO

PROJ. NO. 1397-083-00



NOTES:

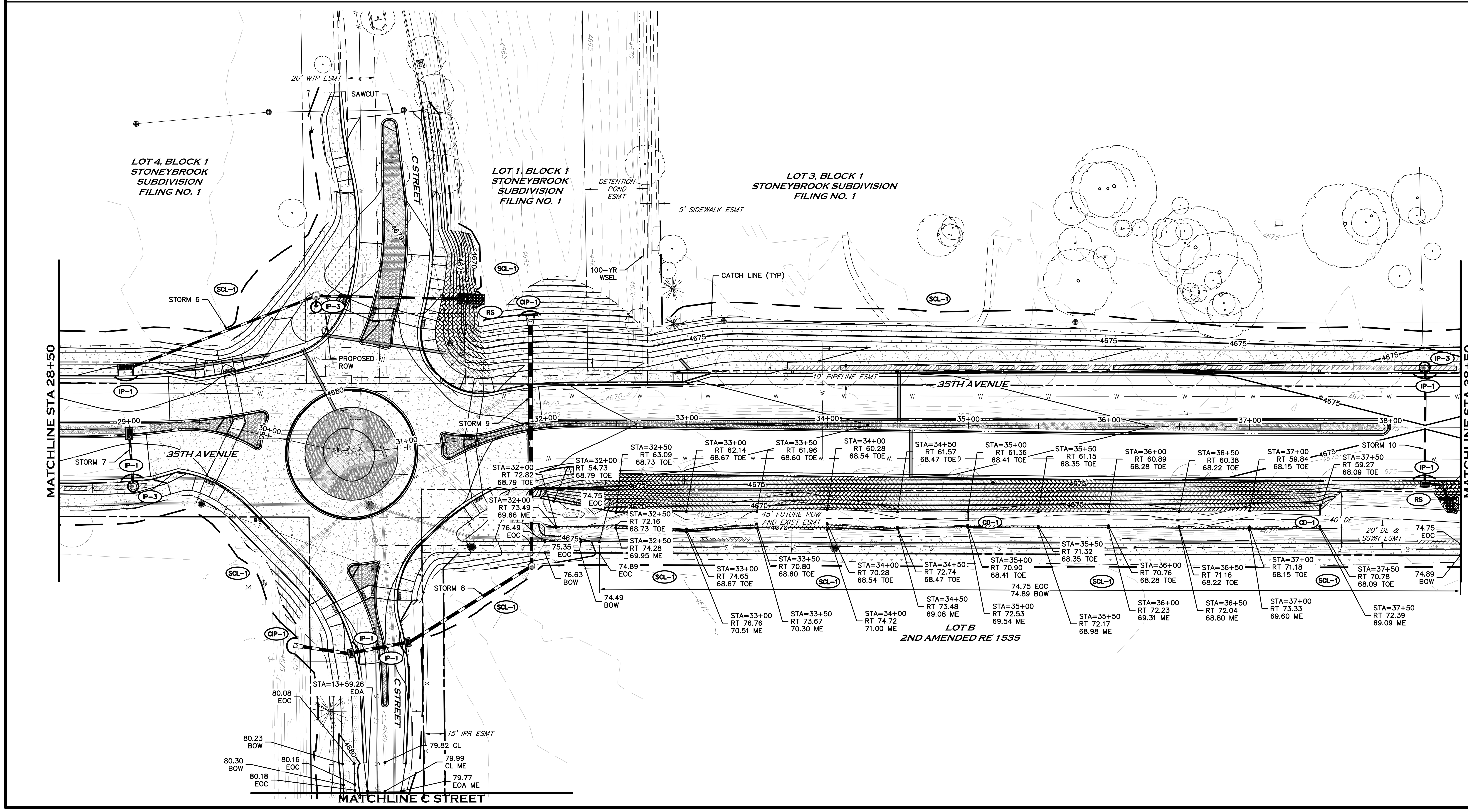
1. INSPECTION OF ALL EROSION AND SEDIMENT CONTROL BMP'S SHALL BE REQUIRED AT THE END OF EACH DAY'S WORK, WITH NECESSARY MAINTENANCE AND REPAIRS PROVIDED IMMEDIATELY.

2. STORM DRAIN INLETS SHALL BE PROTECTED FROM THE ENTRY OF SEDIMENT-LADEN WATER UNTIL FINAL STABILIZATION IS COMPLETE.

3. ALL TREES NOT MARKED FOR REMOVAL SHALL BE PROTECTED IN PLACE.

4. CONTRACTOR SHALL EVALUATE THE GRADING AND IMPACT TO THE EXISTING TREES PRIOR TO TREE REMOVAL. CONTRACTOR SHALL FIELD ADJUST GRADING IF POSSIBLE TO SAVE THE TREES AND COORDINATE WITH THE CITY'S ARBORIST AND ENGINEER PRIOR TO TREE REMOVAL.

SCALE: 1" = 40'



CONTRACTOR TO PROVIDE VEHICLE TRACKING PAD(S) & CONCRETE WASHOUT(S) AS NECESSARY

LEGEND

- EXISTING 1' CONTOUR
- EXISTING 5' CONTOUR
- PROPOSED 1' CONTOUR
- PROPOSED 5' CONTOUR
- LANDSCAPED AREAS
- SOIL RETENTION BLANKET (ALL SLOPES 4:1 OR GREATER)
- PROPOSED STORM PIPE
- PROPOSED INLET
- RS — ROCK SOCK (CURB ROCK SOCKS)
- CD-1 — CHECK DAM
- CIP-1 — CULVERT INLET PROTECTION
- SCL-1 — SEDIMENT CONTROL LOG (TOE OF SLOPE PROTECTION)
- IP-# — INLET PROTECTION (# CORRELATES TO DETAIL)
- VTC CWA — VEHICLE TRACKING CONTROL AND CONCRETE WASHOUT AREA
- A — SEE "INTERSECTION GRADING DETAIL" SHEETS FOR DRIVEWAY AND RAMP GRADING

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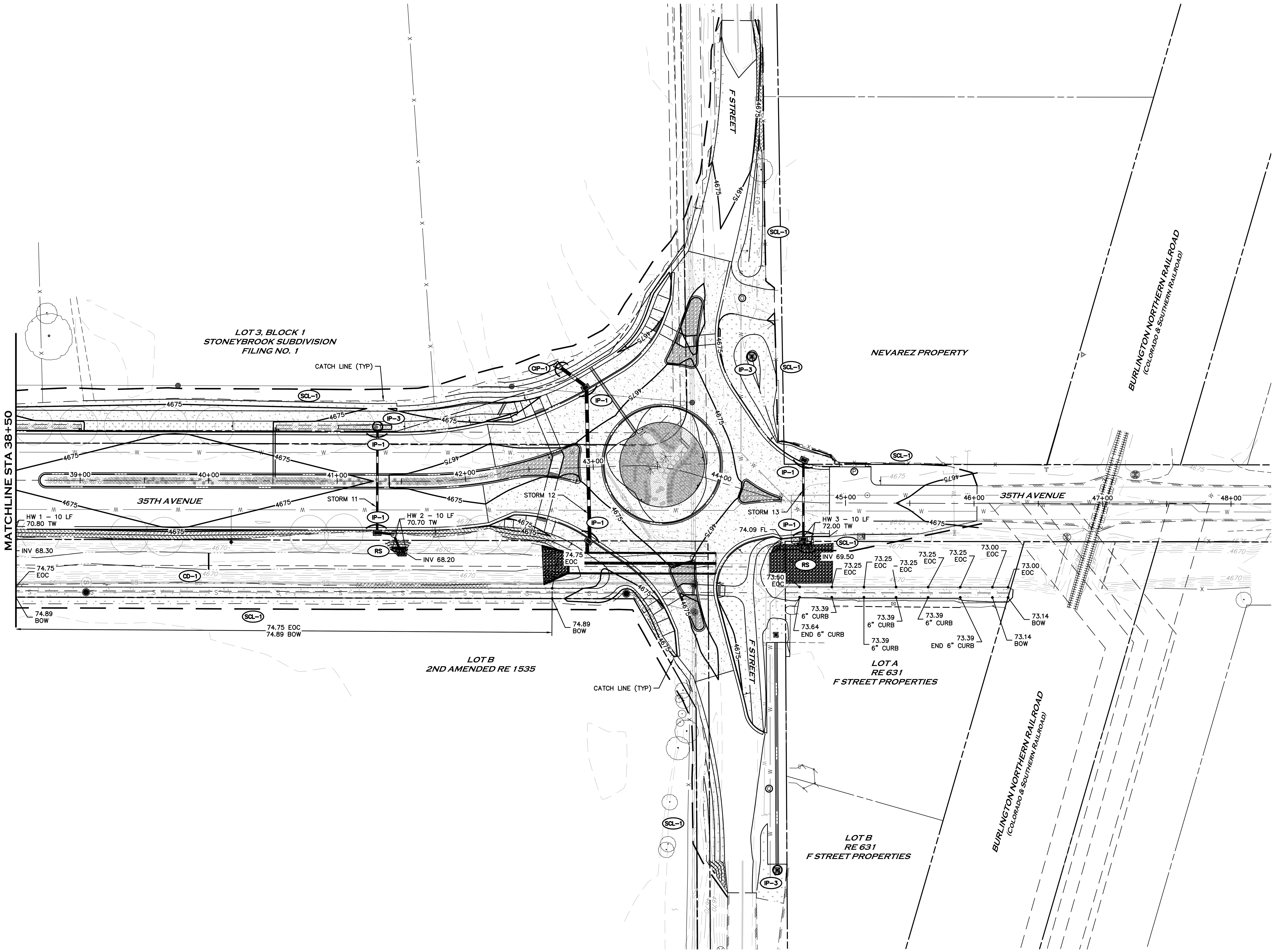

40' 20 0 40 80
SCALE: 1" = 40'

NOTES:

1. INSPECTION OF ALL EROSION AND SEDIMENT CONTROL BMP'S SHALL BE REQUIRED AT THE END OF EACH DAY'S WORK, WITH NECESSARY MAINTENANCE AND REPAIRS PROVIDED IMMEDIATELY.
2. STORM DRAIN INLETS SHALL BE PROTECTED FROM THE ENTRY OF SEDIMENT–LADEN WATER UNTIL FINAL STABILIZATION IS COMPLETE.

CONTRACTOR TO PROVIDE VEHICLE TRACKING PAD(S) & CONCRETE WASHOUT(S) AS NECESSARY

LEGEND

Symbol	Description
4810	EXISTING 1' CONTOUR
	EXISTING 5' CONTOUR
	PROPOSED 1' CONTOUR
4810	PROPOSED 5' CONTOUR
	LANDSCAPED AREAS
	SOIL RETENTION BLANKET (ALL SLOPES 4:1 OR GREATER)
	PROPOSED STORM PIPE
	PROPOSED INLET
RS	ROCK SOCK (CURB ROCK SOCKS)
CD–1	CHECK DAM
CIP–1	CULVERT INLET PROTECTION
SCL–1	SEDIMENT CONTROL LOG (TOE OF SLOPE PROTECTION)
IP–#	INLET PROTECTION (# CORRELATES TO DETAIL)
VTC CWA	VEHICLE TRACKING CONTROL AND CONCRETE WASHOUT AREA
A	SEE "INTERSECTION GRADING DETAIL" SHEETS FOR DRIVEWAY AND RAMP GRADING

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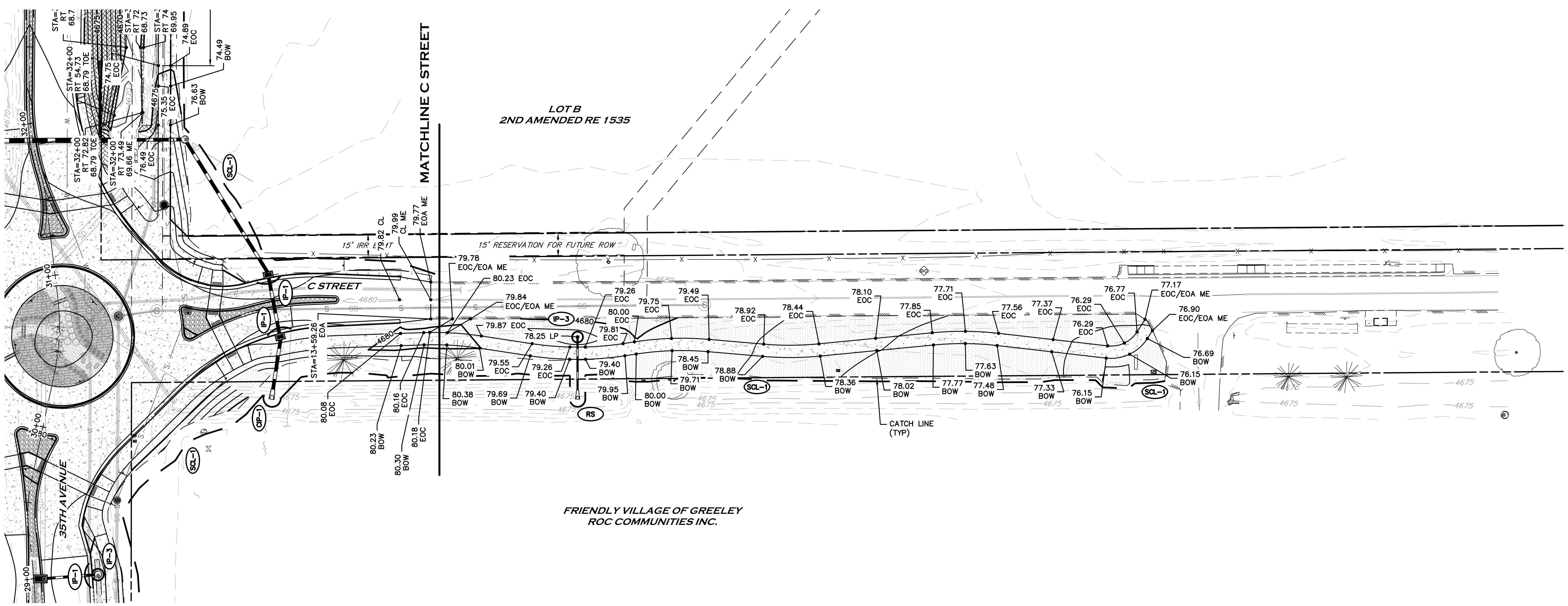
2. STORM DRAIN INLETS SHALL BE PROTECTED FROM THE ENTRY OF SEDIMENT–LADEN WATER UNTIL FINAL STABILIZATION IS COMPLETE.

40' 20 0 40 80

SCALE: 1" = 40'



CONTRACTOR TO PROVIDE VEHICLE TRACKING PAD(S) & CONCRETE WASHOUT(S) AS NECESSARY

LEGEND

- EXISTING 1' CONTOUR
- EXISTING 5' CONTOUR
- PROPOSED 1' CONTOUR
- 4810 PROPOSED 5' CONTOUR
- LANDSCAPED AREAS
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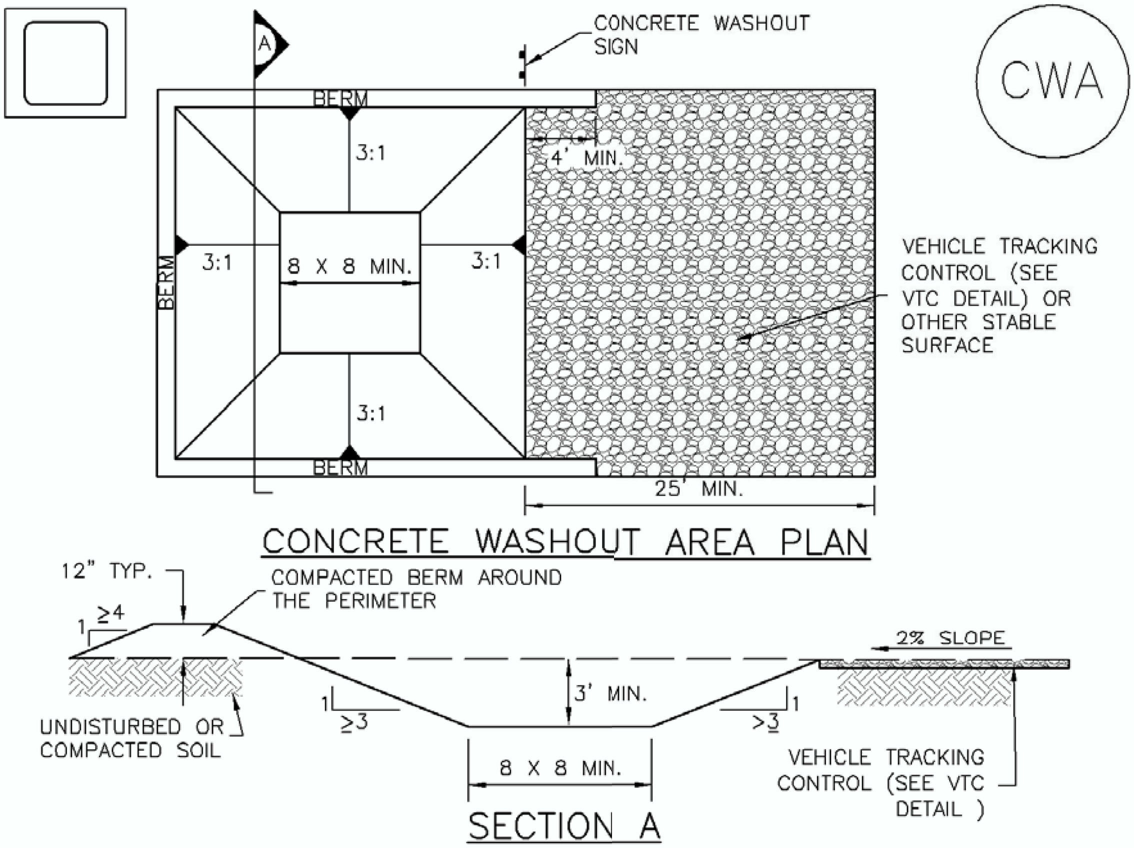


CWA-1. CONCRETE WASHOUT AREA

CWA INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   -CWA INSTALLATION LOCATION.

2. DO NOT LOCATE AN UNLINED CWA WITHIN 400' OF ANY NATURAL DRAINAGE PATHWAY OR WATERBODY. DO NOT LOCATE WITHIN 1,000' OF ANY WELLS OR DRINKING WATER SOURCES. IF SITE CONSTRAINTS MAKE THIS INFEASIBLE, OR IF HIGHLY PERMEABLE SOILS EXIST ON SITE, THE CWA MUST BE INSTALLED WITH AN IMPERMEABLE LINER (16 MIL MIN. THICKNESS) OR SURFACE STORAGE ALTERNATIVES USING PREFABRICATED CONCRETE WASHOUT DEVICES OR A LINED ABOVE GROUND STORAGE ARE SHOULD BE USED.

3. THE CWA SHALL BE INSTALLED PRIOR TO CONCRETE PLACEMENT ON SITE.

4. CWA SHALL INCLUDE A FLAT SUBSURFACE PIT THAT IS AT LEAST 8' BY 8' SLOPES LEADING OUT OF THE SUBSURFACE PIT SHALL BE 3:1 OR FLATTER. THE PIT SHALL BE AT LEAST 3' DEEP.

5. BERM SURROUNDING SIDES AND BACK OF THE CWA SHALL HAVE MINIMUM HEIGHT OF 1'.

6. VEHICLE TRACKING PAD SHALL BE SLOPED 2% TOWARDS THE CWA.

7. SIGNS SHALL BE PLACED AT THE CONSTRUCTION ENTRANCE, AT THE CWA, AND ELSEWHERE AS NECESSARY TO CLEARLY INDICATE THE LOCATION OF THE CWA TO OPERATORS OF CONCRETE TRUCKS AND PUMP RIGS.

8. USE EXCAVATED MATERIAL FOR PERIMETER BERM CONSTRUCTION.

CWA MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. THE CWA SHALL BE REPAIRED, CLEANED, OR ENLARGED AS NECESSARY TO MAINTAIN CAPACITY FOR CONCRETE WASTE. CONCRETE MATERIALS, ACCUMULATED IN PIT, SHALL BE REMOVED ONCE THE MATERIALS HAVE REACHED A DEPTH OF 2'.

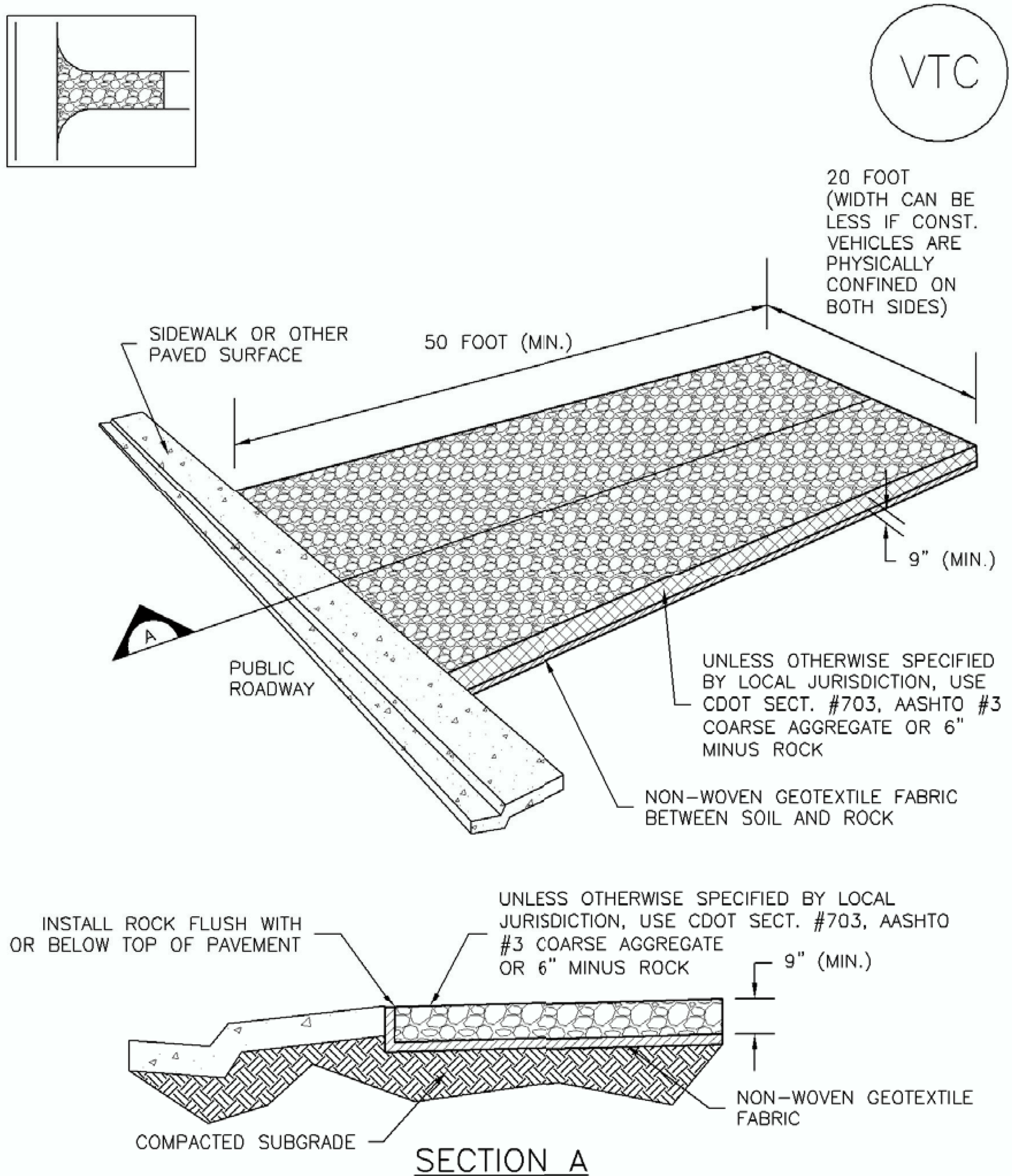
5. CONCRETE WASHOUT WATER, WASTED PIECES OF CONCRETE AND ALL OTHER DEBRIS IN THE SUBSURFACE PIT SHALL BE TRANSPORTED FROM THE JOB SITE IN A WATER-TIGHT CONTAINER AND DISPOSED OF PROPERLY.

6. THE CWA SHALL REMAIN IN PLACE UNTIL ALL CONCRETE FOR THE PROJECT IS PLACED.

7. WHEN THE CWA IS REMOVED, COVER THE DISTURBED AREA WITH TOP SOIL, SEED AND MULCH OR OTHERWISE STABILIZED IN A MANNER APPROVED BY THE LOCAL JURISDICTION.

(DETAIL ADAPTED FROM DOUGLAS COUNTY, COLORADO AND THE CITY OF PARKER, COLORADO, NOT AVAILABLE IN AUTOCAD).

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.



VTC-1. AGGREGATE VEHICLE TRACKING CONTROL

STABILIZED CONSTRUCTION ENTRANCE/EXIT INSTALLATION NOTES

1. SEE PLAN VIEW FOR
   -LOCATION OF CONSTRUCTION ENTRANCE(S)/EXIT(S).
   -TYPE OF CONSTRUCTION ENTRANCE(S)/EXITS(S) (WITH/WITHOUT WHEEL WASH, CONSTRUCTION MAT OR TRM).

2. CONSTRUCTION MAT OR TRM STABILIZED CONSTRUCTION ENTRANCES ARE ONLY TO BE USED ON SHORT DURATION PROJECTS (TYPICALLY RANGING FROM A WEEK TO A MONTH) WHERE THERE WILL BE LIMITED VEHICULAR ACCESS.

3. A STABILIZED CONSTRUCTION ENTRANCE/EXIT SHALL BE LOCATED AT ALL ACCESS POINTS WHERE VEHICLES ACCESS THE CONSTRUCTION SITE FROM PAVED RIGHT-OF-WAYS.

4. STABILIZED CONSTRUCTION ENTRANCE/EXIT SHALL BE INSTALLED PRIOR TO ANY LAND DISTURBING ACTIVITIES.

5. A NON-WOVEN GEOTEXTILE FABRIC SHALL BE PLACED UNDER THE STABILIZED CONSTRUCTION ENTRANCE/EXIT PRIOR TO THE PLACEMENT OF ROCK.

6. UNLESS OTHERWISE SPECIFIED BY LOCAL JURISDICTION, ROCK SHALL CONSIST OF DOT SECT. #703, AASHTO #3 COARSE AGGREGATE OR 6" (MINUS) ROCK.

STABILIZED CONSTRUCTION ENTRANCE/EXIT MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

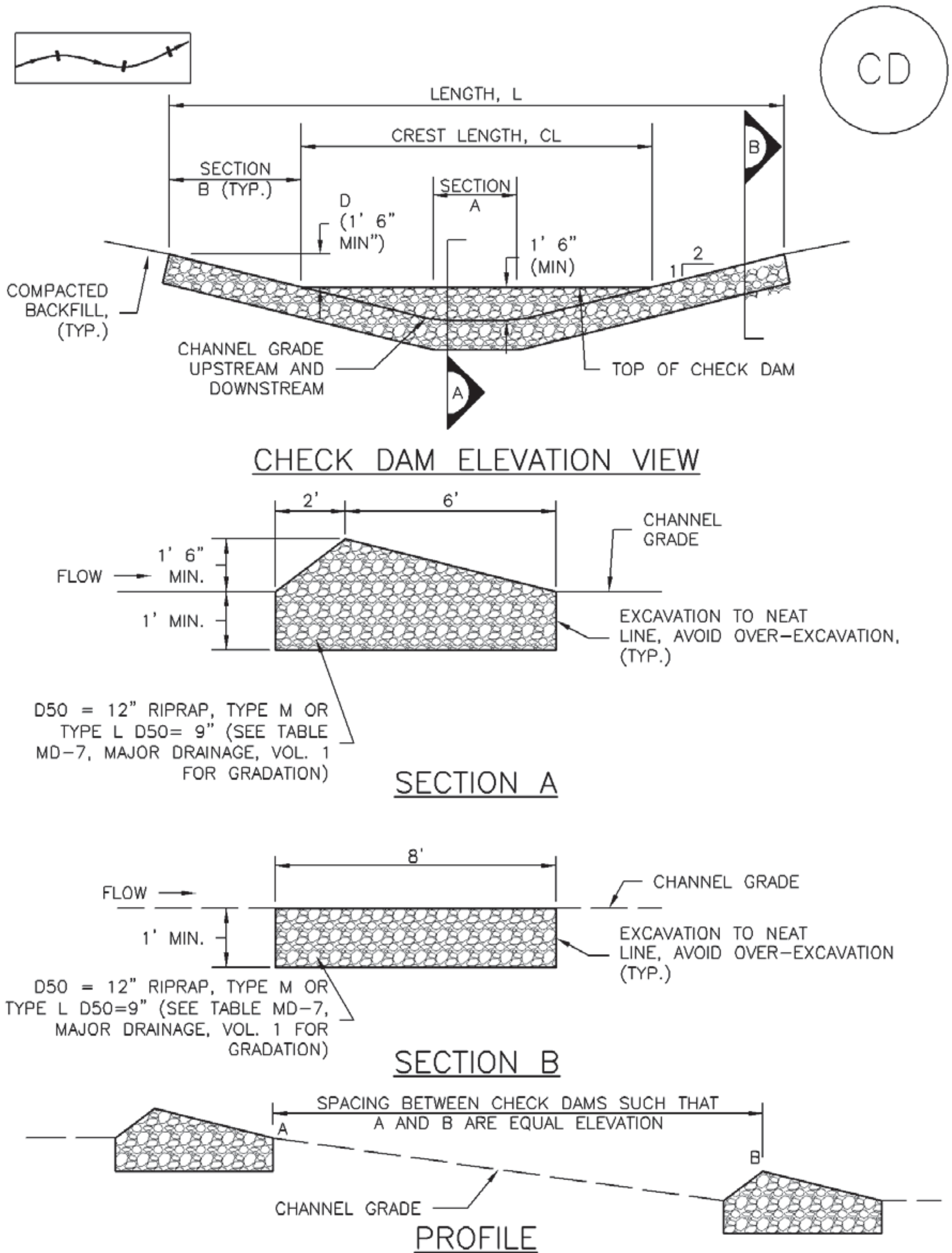
3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. ROCK SHALL BE REAPPLIED OR REGRADED AS NECESSARY TO THE STABILIZED ENTRANCE/EXIT TO MAINTAIN A CONSISTENT DEPTH.

5. SEDIMENT TRACKED ONTO PAVED ROADS IS TO BE REMOVED THROUGHOUT THE DAY AND AT THE END OF THE DAY BY SHOVELING OR SWEEPING. SEDIMENT MAY NOT BE WASHED DOWN STORM SEWER DRAINS.

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

(DETAILS ADAPTED FROM CITY OF BROOMFIELD, COLORADO, NOT AVAILABLE IN AUTOCAD)



CD-1. CHECK DAM

CHECK DAM INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   - –LOCATION OF CHECK DAMS.
   - –CHECK DAM TYPE (CHECK DAM OR REINFORCED CHECK DAM).
   - –LENGTH (L), CREST LENGTH (CL), AND DEPTH (D).

2. CHECK DAMS INDICATED ON INITIAL SWMP SHALL BE INSTALLED AFTER CONSTRUCTION FENCE, BUT PRIOR TO ANY UPSTREAM LAND DISTURBING ACTIVITIES.

3. RIPRAP UTILIZED FOR CHECK DAMS SHOULD BE OF APPROPRIATE SIZE FOR THE APPLICATION. TYPICAL TYPES OF RIPRAP USED FOR CHECK DAMS ARE TYPE M (D50 12") OR TYPE L (D50 9").

4. RIPRAP PAD SHALL BE TRENCHED INTO THE GROUND A MINIMUM OF 1'.

5. THE ENDS OF THE CHECK DAM SHALL BE A MINIMUM OF 1' 6" HIGHER THAN THE CENTER OF THE CHECK DAM.

CHECK DAM MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

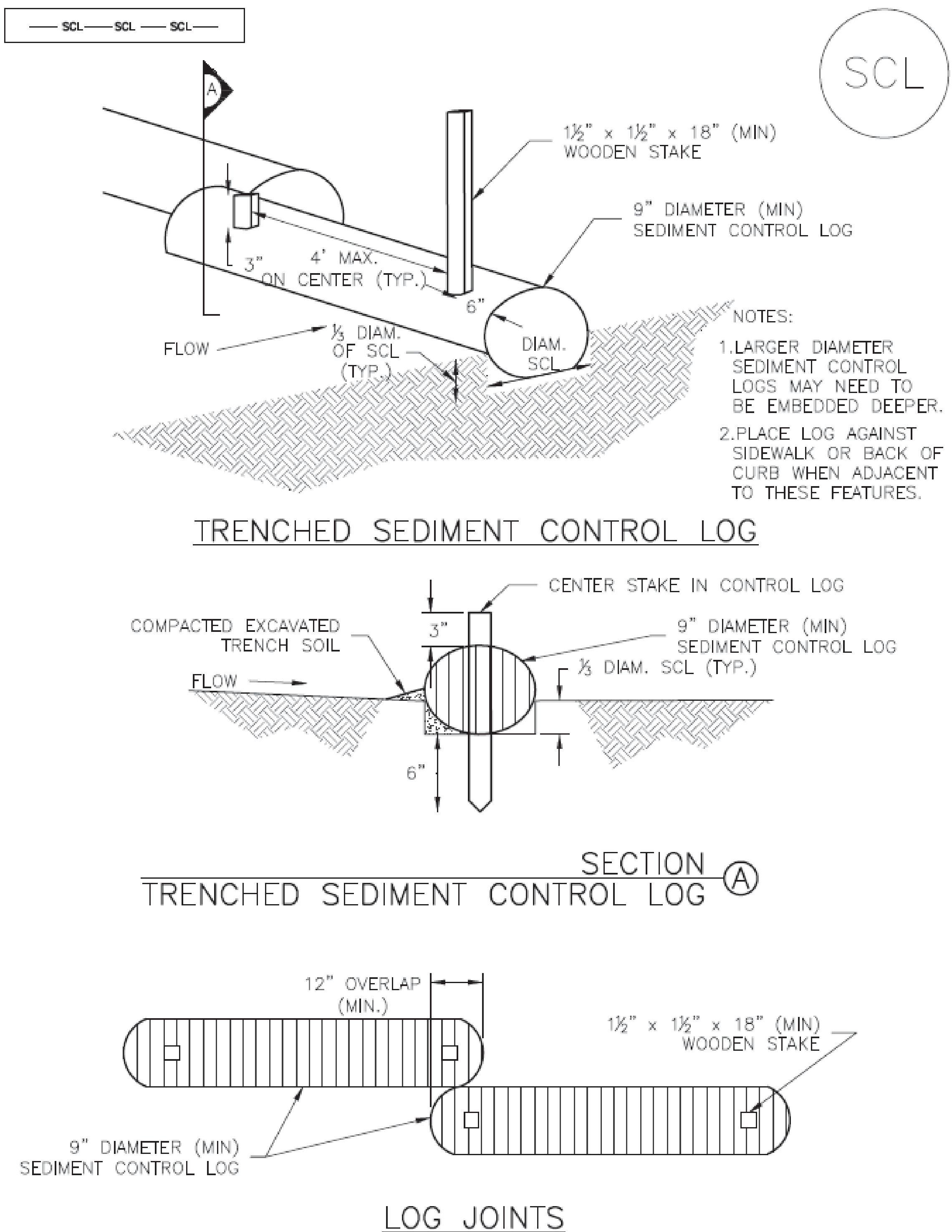
4. SEDIMENT ACCUMULATED UPSTREAM OF THE CHECK DAMS SHALL BE REMOVED WHEN THE SEDIMENT DEPTH IS WITHIN ½ OF THE HEIGHT OF THE CREST.

5. CHECK DAMS ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND APPROVED BY THE LOCAL JURISDICTION.

6. WHEN CHECK DAMS ARE REMOVED, EXCAVATIONS SHALL BE FILLED WITH SUITABLE COMPACTED BACKFILL. DISTURBED AREA SHALL BE SEEDED AND MULCHED AND COVERED WITH GEOTEXTILE OR OTHERWISE STABILIZED IN A MANNER APPROVED BY THE LOCAL JURISDICTION.

(DETAILS ADAPTED FROM DOUGLAS COUNTY, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.



SCL-1. TRENCHED SEDIMENT CONTROL LOG

SEDIMENT CONTROL LOG INSTALLATION NOTES

1. SEE PLAN VIEW FOR LOCATION AND LENGTH OF SEDIMENT CONTROL LOGS.

2. SEDIMENT CONTROL LOGS THAT ACT AS A PERIMETER CONTROL SHALL BE INSTALLED PRIOR TO ANY UPGRADIENT LAND–DISTURBING ACTIVITIES.

3. SEDIMENT CONTROL LOGS SHALL CONSIST OF STRAW, COMPOST, EXCELSIOR OR COCONUT FIBER, AND SHALL BE FREE OF ANY NOXIOUS WEED SEEDS OR DEFECTS INCLUDING RIPS, HOLES AND OBVIOUS WEAR.

4. SEDIMENT CONTROL LOGS MAY BE USED AS SMALL CHECK DAMS IN DITCHES AND SWALES. HOWEVER, THEY SHOULD NOT BE USED IN PERENNIAL STREAMS.

5. IT IS RECOMMENDED THAT SEDIMENT CONTROL LOGS BE TRENCHED INTO THE GROUND TO A DEPTH OF APPROXIMATELY ⅓ OF THE DIAMETER OF THE LOG. IF TRENCHING TO THIS DEPTH IS NOT FEASIBLE AND/OR DESIRABLE (SHORT TERM INSTALLATION WITH DESIRE NOT TO DAMAGE LANDSCAPE) A LESSER TRENCHING DEPTH MAY BE ACCEPTABLE WITH MORE ROBUST STAKING. COMPOST LOGS THAT ARE 8 LB/FT DO NOT NEED TO BE TRENCHED.

6. THE UPHILL SIDE OF THE SEDIMENT CONTROL LOG SHALL BE BACKFILLED WITH SOIL OR FILTER MATERIAL THAT IS FREE OF ROCKS AND DEBRIS. THE SOIL SHALL BE TIGHTLY COMPACTED INTO THE SHAPE OF A RIGHT TRIANGLE USING A SHOVEL OR WEIGHTED LAWN ROLLER OR BLOWN IN PLACE.

7. FOLLOW MANUFACTURERS' GUIDANCE FOR STAKING. IF MANUFACTURERS' INSTRUCTIONS DO NOT SPECIFY SPACING, STAKES SHALL BE PLACED ON 4' CENTERS AND EMBEDDED A MINIMUM OF 6" INTO THE GROUND. 3" OF THE STAKE SHALL PROTRUDE FROM THE TOP OF THE LOG. STAKES THAT ARE BROKEN PRIOR TO INSTALLATION SHALL BE REPLACED. COMPOST LOGS SHOULD BE STAKED 10' ON CENTER.

SEDIMENT CONTROL LOG MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. SEDIMENT ACCUMULATED UPSTREAM OF SEDIMENT CONTROL LOG SHALL BE REMOVED AS NEEDED TO MAINTAIN FUNCTIONALITY OF THE BMP, TYPICALLY WHEN DEPTH OF ACCUMULATED SEDIMENTS IS APPROXIMATELY ½ OF THE HEIGHT OF THE SEDIMENT CONTROL LOG.

5. SEDIMENT CONTROL LOG SHALL BE REMOVED AT THE END OF CONSTRUCTION.COMPOST FROM COMPOST LOGS MAY BE LEFT IN PLACE AS LONG AS BAGS ARE REMOVED AND THE AREA SEEDED. IF DISTURBED AREAS EXIST AFTER REMOVAL, THEY SHALL BE COVERED WITH TOP SOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED IN A MANNER APPROVED BY THE LOCAL JURISDICTION.

(DETAILS ADAPTED FROM TOWN OF PARKER, COLORADO, JEFFERSON COUNTY, COLORADO, DOUGLAS COUNTY, COLORADO, AND CITY OF AURORA, COLORADO, NOT AVAILABLE IN AUTOCAD)

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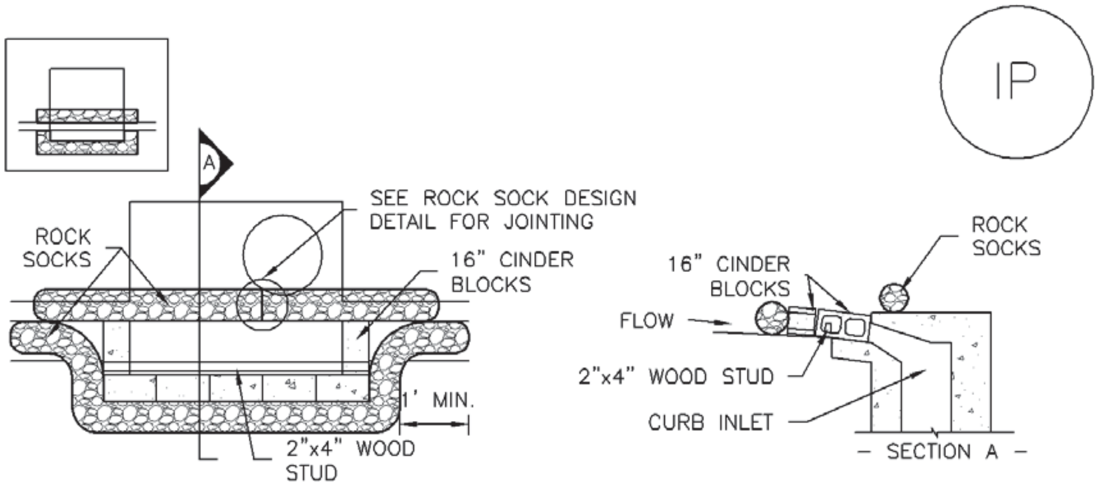


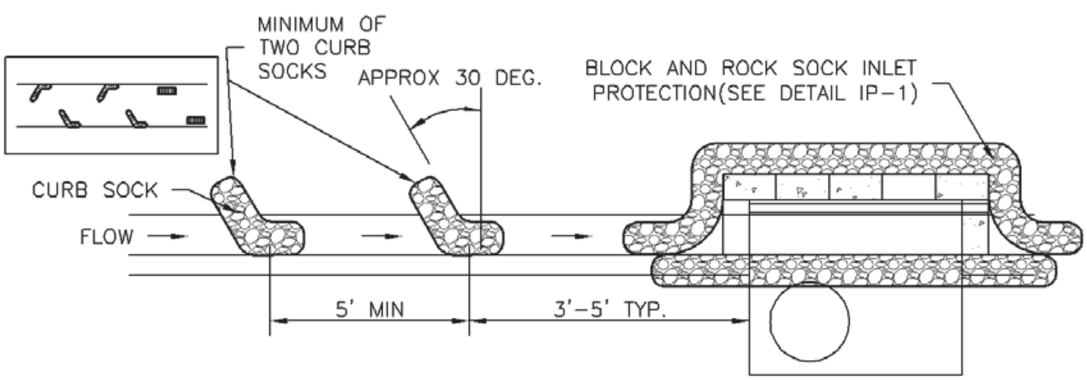
IP–1. BLOCK AND ROCK SOCK SUMP OR ON GRADE INLET PROTECTION

BLOCK AND CURB SOCK INLET PROTECTION INSTALLATION NOTES

1. SEE ROCK SOCK DESIGN DETAIL FOR INSTALLATION REQUIREMENTS.

2. CONCRETE "CINDER" BLOCKS SHALL BE LAID ON THEIR SIDES AROUND THE INLET IN A SINGLE ROW, ABUTTING ONE ANOTHER WITH THE OPEN END FACING AWAY FROM THE CURB.

3. GRAVEL BAGS SHALL BE PLACED AROUND CONCRETE BLOCKS, CLOSELY ABUTTING ONE ANOTHER AND JOINTED TOGETHER IN ACCORDANCE WITH ROCK SOCK DESIGN DETAIL.



IP–2. CURB ROCK SOCKS UPSTREAM OF INLET PROTECTION

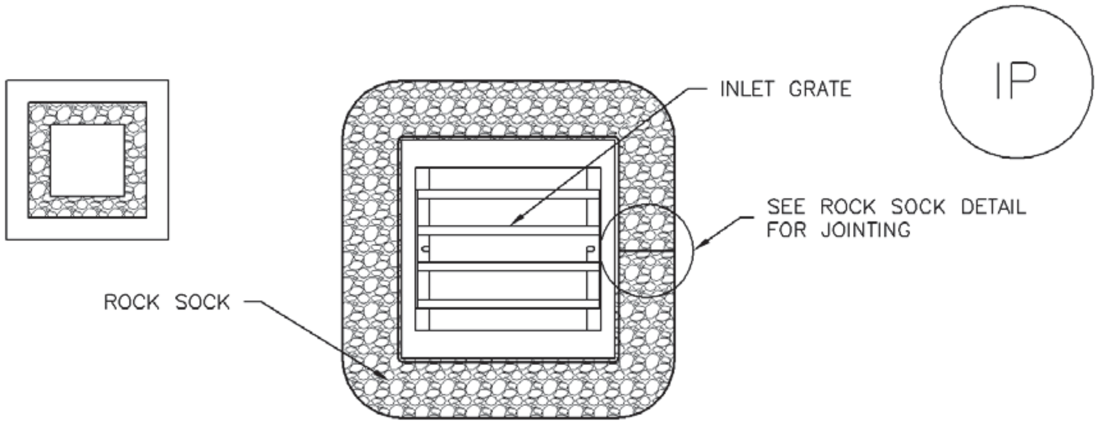
CURB ROCK SOCK INLET PROTECTION INSTALLATION NOTES

1. SEE ROCK SOCK DESIGN DETAIL INSTALLATION REQUIREMENTS.

2. PLACEMENT OF THE SOCK SHALL BE APPROXIMATELY 30 DEGREES FROM PERPENDICULAR IN THE OPPOSITE DIRECTION OF FLOW.

3. SOCKS ARE TO BE FLUSH WITH THE CURB AND SPACED A MINIMUM OF 5 FEET APART.

4. AT LEAST TWO CURB SOCKS IN SERIES ARE REQUIRED UPSTREAM OF ON–GRADE INLETS.

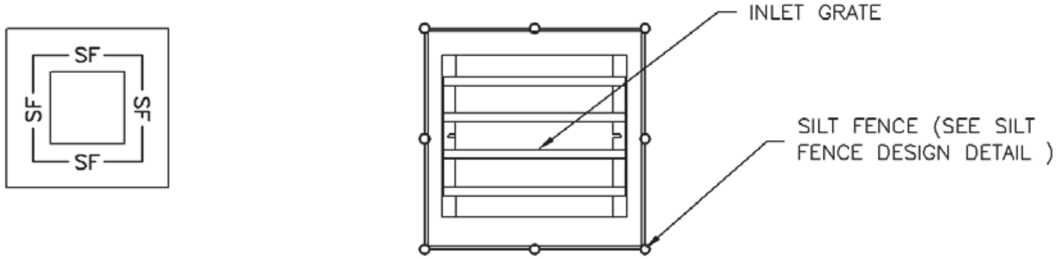


IP–3. ROCK SOCK SUMP/AREA INLET PROTECTION

ROCK SOCK SUMP/AREA INLET PROTECTION INSTALLATION NOTES

1. SEE ROCK SOCK DESIGN DETAIL FOR INSTALLATION REQUIREMENTS.

2. STRAW WATTLES/SEDIMENT CONTROL LOGS MAY BE USED IN PLACE OF ROCK SOCKS FOR INLETS IN PERVIOUS AREAS. INSTALL PER SEDIMENT CONTROL LOG DETAIL.



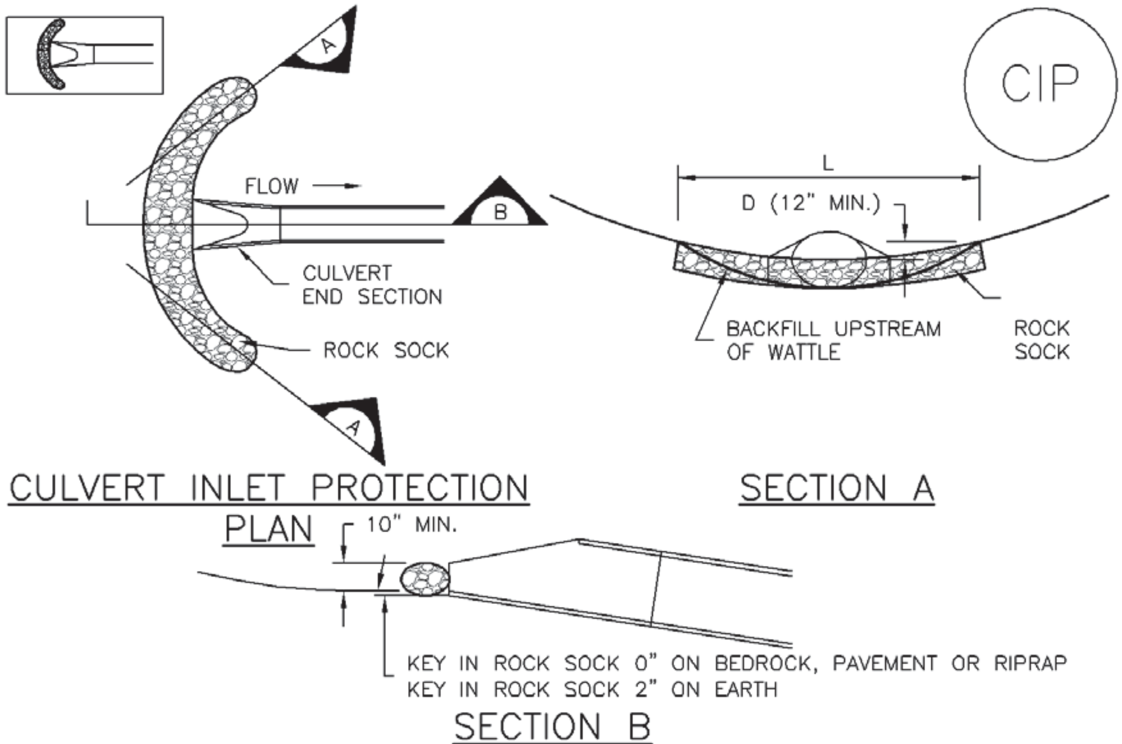
IP–4. SILT FENCE FOR SUMP INLET PROTECTION

SILT FENCE INLET PROTECTION INSTALLATION NOTES

1. SEE SILT FENCE DESIGN DETAIL FOR INSTALLATION REQUIREMENTS.

2. POSTS SHALL BE PLACED AT EACH CORNER OF THE INLET AND AROUND THE EDGES AT A MAXIMUM SPACING OF 3 FEET.

3. STRAW WATTLES/SEDIMENT CONTROL LOGS MAY BE USED IN PLACE OF SILT FENCE FOR INLETS IN PERVIOUS AREAS. INSTALL PER SEDIMENT CONTROL LOG DETAIL.



CIP–1. CULVERT INLET PROTECTION

CULVERT INLET PROTECTION INSTALLATION NOTES

1. SEE PLAN VIEW FOR
   –LOCATION OF CULVERT INLET PROTECTION.

2. SEE ROCK SOCK DESIGN DETAIL FOR ROCK GRADATION REQUIREMENTS AND JOINTING DETAIL.

CULVERT INLET PROTECTION MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. SEDIMENT ACCUMULATED UPSTREAM OF THE CULVERT SHALL BE REMOVED WHEN THE SEDIMENT DEPTH IS ½ THE HEIGHT OF THE ROCK SOCK.

5. CULVERT INLET PROTECTION SHALL REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS PERMANENTLY STABILIZED AND APPROVED BY THE LOCAL JURISDICTION.

(DETAILS ADAPTED FROM AURORA, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

GENERAL INLET PROTECTION INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   -LOCATION OF INLET PROTECTION.
   -TYPE OF INLET PROTECTION (IP.1, IP.2, IP.3, IP.4, IP.5, IP.6)

2. INLET PROTECTION SHALL BE INSTALLED PROMPTLY AFTER INLET CONSTRUCTION OR PAVING IS COMPLETE (TYPICALLY WITHIN 48 HOURS). IF A RAINFALL/RUNOFF EVENT IS FORECAST, INSTALL INLET PROTECTION PRIOR TO ONSET OF EVENT.

3. MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

INLET PROTECTION MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. SEDIMENT ACCUMULATED UPSTREAM OF INLET PROTECTION SHALL BE REMOVED AS NECESSARY TO MAINTAIN BMP EFFECTIVENESS, TYPICALLY WHEN STORAGE VOLUME REACHES 50% OF CAPACITY, A DEPTH OF 6" WHEN SILT FENCE IS USED, OR ¼ OF THE HEIGHT FOR STRAW BALES.

5. INLET PROTECTION IS TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS PERMANENTLY STABILIZED, UNLESS THE LOCAL JURISDICTION APPROVES EARLIER REMOVAL OF INLET PROTECTION IN STREETS.

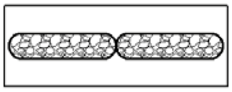
6. WHEN INLET PROTECTION AT AREA INLETS IS REMOVED, THE DISTURBED AREA SHALL BE COVERED WITH TOP SOIL, SEEDED AND MULCHED, OR OTHERWISE STABILIZED IN A MANNER APPROVED BY THE LOCAL JURISDICTION.

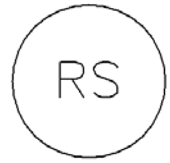
(DETAIL ADAPTED FROM TOWN OF PARKER, COLORADO AND CITY OF AURORA, COLORADO, NOT AVAILABLE IN AUTOCAD)

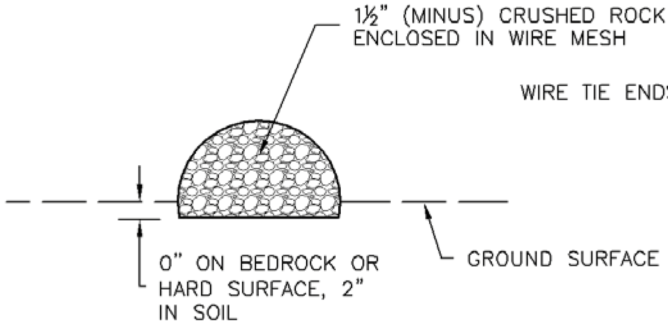
NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

NOTE: THE DETAILS INCLUDED WITH THIS FACT SHEET SHOW COMMONLY USED, CONVENTIONAL METHODS OF INLET PROTECTION IN THE DENVER METROPOLITAN AREA. THERE ARE MANY PROPRIETARY INLET PROTECTION METHODS ON THE MARKET. UDFCD NEITHER ENDORSES NOR DISCOURAGES USE OF PROPRIETARY INLET PROTECTION; HOWEVER, IN THE EVENT PROPRIETARY METHODS ARE USED, THE APPROPRIATE DETAIL FROM THE MANUFACTURER MUST BE INCLUDED IN THE SWMP AND THE BMP MUST BE INSTALLED AND MAINTAINED AS SHOWN IN THE MANUFACTURER'S DETAILS.

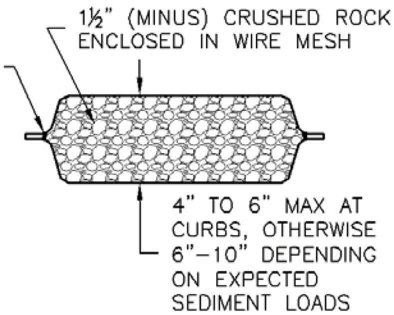
NOTE: SOME MUNICIPALITIES DISCOURAGE OR PROHIBIT THE USE OF STRAW BALES FOR INLET PROTECTION. CHECK WITH LOCAL JURISDICTION TO DETERMINE IF STRAW BALE INLET PROTECTION IS ACCEPTABLE.



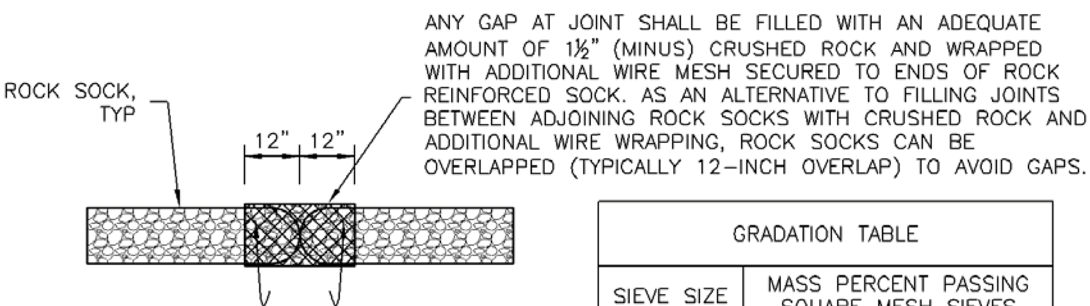




ROCK SOCK SECTION



ROCK SOCK PLAN



ROCK SOCK JOINTING

GRADATION TABLE	
SIEVE SIZE	MASS PERCENT PASSING SQUARE MESH SIEVES
	NO. 4
2"	100
1½"	90 – 100
1"	20 – 55
¾"	0 – 15
⅜"	0 – 5
MATCHES SPECIFICATIONS FOR NO. 4 COARSE AGGREGATE FOR CONCRETE PER AASHTO M43. ALL ROCK SHALL BE FRACTURED FACE, ALL SIDES.	

ROCK SOCK INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   -LOCATION(S) OF ROCK SOCKS.

2. CRUSHED ROCK SHALL BE 1½" (MINUS) IN SIZE WITH A FRACTURED FACE (ALL SIDES) AND SHALL COMPLY WITH GRADATION SHOWN ON THIS SHEET (1½" MINUS).

3. WIRE MESH SHALL BE FABRICATED OF 10 GAGE POULTRY MESH, OR EQUIVALENT, WITH A MAXIMUM OPENING OF ½", RECOMMENDED MINIMUM ROLL WIDTH OF 48"

4. WIRE MESH SHALL BE SECURED USING "HOG RINGS" OR WIRE TIES AT 6" CENTERS ALONG ALL JOINTS AND AT 2" CENTERS ON ENDS OF SOCKS.

5. SOME MUNICIPALITIES MAY ALLOW THE USE OF FILTER FABRIC AS AN ALTERNATIVE TO WIRE MESH FOR THE ROCK ENCLOSURE.

RS-1. ROCK SOCK PERIMETER CONTROL

ROCK SOCK MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. ROCK SOCKS SHALL BE REPLACED IF THEY BECOME HEAVILY SOILED, OR DAMAGED BEYOND REPAIR.

5. SEDIMENT ACCUMULATED UPSTREAM OF ROCK SOCKS SHALL BE REMOVED AS NEEDED TO MAINTAIN FUNCTIONALITY OF THE BMP, TYPICALLY WHEN DEPTH OF ACCUMULATED SEDIMENTS IS APPROXIMATELY ½ OF THE HEIGHT OF THE ROCK SOCK.

6. ROCK SOCKS ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND APPROVED BY THE LOCAL JURISDICTION.

7. WHEN ROCK SOCKS ARE REMOVED, ALL DISTURBED AREAS SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

(DETAIL ADAPTED FROM TOWN OF PARKER, COLORADO AND CITY OF AURORA, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

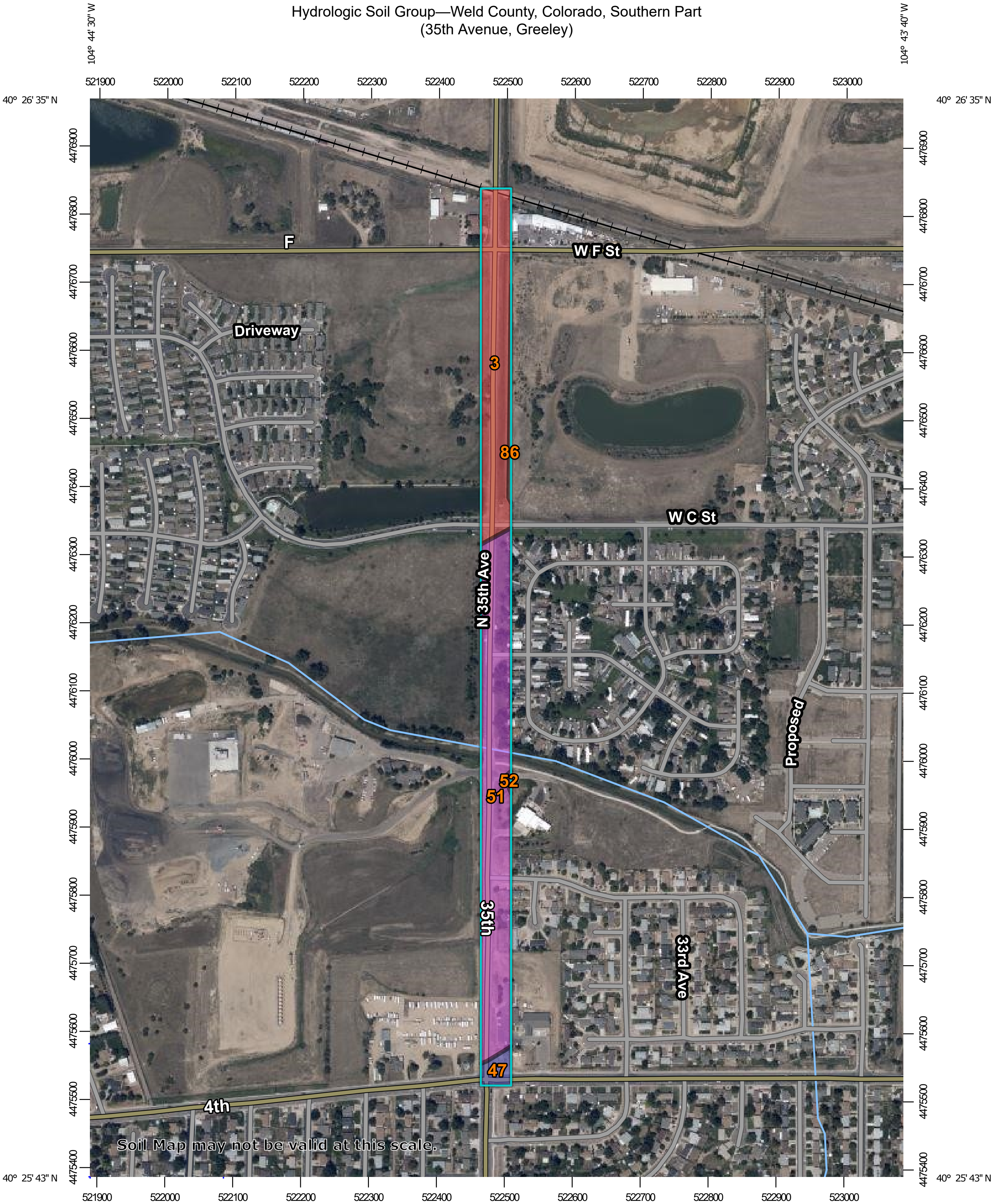
NOTE: THE DETAILS INCLUDED WITH THIS FACT SHEET SHOW COMMONLY USED, CONVENTIONAL METHODS OF ROCK SOCK INSTALLATION IN THE DENVER METROPOLITAN AREA. THERE ARE MANY OTHER SIMILAR PROPRIETARY PRODUCTS ON THE MARKET. UDFCD NEITHER NDORSES NOR DISCOURAGES USE OF PROPRIETARY PROTECTION PRODUCTS; HOWEVER, IN THE EVENT PROPRIETARY METHODS ARE USED, THE APPROPRIATE DETAIL FROM THE MANUFACTURER MUST BE INCLUDED IN THE SWMP AND THE BMP MUST BE INSTALLED AND MAINTAINED AS SHOWN IN THE MANUFACTURER'S DETAILS.

Location: 35th Avenue Improvements, Greeley

Construction Sequence Chart

(Construction Phases)	*Mobilization*	*Clear, Strip, Grade*	*Utility Installation*	*Subgrade*	*Curb, Gutter, Ramp & Sidewalk Installation*	*Concrete and Asphalt Paving*	*Bioswale, Fine Grading & Seeding/Mulching*	*Demobilization*
Best Management Practices (BMPs)								
Structural "Installation"								
Flow Barriers (Sediment Control Logs and Rock Socks)*								
Inlet Protection (IP-#)*								
Contour Furrows (Ripping / Disking)								
Vehicle Tracking Control*								
Concrete Washout Area*								
*All BMPs to be Removed once Construction and Stabilization is Complete.								
Vegetative								
Temporary Seeding Planting		Any time the site will sit dorment longer than 30 Days.						
Mulching/Sealant		Any time the site will sit dorment longer than 30 Days.						
Permanent Seeding Planting								
Other:								

Hydrologic Soil Group—Weld County, Colorado, Southern Part
(35th Avenue, Greeley)



Map Scale: 1:7,720 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 100, 200, 400, 600

Feet: 0, 350, 700, 1400, 2100

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Weld County, Colorado, Southern Part
Survey Area Data: Version 19, Jun 5, 2020

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

Date(s) aerial images were photographed: Jul 19, 2018—Aug 10, 2018

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
3	Aquolls and Aquents, gravelly substratum	D	5.5	37.8%
47	Olney fine sandy loam, 1 to 3 percent slopes	B	0.5	3.3%
51	Otero sandy loam, 1 to 3 percent slopes	A	8.4	57.6%
52	Otero sandy loam, 3 to 5 percent slopes	A	0.0	0.3%
86	Borrow Pits		0.1	1.0%
Totals for Area of Interest			**14.6**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

K Factor, Whole Soil—Weld County, Colorado, Southern Part
(35th Avenue, Greeley)

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

.02

.05

.10

.15

.17

.20

.24

.28

.32

.37

.43

.49

.55

.64

Not rated or not available

Soil Rating Lines

.02

.05

.10

.15

.17

.20

.24

.28

.32

.37

.43

.49

.55

.64

Not rated or not available

Soil Rating Points

.02

.05

.10

.15

.17

.20

.24

.28

.32

.37

.43

.49

.55

.64

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Weld County, Colorado, Southern Part
Survey Area Data: Version 19, Jun 5, 2020

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

Date(s) aerial images were photographed: Jul 19, 2018—Aug 10, 2018

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

K Factor, Whole Soil

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
3	Aquolls and Aquents, gravelly substratum	.24	5.5	37.8%
47	Olney fine sandy loam, 1 to 3 percent slopes	.24	0.5	3.3%
51	Otero sandy loam, 1 to 3 percent slopes	.15	8.4	57.6%
52	Otero sandy loam, 3 to 5 percent slopes	.15	0.0	0.3%
86	Borrow Pits		0.1	1.0%
Totals for Area of Interest			**14.6**	**100.0%**

Description

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Rating Options

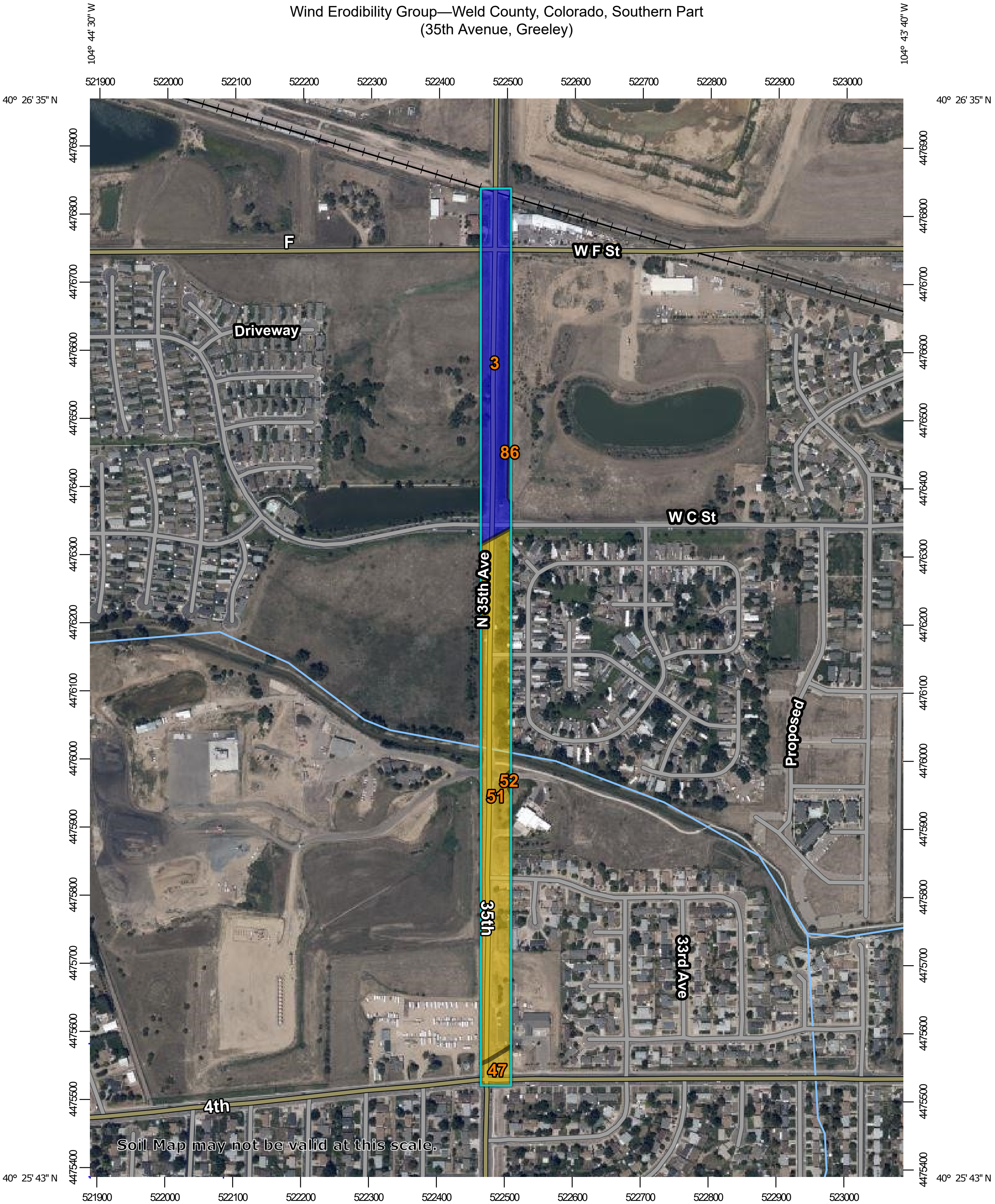
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

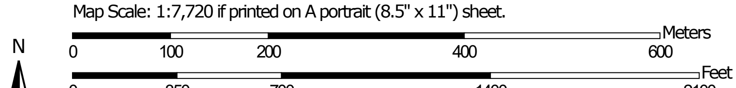
Tie-break Rule: Higher

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

Wind Erodibility Group—Weld County, Colorado, Southern Part
(35th Avenue, Greeley)



Map Scale: 1:7,720 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

1

2

3

4

4L

5

6

7

8

Not rated or not available

Soil Rating Lines

1

2

3

4

4L

5

6

7

8

Not rated or not available

Soil Rating Points

1

2

3

4

4L

5

6

7

8

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

> Warning: Soil Map may not be valid at this scale.
>
> Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

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

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

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

Soil Survey Area: Weld County, Colorado, Southern Part
Survey Area Data: Version 19, Jun 5, 2020

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

Date(s) aerial images were photographed: Jul 19, 2018—Aug 10, 2018

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

Wind Erodibility Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
3	Aquolls and Aquents, gravelly substratum	8	5.5	37.8%
47	Olney fine sandy loam, 1 to 3 percent slopes	3	0.5	3.3%
51	Otero sandy loam, 1 to 3 percent slopes	3	8.4	57.6%
52	Otero sandy loam, 3 to 5 percent slopes	3	0.0	0.3%
86	Borrow Pits		0.1	1.0%
Totals for Area of Interest			**14.6**	**100.0%**

Description

A wind erodibility group (WEG) consists of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower