Please refer to drainage report in application SF-20-032 for review 2 comments.

FINAL DRAINAGE REPORT
FOR
SOLACE AT CIMARRON HILLS

Prepared For:
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March 12, 2021
Project No. 25174.00

Prepared By:
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PCD File No. PPR-20-047
PCD File No. SF2032

ENGINEER'S STATEMENT:
The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by El Paso County for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

______________________________________ ______________________

Mike Bramlett, Colorado P.E. # 32314 Date
For and On Behalf of JR Engineering, LLC

DEVELOPER'S STATEMENT:
I, the developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Business Name: Jackson Dearborn Partners

By: ______________________________

Title: ______________________________
Address: 404 S. Wells Street
Chicago, IL 60607

El Paso County:
Filed in accordance with the requirements of the El Paso County Land Development Code, Drainage Criteria Manual, Volumes 1 and 2 and Engineering Criteria Manual, as amended.

______________________________________ ______________________

Jennifer Irvine, P.E. Date
County Engineer/ ECM Administrator

Conditions:

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PURPOSE

This document is the Final Drainage report for the Solace Apartments. The purpose of this report is to:

1. Identify on-site and off-site drainage patterns.
2. Design storm water facilities to collect and convey storm runoff from the proposed development to appropriate discharge and/or detention locations.
3. Design water quality and detention facilities to control discharge release rates to below historic.
4. Demonstrate compliance with surrounding major drainage basin planning studies, master development drainage plans and flood insurance studies.

GENERAL LOCATION AND DESCRIPTION

Location

The proposed Solace Apartments, known as “Solace” from herein, is a parcel of land located in Section 7, Township 14 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. Solace is a 28.83 acre, urban, multifamily-development and is comprised of 16 apartment dwellings and associated infrastructure. Solace will be split into two phases for construction, lot 1 (phase 1) contains most of the site with lot 2 (phase 2) containing the northern most section of the development. See appendix A for a site plan exhibit showing the Solace phasing. Solace is bound by existing industrial developments to the North and vacant land to the West. Galley Road bounds the property to the south and existing light industrial businesses to the east. A vicinity map of the area is presented in Appendix A.

Currently, there is one major Drainageway that runs along Solace: Sand Creek (Center Tributary) Drainageway. This Drainageway was analyzed, both hydrologically and hydraulically, in the following reports:

- Sand Creek Drainage Basin Planning Study (KEC), January 1993.
- Flood Insurance Study– El Paso County, Colorado & Incorporated Areas Vol 7 of 8, December 2018.
- Sand Creek – Center Tributary Channel Analysis Report for Solace Apartments (JR), June 2020
- LOMR- Case No. 05-08-0368P Federal Emergency Management Agency, May 23, 2007.

The impact of this Drainageway and planning studies on the proposed development will be discussed later in the report.

Description of Property

Solace is currently unoccupied and undeveloped. The existing ground cover is sparse vegetation and open space, typical of a Colorado rolling range land condition. In general, Solace slopes from northwest to southeast.

Per an NRCS web soil survey of the area, Solace is made up of Type B soils with a very small percentage of Type A in the northwest corner of the property. This Type B soil is a Blendon sandy loam. This soil type has a moderate infiltration rate when thoroughly wet. It also consists of moderately deep or deep, moderately well drained or well drained soil. A soil survey map has been presented in Appendix A.

Floodplain Statement

Based on the FEMA FIRM Maps number 08041C0751G and 08041C0752G, dated December 7, 2018, a portion of the existing drainageway lies within Zone AE and Zone X. Zone AE is defined as area subject to inundation by the 1-percent-annual-chance flood event. Zone X is defined as area outside the Special Flood Hazard Area (SFHA) and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. The FIRM Maps have been presented in Appendix A.

DRAINAGE BASINS AND SUB-BASINS

Existing Major Basin Descriptions

Solace lies within Sand Creek Drainage Basin based on the "*Sand Creek Drainage Basin Planning Study*" prepared by Kiowa Engineering in January 1993.

The Sand Creek Drainage Basin covers approximately 54 square miles in unincorporated El Paso County, CO. The Sand Creek Drainage Basin is tributary to Fountain Creek. In its existing condition, the basin is comprised of rolling rangeland with fair to good vegetative cover associated with Colorado's semi-arid climate. The natural Drainageway within the site limits is typically deep and narrow with a well-defined flow path in most areas. Anticipated land use for the basin includes multifamily residential and open space.

As part of its drainage research, JR Engineering reviewed the following drainage studies, reports and LOMRs:

- Sand Creek Drainage Basin Planning Study prepared by Kiowa Engineering Corporation in January 1993.
- Flood Insurance Study– El Paso County, Colorado, & Incorporated Areas Vol 7, December 2018.
- LOMR- Case No. 05-08-0368P Federal Emergency Management Agency, May 23, 2007.
- Sand Creek – Center Tributary Channel Analysis Report for Solace Apartments (JR), June 2020

- Preliminary Drainage Report For Solace Apartments (JR), September 3, 2020

The *Sand Creek Drainage Basin Planning Study* was used to establish a stormwater management plan for the existing and future stormwater infrastructure needs within the Sand Creek Drainage Basin. Based on provided drainage maps and analysis, in its existing condition, the Sand Creek Center Tributary Drainageway contains a 100-year flow of 820-1100 cfs along Solace's east property line. The major Sand Creek Drainageway conveys the stormwater south along the eastern property line where it ultimately outfalls into the Fountain Creek. JR Engineering has performed checks on these flow rates to verify their validity. Basin calculations show that the 820-1100 cfs are still valid for this existing condition.

FEMA prepared a revised FIS for El Paso County Colorado, Volume 7 of 8, dated December 7, 2018. The effective floodplain for the site is shown on the FIRM 08041C0752G, revised to reflect LOMR, dated December 7, 2018. The study area of the FIS where the Sand Creek Drainageway crosses Galley Road, was found to overtop the culverts and flow onto the road. According to the FIS, this crossing has a 10% annual chance of flooding and is located in Zone AE of the FIRM. The *Sand Creek Drainage Basin LOMR* was executed on May 23, 2007. The LOMR revised the flood zone or the area south of Galley Road. See FIRM Map Panel 08041C0752G for limits of LOMR study and revised flood zones, presented in Appendix D.

Existing Sub-basin Drainage

On-site, existing basin drainage patterns are generally from northwest to southeast by way of on-site swales. Existing on-site areas flow directly into the Sand Creek Drainageway. For this development, the existing onsite drainage has been broken into Basin A and Basin B. All existing basins that are offsite are represented by Basin OS. All basin delineation for the existing condition can be found in the existing drainage map located in Appendix E.

Basin A contains a total of 23.98 acres and is broken down into three sub-basins: A1, A2, and A3. This basin represents a majority of the proposed development and is comprised solely of undeveloped land. Flows from this basin are tributary to the Sand Creek Center Tributary Drainageway in the existing condition.

Sub-basin A1 (Q_5=3.1 cfs, Q_{100}=21.0 cfs) is 14.75 acres of undeveloped land, and represents the easternmost portion of the site that is adjacent to the Sand Creek Center Tributary Drainageway. Storm runoff from this sub-basin flows southeast, via overland flow, directly into the Sand Creek Center Tributary Drainageway at Design Point 1.

Sub-basin A2 (Q_5=0.9 cfs, Q_{100}=6.2 cfs) is 3.79 acres and represents the undeveloped land in the center of the development. Storm runoff from this sub-basin flows south (Design Point 2), via overland flow, directly onto Galley Road. From here, flows are conveyed east in the existing curb and gutter into the Sand Creek Center Tributary Drainageway.

Sub-basin A3 (Q_5=1.4 cfs, Q_{100}=9.5 cfs) is 5.44 Acres and represents the undeveloped land on the southern property line of the development. Storm runoff from this sub basin flows south (Design Point 3), via overland flow, directly onto Galley Road. From here, flows are conveyed east via the existing curb and gutter to the Sand Creek Center Tributary Drainageway.

Sub-basin B1 (Q_5=1.3 cfs, Q_{100}=9.0 cfs) Sub-basin B1 consists of 4.84 acres of undeveloped land that drains overland to the southwest (Design Point 4) and offsite where it ultimately outfalls into an existing retention pond on the northeast corner of the intersection of Galley Road and Powers Blvd. This basin represents the westernmost portion of the site.

Basin OS consists of Sub-Basins OS1-OS2 combining for a total of 26.66 acres. This basin represents the developed land located to the north of the proposed development's property line, where the site ties in to Paonia Street. These sub-basins are primarily light industrial sites, and stormwater runoff is conveyed via overland flow and local roads.

Sub-basin OS1 (Q_5=36.7 cfs, Q_{100}=73.1 cfs) consists of the existing Paonia Street and the existing light industrial properties located just north of the site. In the existing condition, a portion of runoff from this sub-basin is captured by an existing concrete line channel along the north boundary of the site. The remaining runoff flows south onsite into the second drainageway where it ultimately outfalls into Sand Creek Center Tributary Drainageway at Galley Road. In the proposed condition, the runoff will be captured by the existing concrete channel and a proposed overflow channel at the north property line (Design Point 5 in the existing condition and Design Point 43 in the proposed condition) to prevent any offsite flows from entering the property. Once this existing flow has been captured, the runoff will be conveyed directly into the existing Sand Creek Center Tributary Drainageway at Design Point 1.1. Capturing this flow and draining it directly into the Sand Creek Center Tributary Drainageway will cause a slight change in the existing drainage patterns. A portion of this flow will no longer enter the existing second drainageway along the proposed Paonia Street alignment. Instead, this entire flow will enter the Sand Creek Center Tributary Drainageway near the north property line at Design Point 1.1. In order to accommodate this change, combination of rip rap and concrete lining shall be utilized in the overflow channel to prevent channel erosion. The Sand Creek Drainageway channel shall be modified to give the drainageway adequate capacity to contain the 100 year water surface and protect against erosive velocities in the channel. A typical cross section of the channel can also be found on the Channel Improvement Plans in Appendix E, for further detail of channel improvements see the JR Engineering Sand Creek Center Tributary Channel Improvements Letter. Channel analysis and weir calculations can be found in the *Sand Creek – Center Tributary Channel Analysis Report for Solace Apartments,* prepared by JR Engineering in May 2020.

Sub-basin OS2 (Q_5=21.3 cfs, Q_{100}=42.5 cfs) consists of the existing Ainsworth Street and the existing light industrial properties located just east of Ainsworth Street. Runoff from this sub-basin is captured by an existing swale along N. Powers Boulevard. The Solace Apartment site has a 5' berm that is proposed along the northern property line. This berm will prevent any drainage from this basin to reach the site, and will utilize an onsite conveyance swale located at the toe of the berm to convey the flow to the western property line (Design Point 6 in the existing condition and Design Point 44 in the proposed condition). This proposed berm will slightly modify the existing drainage patterns, as it will prevent offsite flows from entering the northwestern corner of the site. These flows however, will still continue to outfall into the CDOT right-of-way located to the west of the site.

Flows within the Sand Creek Drainageway are represented by Design Points 1.0-1.3 in the existing condition, and Design Points 5.0-5.3 in the proposed condition. Flows for these design points were taken directly from modeling date used by FEMA for the determination of the flood plain extents shown in FEMA FIRM 08041C0752G. These flows were used in the development of the HEC-RAS model to show the 100-year capacity of the drainageway in its proposed condition. Design Point 1.0 in the existing condition and 5.0 in the proposed condition (Q_{100}=820 cfs) represents the flows in the drainageway prior to entering the site boundary. Design Point 1.1in the existing condition and 5.1 in the proposed condition (Q_{100}=820 cfs) represents the flow in the drainageway after the flows from Basin OS1 enter the channel. Design Point 1.2 in the existing condition and 5.2 in the proposed condition (Q_{100}=1037 cfs) represents the area where flows enter the drainageway from developments and roads located to the east of the site. Design Point 1.3 in the existing condition and 5.3 in the proposed condition (Q_{100}=1100 cfs) represents the flows at the Galley Road crossing. This flow was used to analyze the overtopping of Galley Road and the existing weir structure on the south side of the road.

Proposed Sub-basin Drainage

The proposed Solace basin delineation is as follows;

Sub-basin A1 (Q_5=1.7 cfs, Q_{100}=3.3 cfs) contains a total of 0.50 acres. This basin represents the north eastern portion of the proposed Phase 1 development. This basin is primarily multi-family residential and minor open space. Stormwater runoff from this basin is conveyed via private streets, where it is captured via a series of on-grade and sump inlets (Design Point 4). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond A. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.2.

Sub-basin A2 (Q_5=1.6 cfs, Q_{100}=3.1 cfs) contains a total of 0.47 acres. This basin represents the eastern portion of the proposed along the Phase 1 development phase line. This basin is primarily multi-family residential and minor open space. Stormwater runoff from this basin is conveyed via private streets, where it is captured via a series of on-grade and sump inlets (Design Point 5). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond A. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.2.

Sub-basin A3 (Q_5=1.6 cfs, Q_{100}=3.1 cfs) contains a total of 0.45 acres. This basin represents the center portion of the proposed development along the Phase 1 development phase line. This basin is primarily parking lot with garages and minor open space. Stormwater runoff from this basin is conveyed via private streets, where it is captured by an area inlet (Design Point 6). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond A. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.2.

Sub-basin A4 (Q_5=0.6 cfs, Q_{100}=1.0 cfs) contains a total of 0.15 acres. This basin represents a northern half of a proposed building and is comprised solely of proposed roof. Stormwater runoff from this basin is captured by proposed roof drains and conveyed to the proposed storm sewer infrastructure (Design Point 2.1). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond A. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.2.

Sub-basin A5 (Q_5=0.5 cfs, Q_{100}=1.0 cfs) contains a total of 0.13 acres. This basin represents a northern half of a proposed building and is comprised solely of proposed roof. Stormwater runoff from this basin is captured by proposed roof drains and conveyed to the proposed storm sewer infrastructure (Design Point 2.3). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond A. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.2.

Sub-basin A6 (Q_5=3.2 cfs, Q_{100}=7.0 cfs) contains a total of 1.51 acres. This basin represents the central portion of the proposed Phase 1 development. This basin is primarily multi-family residential and minor open space. Stormwater runoff from this basin is conveyed via private streets, where it is captured by a sump inlet (Design Point 10). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond A. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.2.

Sub-basin A7 (Q_5=1.0 cfs, Q_{100}=2.4 cfs) contains a total of 0.58 acres. This basin represents the northwestern portion of Paonia Street and minor open. This basin is primarily minor open space with some asphalt paving and concrete sidewalks. Stormwater runoff from this basin is conveyed via curb & gutter, where it is captured by an on-grade inlet (Design Point 11). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond A. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.2.

Sub-basin A8 (Q_5=0.8 cfs, Q_{100}=1.7 cfs) contains a total of 0.30 acres. This basin represents the northeastern portion of Paonia Street. Half of this sub-basin is comprised of asphalt paving, while the second half is open space. Stormwater runoff from this basin is conveyed via curb & gutter, where it is captured by an on-grade inlet (Design Point 12). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond A. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.2.

Sub-basin A9 (Q_5=0.4 cfs, Q_{100}=2.9 cfs) contains a total of 1.33 acres. This basin represents the northeastern portion of the development. This basin is primarily open space and Pond A. Stormwater runoff from this basin is conveyed via overland flow, where it is captured by Pond A (Design Point 6A). From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.2.

Sub-basin B1 (Q_5=1.6 cfs, Q_{100}=2.8 cfs) contains a total of 0.37 acres. This basin represents the western portion of the proposed Phase 1 development along the phase line. This basin is primarily parking lot and minor open space. Stormwater runoff from this basin is conveyed via private streets, where it is captured by an on-grade inlet (Design Point 14). Runoff from this sub-basin, ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3.

Sub-basin B2 (Q_5=1.4 cfs, Q_{100}=2.7 cfs) contains a total of 0.35 acres. This basin represents a small western portion of the proposed Phase 1 development along the phase line. This basin is primarily parking lot and minor open space. Stormwater runoff from this basin is conveyed via private streets, where it is captured by an area inlet (Design Point 15). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3

Sub-basin B3 (Q_5=1.2 cfs, Q_{100}=2.4 cfs) contains a total of 0.35 acres. This basin represents the northwestern portion of the proposed Phase 1 development along the phase line. This basin is primarily parking lot and minor open space. Stormwater runoff from this basin is conveyed via private streets, where it is captured by an area inlet (Design Point 16). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3

Sub-basin B4 (Q_5=0.1 cfs, Q_{100}=0.2 cfs) contains a total of 0.03 acres. This basin represents a western portion of a proposed building and is comprised solely of proposed roof. Stormwater runoff from this basin is captured by proposed roof drains and conveyed to the proposed storm sewer infrastructure (Design Point 3.2). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3.

Sub-basin B5 (Q_5=1.0 cfs, Q_{100}=1.8 cfs) contains a total of 0.26 acres. This basin represents a eastern portion of a proposed building and a small western portion of an adjacent building. This sub-basin is comprised solely of proposed roof. Stormwater runoff from this basin is captured by proposed roof drains and conveyed to the proposed storm sewer infrastructure (Design Point 3.3).

Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3.

Sub-basin B6 (Q_5=1.9 cfs, Q_{100}=4.1 cfs) contains a total of 0.73 acres. This basin represents the western drive aisle of the proposed Phase 1 development. This basin is primarily parking lot with garages and minor open space. Stormwater runoff from this basin is conveyed via private streets, where it is captured by an area inlet (Design Point 19). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3.

Sub-basin B7 (Q_5=0.8 cfs, Q_{100}=2.0 cfs) contains a total of 0.47 acres. This basin represents a proposed building and open space in the center of the development. This sub-basin is comprised primarily of proposed roof and open space. Stormwater runoff from this basin is captured by proposed roof and area drains. Runoff is then conveyed to the proposed storm sewer infrastructure (Design Point 3.5). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3.

Sub-basin B8 (Q_5=0.9 cfs, Q_{100}=1.7 cfs) contains a total of 0.25 acres. This basin represents an eastern portion of a proposed building and a small western portion of an adjacent building. This sub-basin is comprised solely of proposed roof. Stormwater runoff from this basin is captured by proposed roof drains and conveyed to the proposed storm sewer infrastructure (Design Point 3.6). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3.

Sub-basin B9 (Q_5=0.7 cfs, Q_{100}=1.3 cfs) contains a total of 0.19 acres. This basin represents a eastern portion of a proposed building and is comprised solely of proposed roof. Stormwater runoff from this basin is captured by proposed roof drains and conveyed to the proposed storm sewer infrastructure (Design Point 3.7). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3.

Sub-basin B10 (Q_5=1.0 cfs, Q_{100}=2.2 cfs) contains a total of 0.38 acres. This basin represents the clubhouse parking area and open space. This basin is primarily parking lot with open space. Stormwater runoff from this basin is conveyed curb and gutter, where it is captured by an on-grade inlet (Design Point 23). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3.

Sub-basin B11 (Q_5=1.0 cfs, Q_{100}=2.6 cfs) contains a total of 0.74 acres. This basin represents a proposed building and open space in the center of the development. This sub-basin is comprised primarily of proposed roof and open space. Stormwater runoff from this basin is captured by proposed roof and area drains. Runoff is then conveyed to the proposed storm sewer infrastructure (Design Point 4.0). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3.

Sub-basin B12 (Q_5=2.7 cfs, Q_{100}=5.6 cfs) contains a total of 1.08 acres. This basin represents the drive aisle just west of the clubhouse of the Phase 1 development. This basin is primarily parking lot with garages and minor open space. Stormwater runoff from this basin is conveyed via private streets, where it is captured by a sump inlet (Design Point 27). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3.

Sub-basin B13 (Q_5=1.5 cfs, Q_{100}=3.2 cfs) contains a total of 0.48 acres. This basin represents the drive aisle and open space in the center of Basin B. This basin is primarily parking lot with open space. Stormwater runoff from this basin is conveyed via private streets, where it is captured by an area inlet (Design Point 25). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3.

Sub-basin B13A (Q_5=0.5 cfs, Q_{100}=1.6 cfs) contains a total of 0.58 acres. This basin represents a northern portion of a proposed building and the southern portion of another, the middle portion of the basin is comprised of minor open space. Stormwater runoff from this basin is captured by proposed roof and area drains. Runoff is then conveyed to the propose storm sewer infrastructure (Design Point 3.9). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3.

Sub-basin B14 (Q_5=1.3 cfs, Q_{100}=2.6 cfs) contains a total of 0.49 acres. This basin represents the western portion of the clubhouse and associated parking and drive aisle. This basin is primarily roof, parking lot, and open space. Stormwater runoff from this basin is conveyed via private streets, where it is captured by a sump inlet (Design Point 28). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3.

Sub-basin B15 (Q_5=0.9 cfs, Q_{100}=1.8 cfs) contains a total of 0.27 acres. This basin represents the eastern portion of the clubhouse and associated parking and drive aisle. This basin is primarily roof, parking lot, and open space. Stormwater runoff from this basin is conveyed via private streets, where it is captured by a sump inlet (Design Point 30). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3.

Sub-basin B16 (Q_5=0.4 cfs, Q_{100}=0.8 cfs) contains a total of 0.15 acres. This basin represents a southern portion of a proposed building and a small open space area. Stormwater runoff from this basin is captured by proposed roof drains and an area inlet. Runoff is then conveyed to the proposed storm sewer infrastructure (Design Point 4.3). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3.

Sub-basin B17 (Q_5=1.8 cfs, Q_{100}=4.5 cfs) contains a total of 0.99 acres. This basin represents the northwestern portion of Paonia Street within Basin B. This basin is primarily road paving and open space. Stormwater runoff from this basin is conveyed via curb & gutter, where it is captured by an on-grade inlet (Design Point 31). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3

Sub-basin B18 (Q_5=1.1 cfs, Q_{100}=2.4 cfs) contains a total of 0.47 acres. This basin represents the northeastern portion of Paonia Street within Basin B. This basin is primarily road paving and minor open space. Stormwater runoff from this basin is conveyed via curb & gutter, where it is captured by an on-grade inlet (Design Point 32). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3

Sub-basin B19 (Q_5=2.1 cfs, Q_{100}=5.7 cfs) contains a total of 1.92 acres. This basin represents the southern half of the clubhouse and patio area, along with the southwestern portion of Paonia Street within Basin B. This basin is primarily road paving, open space, and roof. Stormwater runoff from this basin is conveyed via overland flow and curb & gutter, where it is captured by an on-grade inlet (Design Point 33). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3

Sub-basin B20 (Q_5=0.6 cfs, Q_{100}=1.4 cfs) contains a total of 0.26 acres. This basin represents the southeastern portion of Paonia Street within Basin B. This basin is primarily road paving and minor open space. Stormwater runoff from this basin is conveyed via curb & gutter, where it is captured by an on-grade inlet (Design Point 34). Runoff from this sub-basin ultimately outfalls into the proposed onsite Pond B. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3

Sub-basin B21 (Q_5=0.5 cfs, Q_{100}=3.6 cfs) contains a total of 2.46 acres. This basin represents the northeastern portion of the development. This basin is primarily open space and Pond B. Stormwater runoff from this basin is conveyed via overland flow, where it is captured by Pond B

(Design Point 37). From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3

Sub-Basin C1 (Q_5=0.8 cfs, Q_{100}=2.2 cfs) contains a total of 0.74 acres. This basin represents the southernmost portion of the proposed development. This basin is primarily proposed roadway and minor open space. Stormwater runoff from this basin is conveyed via proposed curb and gutter to a proposed crosspan (Design Point 40) at the intersection of Paonia Street and Galley Road. Runoff is then conveyed east by the existing curb and gutter in Galley Road to the Sand Creek Center Tributary Drainageway, per historic conditions.

Sub-Basin C2 (Q_5=0.3 cfs, Q_{100}=2.3 cfs) contains a total of 0.80 acres. This basin represents the westernmost portion of the proposed Phase 1 development. This basin is solely comprised of open space. Stormwater runoff from this basin follows historic drainage patterns and sheet flows offsite (Design Point 41).

Sub-Basin D1 (Q_5=0.7 cfs, Q_{100}=2.6 cfs) contains a total of 0.95 acres and represents the northern most portion of Paonia Street and the site. This basin is comprised primarily of proposed roadway and open space. Runoff from this basin is conveyed via emergency overflow channel to the Sand Creek Center Tributary Drainageway (Design Point 42) per historic conditions. See the *Sand Creek-Center Tributary Channel Analysis Report for Solace Apartments,* prepared by JR Engineering October 15th, 2020 for overflow channel details.

Sub-Basin F1 (Q_5=2.2 cfs, Q_{100}=4.7 cfs) contains a total of 0.92 acres and represents the northwestern most portion of the Pond A tributary. This basin is comprised primarily of future parking areas, open space, and a future building. Runoff from this basin will be captured by future storm sewer infrastructure (Design Point 1). The proposed storm sewer infrastructure for the Phase 1 improvements have been sized to account for the future flows from this sub-basin. The future flows have also been analyzed in the Storm CAD model to ensure ultimate build out conditions have been accounted for. Runoff from this sub-basin will ultimately outfall into the proposed onsite Pond A. The proposed Pond A has also been sized to account for these future flows. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.2.

Sub-Basin F2 (Q_5=0.5 cfs, Q_{100}=1.0 cfs) contains a total of 0.14 acres and represents the future parking spaces along the drive aisle of the northernmost site access location. This basin is comprised solely of future parking. Runoff from this basin will be captured by the existing storm sewer infrastructure (Design Point 4). The proposed storm sewer infrastructure for the Phase 1 improvements have been sized to account for the future flows from this sub-basin. The future flows have also been analyzed in the Storm CAD model to ensure ultimate build out conditions have been accounted for. Runoff from this sub-basin will ultimately outfall into the proposed onsite Pond A. The proposed Pond A has also been sized to account for these future flows. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.2.

Sub-Basin F3 (Q_5=2.1 cfs, Q_{100}=4.4 cfs) contains a total of 0.73 acres and represents the eastern portion of the future parking spaces along the north property line of the site. This basin is comprised primarily of future parking and open space. Runoff from this basin will be captured by future storm sewer infrastructure (Design Point 3). The proposed storm sewer infrastructure for the Phase 1 improvements have been sized to account for the future flows from this sub-basin. The future flows have also been analyzed in the Storm CAD model to ensure ultimate build out conditions have been accounted for. Runoff from this sub-basin will ultimately outfall into the proposed onsite Pond A. The proposed Pond A has also been sized to account for these future flows. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.2.

Sub-Basin F4 (Q_5=0.8 cfs, Q_{100}=2.3. cfs) contains a total of 0.68 acres and represents a portion of the Phase 2 improvements located in the center of the site. This basin is comprised primarily of future open space and a future building. Runoff from this basin will be captured by future storm sewer infrastructure (Design Point 7). The proposed storm sewer infrastructure for the Phase 1 improvements have been sized to account for the future flows from this sub-basin. The future flows have also been analyzed in the Storm CAD model to ensure ultimate build out conditions have been accounted for. Runoff from this sub-basin will ultimately outfall into the proposed onsite Pond A. The proposed Pond A has also been sized to account for these future flows. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.2.

Sub-Basin F5 (Q_5=5.7 cfs, Q_{100}=14.7 cfs) contains a total of 3.88 acres and represents the western portion of the future parking spaces along the north property line of the site, the future buildings on the northwest portion of the site, and the open space associated with these improvements. This basin is comprised primarily of future parking, future buildings, and open space. Runoff from this basin will be captured by future storm sewer infrastructure (Design Point 3.0). The proposed storm sewer infrastructure for the Phase 1 improvements have been sized to account for the future flows from this sub-basin. The future flows have also been analyzed in the Storm CAD model to ensure ultimate build out conditions have been accounted for. Runoff from this sub-basin will ultimately outfall into the proposed onsite Pond B. The proposed Pond B has also been sized to account for these future flows. From the detention pond, the treated flows are then released directly into the Sand Creek Center Tributary Drainageway below historic rates at Design Point 5.3.

Sub-Basin F6 (Q_5=0.2 cfs, Q_{100}=1.0 cfs) contains a total of 0.35 acres. This basin represents the westernmost portion of the proposed Phase 1 development. This basin is solely comprised of open space. Stormwater runoff from this basin follows historic drainage patterns and sheet flows offsite (Design Point 41).

Sub-Basin F7 (Q_5=0.2 cfs, Q_{100}=1.5 cfs) contains a total of 0.53 acres. This basin represents the westernmost portion of the proposed Phase 1 development. This basin is solely comprised of open space. Stormwater runoff from this basin follows historic drainage patterns and sheet flows offsite (Design Point 41).

All calculations and stormwater routing can be found in Appendix B.

Existing Major Drainageway – Sand Creek

The Sand Creek channel conveys an existing 820-1100 cfs along the sites eastern property line. In order to maintain the drainage patterns on the site, 2 detention ponds have been proposed to release developed flows, at or below historic rates. Based on the results of the *Sand Creek – Center Tributary Channel Analysis Report for Solace Apartments*, prepared by JR Engineering in May 2020, the existing channel sections will need protection from erosion as a result of the Solace development. This report analyzed the existing conditions to ensure that the Sand Creek channel is stable and velocities do not exceed allowable limits. Based on the results of this report, it was found that the channel in its current conditions is inadequate, as velocities in the channel exceeded allowable limits and overtopping occurs at the Galley Road. The report recommended several improvements to ensure channel stability, including channel lining such as riprap or concrete to protect from the high velocities, widening the channel to increase capacity and decrease velocity & adding check/ drop structures to reduce velocities. The report also indicates that improvements will be necessary to address the overtopping at the Galley Road crossing. An existing overflow structure is currently in place to convey any overtopping flows, but does not have adequate capacity. Analysis of the proposed improvements to the channel can be found in the *Sand Creek Center Tributary Channel Improvements Letter.* Channel hydraulic analysis sheets are presented in Appendix B of the aforementioned report and Channel Plans for the proposed improvements can be found in Appendix E. A drainage map for the Solace site can be found in Appendix E.

DRAINAGE DESIGN CRITERIA

Development Criteria Reference

Storm drainage analysis and design criteria for the project were taken from the "*City of Colorado Spring/El Paso County Drainage Criteria Manual*" Volumes 1 and 2 (EPCDCM), dated October 12, 1994, the "*Urban Storm Drainage Criteria Manual"* Volumes 1 - 3 (USDCM) and Chapter 6 and Section 3.2.1 of Chapter 13 of the "Colorado Springs Drainage Criteria Manual (CCSDCM), dated May 2014, as adopted by El Paso County.

Hydrologic Criteria

All hydrologic data was obtained from the "El Paso Drainage Criteria Manual" Volumes 1 and 2, and the "Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual" Volumes 1, 2, and 3. Onsite drainage improvements were designed based on the 5 year (minor) storm event and the 100-year (major) storm event. Rational Method calculations were prepared, in accordance with

Chapter 6, Section 3.0 of the EPCDCM, for the sub-basins that directly impact the sizing of the proposed storm sewer outfalls. Rational method calculations are presented in Appendix B.

Mile High Flood District's MHFD-Detention, Version 4.03 workbook was used for pond sizing. Required detention volumes and allowable release rates were designed per USDCM and CCS/EPCDCM. Pond sizing spreadsheets are presented in Appendix C.

Hydraulic Criteria

GeoHECRAS was used as the primary analysis method for the site in the *Sand Creek – Center Tributary Channel Analysis Report for Solace Apartments* and the *Sand Creek Center Tributary Channel Improvements Letter*. GeoHECRAS was used to model existing flows within the Sand Creek Drainageway in its existing and proposed conditions. This model was used to verify flood plains and analyze any overtopping that may occur within the project site. The 100-year water surface profiles for the model were analyzed form the north property line of the site to the area just south of the Galley Road Crossing.

Using StormCAD V8i, a modeling program for stormwater drainage, the hydraulic grade lines and energy grade lines were determined for the storm sewer network. Manhole and pipe losses for the model were obtained from the *Urban Storm Drainage Criteria Manual*, Mile High Flood District. Model results for the project site have been included in Appendix B.

DRAINAGE FACILITY DESIGN

General Concept

The proposed stormwater conveyance system was designed to convey the developed Solace runoff to two proposed full spectrum water quality and detention ponds via private storm sewer. The proposed pond bottoms are approximately 1.5 feet higher than the existing channel bottom. This allows adequate drainage from the ponds to outfall into the channel without the need for backflow prevention measures. The proposed ponds were also designed to release at less than historic rates to minimize adverse impacts downstream. Treated water will outfall directly into the Sand Creek Drainageway, where it will eventually outfall into Fountain Creek. The current site will be constructed in 2 phases. Both of the proposed ponds will be designed and constructed with the Phase 1 improvements along with the storm sewer within Paonia Street. Proposed drainage maps are presented in Appendix E, showing locations of the pond and channel outfall locations and improvements.

Specific Details

Four Step Process to Minimize Adverse Impacts of Urbanization

In accordance with the El Paso County Drainage Criteria Manual Volume 2, this site has implemented the four step process to minimize adverse impacts of urbanization. The four step process includes reducing runoff volumes, stabilizing drainageways, treating the water quality capture volume (WQCV), and consider the need for Industrial Commercial BMP's.

Step 1, Reducing Runoff Volumes: The development of the project site is a proposed multi-family development with open spaces and lawn areas interspersed within the development which helps disconnect impervious areas and reduce runoff volumes.

Step 2, Stabilize Drainageways: Solace utilizes private storm sewer throughout the project site. This private storm sewer directs the on-site development flows to the multiple detention ponds within the project that release at or below historic rates into the Sand Creek Drainageway. Sand Creek (Center Tributary) Drainageway is stabilized downstream of the development, however additional stabilization measures shall be implemented to prevent any negative impacts to the drainageway. Drop structures have been added in order to reduce the slope of the channel. The channel shall also utilize concrete paving to avoid any erosion of the channel along the site.

Step 3, Provide WQCV: Runoff from this development is treated through capture and slow release of the WQCV in multiple full spectrum water quality and detention ponds that are designed per current El Paso County drainage criteria for Extended Detention Basins (EDB). These ponds will facilitate pollutant removal for the site, while also reducing peak stormwater rates into the Sand Creek Drainageway.

Step 4, Consider the need for Industrial and Commercial BMP's: No industrial or commercial uses are proposed within this development. However, a site specific storm water quality and erosion control plan and narrative have been prepared in conjunction with this final drainage report. Site specific temporary source control BMPs as well as permanent BMP's are detailed in this plan and narrative to protect receiving waters.

Water Quality

In accordance with Section 13.3.2.1 of the CCS/EPCDCM, full spectrum water quality and detention are provided for all developed basins. Outlet structure release rates shall be limited to less than historic rates to minimize adverse impacts to downstream stormwater facilities. Complete pond and outlet structure designs can be found in the appendix C. See Table 3 below for the proposed pond parameters.

Table 3: Pond Summary

Tributary Sub-Basin	Pond Name	Tributary Acres	Comp. % Imperv.	WQ Volume (ac-ft)	Total Detention Volume (ac-ft)	Provided Volume (ac-ft)
A	POND A	7.89	49.43	0.135	0.732	1.292
B	POND B	17.50	40.6	0.264	1.412	2.659

Per Section I.7.1.B.7 of the ECM – Stromwater Quality Policy and Procedures, sites with land disturbance to undeveloped land (land with no human-made structures such as buildings or pavement) that will remain undeveloped after the site, may be excluded from the water quality requirements set for in Section 1.7. Per this section, we respectfully request that Basins C2, F6, and F7 be excluded from permanent stormwater quality management. Due to existing topography and design constraints, Basins C1 and D1 could not be captured and routed to a permanent full spectrum water quality and detention pond. Per Section I.7.1.C.1 of the ECM – Stormwater Quality Policy and Procedures, the County may exclude up to 20%, not to exceed 1 acre, of the applicable development site, from the WQCV standard. Basin C1 & D1 contain approximately 0.32 acres of pavement, equal to approximately 1.11% of the total development site. Per this section, we respectfully request that Basin C1 & D1 be excluded from the permanent stromwater quality management.

Erosion Control Plan

The El Paso County Drainage Criteria Manual specifies an Erosion Control Plan and associated cost estimate must be submitted with each Final Drainage Report. The Erosion Control Plan for Solace has been submitted with this report.

Operation & Maintenance

In order to ensure the function and effectiveness of the stormwater infrastructure, maintenance activities such as inspection, routine maintenance, restorative maintenance, rehabilitation and repair, are required. All proposed drainage structures within the any platted County ROW will be owned and maintained by El Paso County. All proposed drainage structures within the property or tracts will be owned and maintained by the property owner. Vegetation in the natural and improved portions of Sand Creek Drainageway is the responsibility of El Paso County. This includes all mowing, seeding and weed control activities. An Inspection & Maintenance Plan has been submitted concurrently with this report that details the required maintenance activities and intervals to ensure proper function of all stormwater infrastructure in the future. The full spectrum detention ponds will be owned & maintained by the property owner.

Drainage & Bridge Fees

The site lies within the Sand Creek Drainage Basin.

2021 DRAINAGE AND BRIDGE FEES – Solace Apartments				
Impervious Acres (ac)	Drainage Fee (Per Imp. Acre)	Bridge Fee (Per Imp. Acre)	Solace Drainage Fee	Solace Bridge Fee
11.67	$20,387	$8,339	$237,916	$97,316

The Solace development will receive full credit for any channel improvements indicated in the Sand Creek DBPS. From the Sand Creek DBPS, the channel improvements estimated for this reach of the tributary was estimated to be $323,500. The table regarding these costs can be found in the Appendix. From the *Sand Creek (Center Tributary) Channel Analysis, by* JR Engineering, the estimated channel improvements will cost $554,950. Per the Sand Creek Drainage Basin Planning Study, the Center Tributary has proposed crossing improvements at Terminal Avenue and Omaha

Boulevard. Both of these crossing were estimated to be $72,000. Crossing improvements were also proposed at W. Frontage Road for $106,200, US 24 Bypass for $211,500, E. Frontage Road for $84,600, Bijou Street for $84,600, Platte Avenue for $169,200, & Galley Road for $90,000. These estimates provide costs for the storm sewer required to replace the existing infrastructure at these locations. The Galley Road crossing estimate reflects upsizing the existing culverts to 5'x 8' concrete box structures. These estimates can be found in Appendix D. Based on these estimated costs, it is presumed that no drainage basin fees will be necessary.

Construction Cost Opinion

El Paso County specifies a cost estimate of proposed drainage facility improvements be submitted with the Final Drainage Report. A construction cost opinion for both public and private drainage improvements have been provided below. Please note that the following cost estimate does not include channel improvements.

PUBLIC DRAINAGE FACILITIES				
Item	**Quantity**	**Unit**	**Unit Price**	**Extended Cost**
18" RCP	93	LF	$65.00	$6,045.00
24" RCP	41	LF	$78.00	$3,198.00
36" RCP	188	LF	$120.00	$22,560.00
42" RCP	31	LF	$160.00	$4,960.00
5' Type R Inlet	2	EA	$6,200.00	$12,400.00
10' Type R Inlet	4	EA	$7,600.00	$30,400.00
15' Type R Inlet	2	EA	$12,000.00	$24,000.00
Storm Sewer Manhole (Box Base)	2	EA	$11,627.00	$23,254.00
			Sub-Total	$126,817.00
	10% Eng. And Contingency			$12,681.70
			Grand Total	$139,498.70

PRIVATE DRAINAGE FACILITIES				
Item	**Quantity**	**Unit**	**Unit Price**	**Extended Cost**
18" RCP	1,254	LF	$65.00	$81,510.00
24" RCP	763	LF	$78.00	$59,514.00
30" RCP	464	LF	$97.00	$45,008.00
36" RCP	327	LF	$120.00	$39,240.00
42" RCP	44	LF	$160.00	$7,040.00
18" FES	2	EA	$390.00	$780.00
24" FES	1	EA	$468.00	$468.00
5' Type R Inlet	8	EA	$6,159.00	$49,274.00
Type 13 Valley Inlet	7	EA	$4,640.00	$32,480.00
Storm Sewer Manhole (Slab Base)	18	EA	$6,395.00	$115,110.00
Storm Sewer Manhole (Box Base)	3	EA	$11,627.00	$34,881.00
Pond Grading	3,682	CY	$20.00	$73,640.00
Pond Spillway	2	EA	$7,500.00	$15,000.00
Pond Outlet Structure	2	EA	$25,000.00	$50,000.00
Pond Forebay	4	EA	$12,000.00	$48,000.00
2' Concrete Trickle Channel	728	LF	$75.00	$54,600.00
Maintenance Trail (Asphalt)	2486	SY	$90.00	$223,740.00
Rip Rap	198	CY	$112.00	$22,176.00
			Sub-Total	$952,461.00
	10% Eng. And Contingency			$95,246.10
			Grand Total	$1,047,707.10

SUMMARY

The proposed development remains consistent with pre-development drainage conditions with the construction of the recommended drainage improvements, including storm sewer, detention ponds and existing drainageways. The proposed development will not adversely affect the offsite major drainageways or surrounding development. In order to safely convey flows through the Sand Creek Drainageway, channel improvements will be necessary to ensure channel stability and prevent channel degradation. Concrete paving will be required to armor the channel and stabilize the slopes during a major storm event. These improvements will ensure the drainageway functions properly as a primary drainage conveyance system for the Solace Apartments. These improvements to the Sand Creek Center Tributary Drainageway are discussed in the *Sand Creek Center Tributary Channel Improvements Letter.* This report meets the latest El Paso County Drainage Criteria requirements for this site.

REFERENCES:

1. El Paso County Drainage Criteria Manual Volume 1, El Paso County, CO, 1994.

2. Urban Storm Drainage Criteria Manual, Mile High Flood District, Latest Revision.

3. Flood Insurance Study- El Paso County, Colorado & Incorporated Areas Vol 7 of 8, Federal Emergency Management Agency, December 7, 2018.

4. Sand Creek Drainage Basin Planning Study, Kiowa Engineering, January 1993.

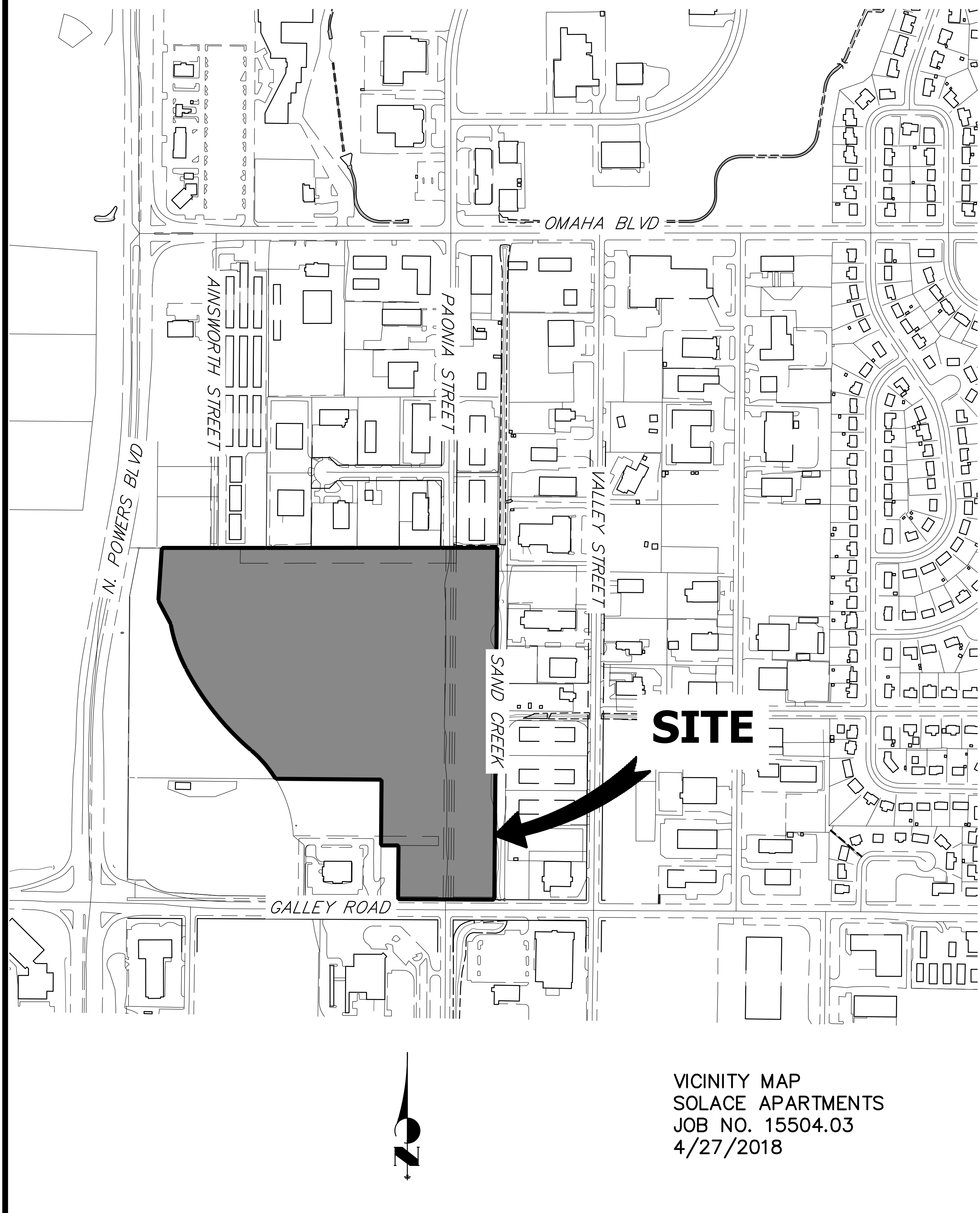
5. Sand Creek Drainage Basin LOMR, Federal Emergency Management Agency, May 23, 2007.

6. Sand Creek - Center Tributary Channel Analysis Report for Solace Apartments, JR Engineering, May, 2020

7. Preliminary Drainage Report for Solace Apartments, JR Engineering, September 3, 2020

APPENDIX A

FIGURES AND EXHIBITS

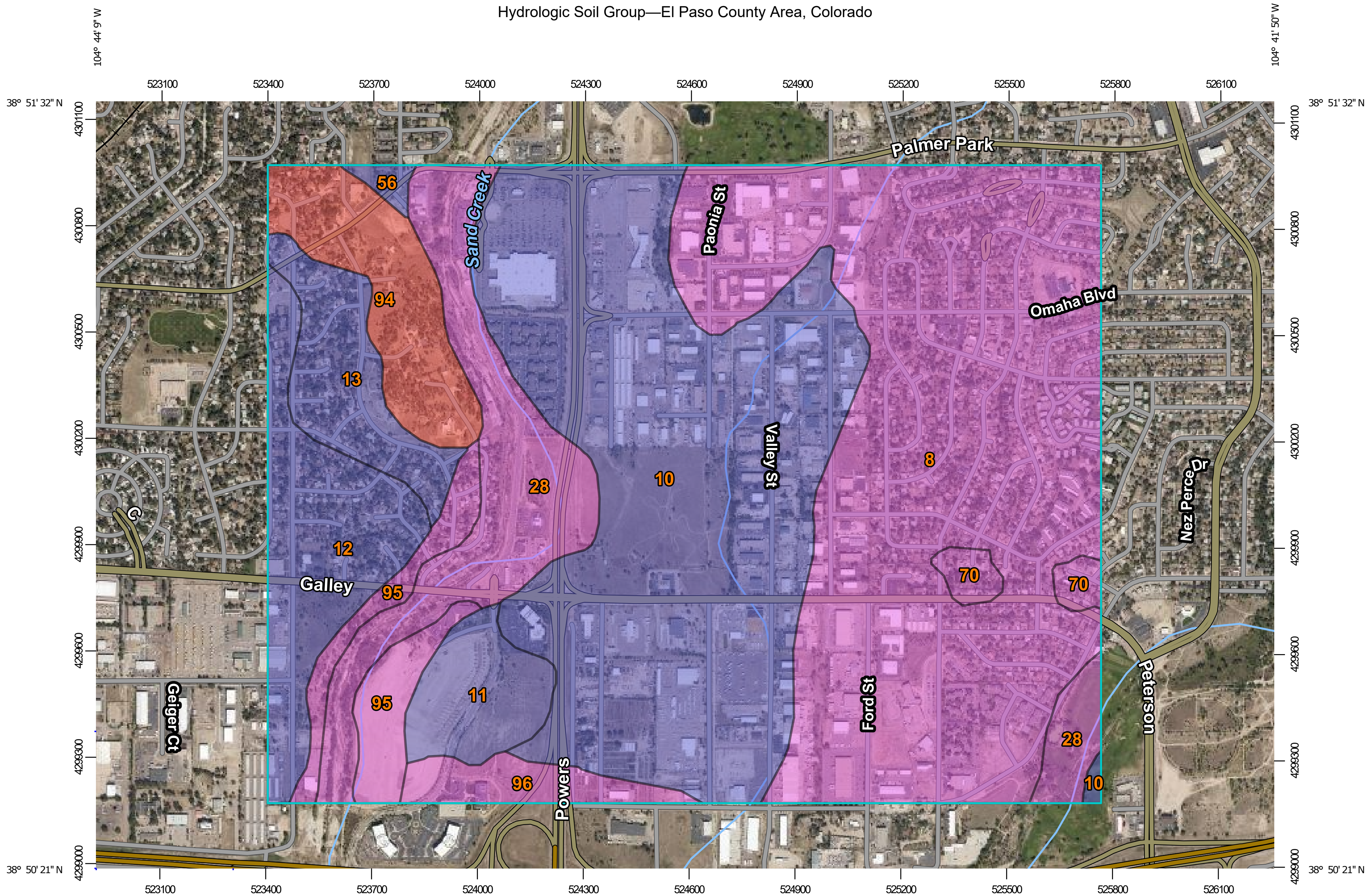


VICINITY MAP
SOLACE APARTMENTS
JOB NO. 15504.03
4/27/2018

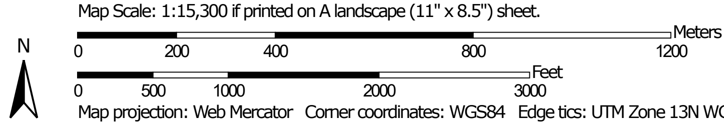
J·R ENGINEERING
A Westrian Company

Centennial 303–740–9393 • Colorado Springs 719–593–2593
Fort Collins 970–491–9888 • www.jrengineering.com

X:\2510000.all\2517400\Drawings\Blocks\Vicinity Map - Drainage.dwg, 8.5x11 Portrait, 12/17/2019 11:14:34 AM, PhillipsJ



Map Scale: 1:15,300 if printed on A landscape (11" x 8.5") 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

- 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.

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: El Paso County Area, Colorado
Survey Area Data: Version 17, Sep 13, 2019

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 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
8	Blakeland loamy sand, 1 to 9 percent slopes	A	373.7	35.4%
10	Blendon sandy loam, 0 to 3 percent slopes	B	321.4	30.5%
11	Bresser sandy loam, cool, 0 to 3 percent slopes	B	31.9	3.0%
12	Bresser sandy loam, cool, 3 to 5 percent slopes	B	69.8	6.6%
13	Bresser sandy loam, cool, 5 to 9 percent slopes	B	41.4	3.9%
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	A	96.1	9.1%
56	Nelson-Tassel fine sandy loams, 3 to 18 percent slopes	B	3.7	0.3%
70	Pits, gravel	A	10.3	1.0%
94	Travessilla-Rock outcrop complex, 8 to 90 percent slopes	D	51.5	4.9%
95	Truckton loamy sand, 1 to 9 percent slopes	A	35.7	3.4%
96	Truckton sandy loam, 0 to 3 percent slopes	A	19.7	1.9%
Totals for Area of Interest			**1,055.2**	**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.

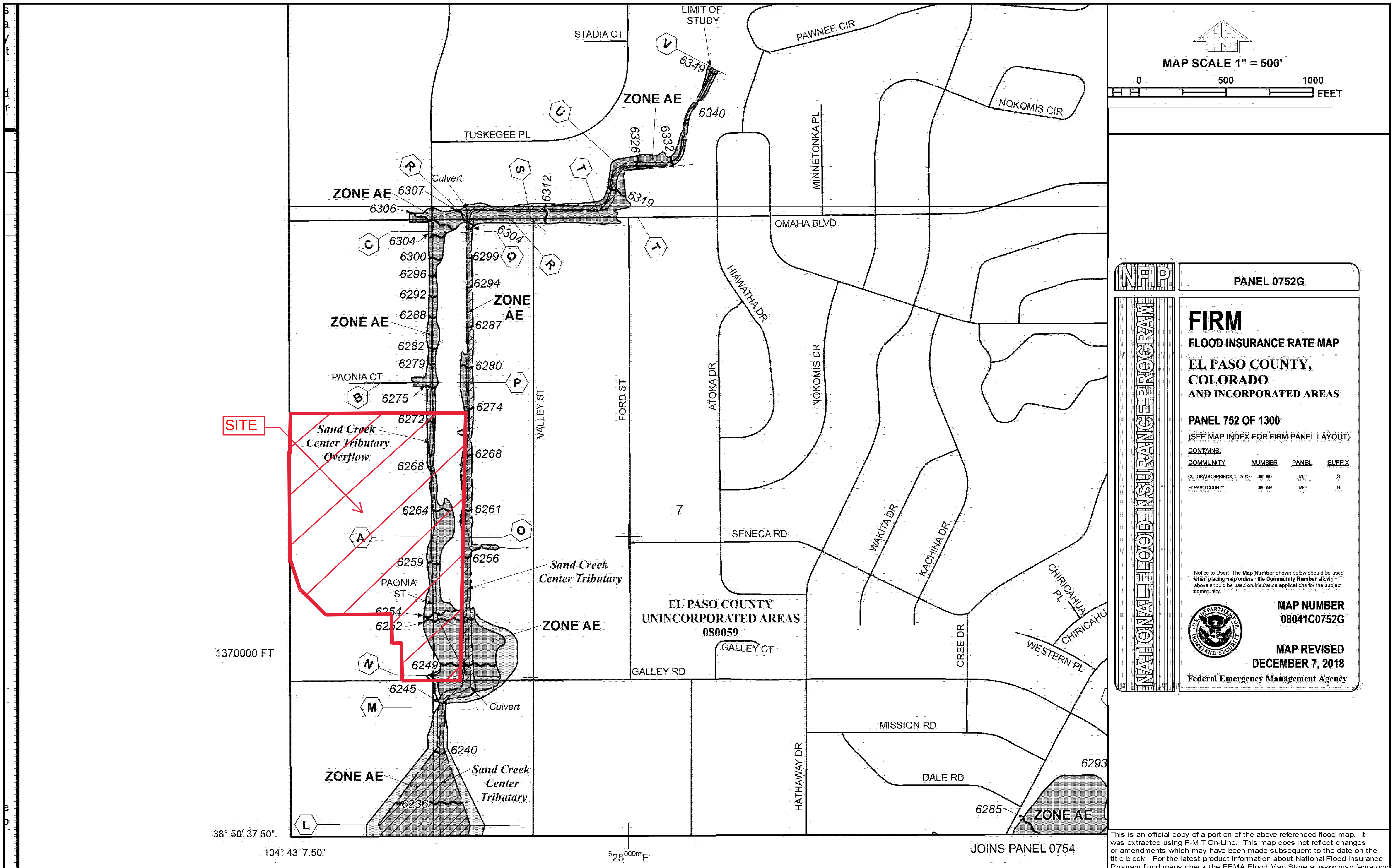
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



SITE
ZONE AE
Sand Creek Center Tributary Overflow
Sand Creek Center Tributary
LIMIT OF STUDY
STADIA CT
PAWNEE CIR
NOKOMIS CIR
TUSKEGEE PL
MINNETONKA PL
OMAHA BLVD
HIAWATHA DR
ATOKA DR
NOKOMIS DR
PAONIA CT
PAONIA ST
VALLEY ST
FORD ST
SENECA RD
WAKITA DR
KACHINA DR
CHIRICAHUA PL
CHIRICAHUA
WESTERN PL
GALLEY CT
GALLEY RD
CREE DR
MISSION RD
HATHAWAY DR
DALE RD
Culvert
EL PASO COUNTY UNINCORPORATED AREAS 080059
7
1370000 FT
38° 50' 37.50"
104° 43' 7.50"
525000mE
JOINS PANEL 0754
MAP SCALE 1" = 500'
0 500 1000 FEET
NFIP
PANEL 0752G
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO AND INCORPORATED AREAS
PANEL 752 OF 1300
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
COLORADO SPRINGS, CITY OF 080060 0752 G
EL PASO COUNTY 080059 0752 G
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.
MAP NUMBER 08041C0752G
MAP REVISED DECEMBER 7, 2018
Federal Emergency Management Agency
This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at http://www.ngs.noaa.gov/.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

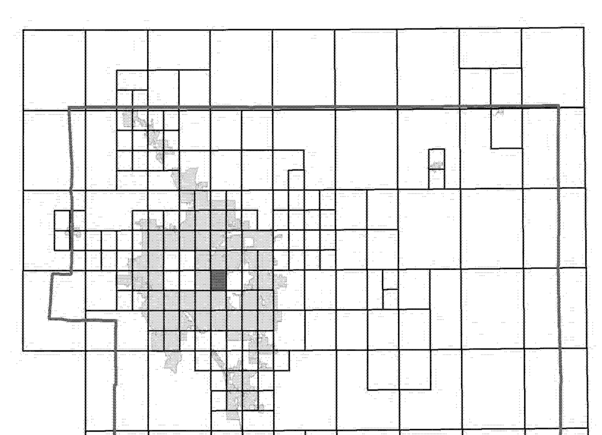
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

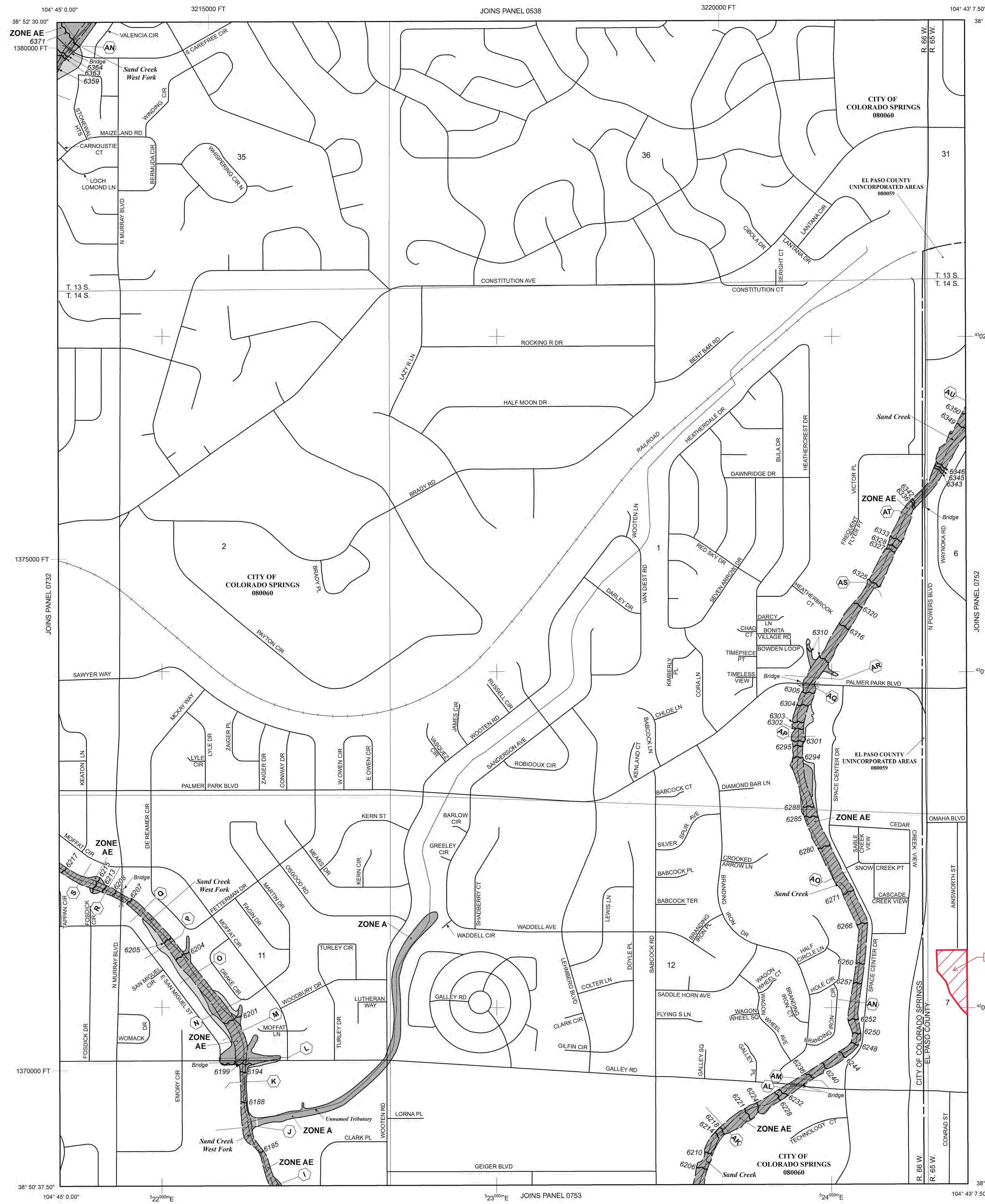
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	Floodplain boundary
	Floodway boundary
	Zone D Boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
~~ 513 ~~	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

(A)—(A)	Cross section line
(23)- - - -(23)	Transect line
97° 07' 30.00" 32° 22' 30.00"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
$^{42}75^{000m}$N	1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT	5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0751G

FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 751 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0751	G
EL PASO COUNTY	080059	0751	G

Notice to User: The **Map Number** shown below should be used when placing map orders: the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0751G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

APPENDIX B

HYDROLOGIC/ HYDRAULIC CALCULATIONS

COMPOSITE % IMPERVIOUS & COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Solace (Existing Condition)
Location: El Paso County

Project Name: Solace Apartments
Project No.: 25174.00
Calculated By: JBP
Checked By:
Date: 6/29/20

Basin ID	Total Area (ac)	Streets (100% Impervious)				Roofs (90% Impervious)				Light Industrial (80% Impervious)				Undeveloped (2% Impervious)				Basins Total Weighted C		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
A1	14.75	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	14.75	2.0%	0.09	0.36	2.0%
A2	3.79	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	3.79	2.0%	0.09	0.36	2.0%
A3	5.44	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	5.44	2.0%	0.09	0.36	2.0%
B1	4.84	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	4.84	2.0%	0.09	0.36	2.0%
OS1	17.73	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	17.73	80.0%	0.09	0.36	0.00	2.0%	0.59	0.70	80.0%
OS2	8.93	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.73	0.81	8.93	90.0%	0.09	0.36	0.00	2.0%	0.73	0.81	90.0%
TOTAL (A1-B1)	28.82																			2.0%
TOTAL (OS1-OS3)	26.66																			83.3%
TOTAL	55.48																			41.1%

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Solace (Existing Condition)
Location: El Paso County

Project Name: Solace Apartments
Project No.: 25174.00
Calculated By: JBP
Checked By:
Date: 6/29/20

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					tc CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
A1	14.75	B	2%	0.09	0.36	100	2.4%	13.7	1119	2.0%	7.0	1.0	18.8	32.5	1219.0	39.9	32.5
A2	3.79	B	2%	0.09	0.36	100	2.0%	14.5	611	1.8%	7.0	0.9	10.8	25.4	711.0	33.8	25.4
A3	5.44	B	2%	0.09	0.36	100	1.8%	15.0	444	1.9%	7.0	1.0	7.7	22.7	544.0	31.4	22.7
B1	4.84	B	2%	0.09	0.36	100	3.0%	12.7	351	1.2%	7.0	0.8	7.6	20.3	451.0	31.4	20.3
OS1	17.73	B	80%	0.59	0.70	100	1.9%	7.5	1236	1.8%	20.0	2.7	7.7	15.1	1336.0	20.0	15.1
OS2	8.93	B	90%	0.73	0.81	100	2.1%	5.2	415	1.9%	15.0	2.1	3.3	8.6	515.0	13.0	8.6

NOTES:

$$t_c = t_i + t_t$$ Equation 6-2

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}}$$ Equation 6-3

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L_i = length of overland flow (ft)
S_o = average slope along the overland flow path (ft/ft).

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$ Equation 6-4

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_o}$
K = NRCS conveyance factor (see Table 6-2).

$$t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$ Equation 6-5

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = slope of the channelized flow path (ft/ft).

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

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Solace (Existing Condition)
Location: El Paso County
Design Storm: 5-Year

Project Name: Solace Apartments
Project No.: 25174.00
Calculated By: JBP
Checked By:
Date: 6/29/20

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	1	A1	14.75	0.09	32.5	1.33	2.36	3.1					3.1	1.33	0.7								Surface runoff from existing basin A1, Surface flow into Sand Creek Drainageway at DP 1
	2	A2	3.79	0.09	25.4	0.34	2.73	0.9					0.9	0.34	2.0								Surface runoff from Basin A2 Surface flow offsite to the south at DP 2
	3	A3	5.44	0.09	22.7	0.49	2.90	1.4					1.4	0.49	2.5								Surface runoff from Basin A3 Surface flow offsite to the south at DP 3
	4	B1	4.84	0.09	20.3	0.44	3.07	1.3					1.3	0.44	1.0								Surface runoff from Basin B1 Surface flow offsite to the southwest at DP 4
	5	OS1	17.73	0.59	15.1	10.46	3.51	36.7					36.7	10.46	1.78					200	2.0	1.7	Surface runoff from Basin OS1, captured by existing concrete channel at DP 5 Channel conveyance to Sand Creek at DP 1.1
	6	OS2	8.93	0.73	8.6	6.52	4.36	28.4					28.4	6.52	3.2					147	2.7	0.9	Surface runoff from Basin OS2 diverted to swale west of site at DP 6
	1.0	-	-	-	-	-	-	-															5-Year Flows were not analyzed as part of the Sand Creek Drainage Basin Planning Study.
	1.1	-	-	-	-	-	-	-															5-Year Flows were not analyzed as part of the Sand Creek Drainage Basin Planning Study.
	1.2	-	-	-	-	-	-	-															5-Year Flows were not analyzed as part of the Sand Creek Drainage Basin Planning Study.
	1.3	-	-	-	-	-	-	-															5-Year Flows were not analyzed as part of the Sand Creek Drainage Basin Planning Study.
	1.4	-	-	-	-	-	-	-															5-Year Flows were not analyzed as part of the LOMR for Sand Creek Center Tributary.
	1.5	-	-	-	-	-	-	-															5-Year Flows were not analyzed as part of the Sand Creek Drainage Basin Planning Study.
	1.6	-	-	-	-	-	-	-															5-Year Flows were not analyzed as part of the Sand Creek Drainage Basin Planning Study.

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Solace (Existing Condition)
Location: El Paso County
Design Storm: 100-Year

Project Name: Solace Apartments
Project No.: 25174.00
Calculated By: JBP
Checked By:
Date: 6/29/20

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	*I* (in/hr)	Q (cfs)	tc (min)	C*A (ac)	*I* (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	1	A1	14.75	0.36	32.5	5.31	3.96	21.0					21.0	5.31	0.7								Surface runoff from existing basin A1, Surface flow into Sand Creek Drainageway at DP 1
	2	A2	3.79	0.36	25.4	1.36	4.59	6.2					6.2	1.36	2.0								Surface runoff from Basin A2 Surface flow offsite to the south at DP 2
	3	A3	5.44	0.36	22.7	1.96	4.87	9.5					9.5	1.96	2.5								Surface runoff from Basin A3 Surface flow offsite to the south at DP 3
	4	B1	4.84	0.36	20.3	1.74	5.15	9.0					9.0	1.74	1.0								Surface runoff from Basin B1 Surface flow offsite to the southwest at DP 4
	5	OS1	17.73	0.70	15.1	12.41	5.89	73.1				573.1	573.1		1.78					200	2.0	1.7	Surface runoff from Basin OS1 & DP 1.4, captured by existing concrete channel at DP 5 Street conveyance to DP 5, flow split to DP 1.5 & DP 1.6
	6	OS2	8.93	0.81	8.6	7.23	7.32	52.9					52.9	7.23	3.2					147	2.7	0.9	Surface runoff from Basin OS2 diverted to swale west of site at DP 6
	1.0	-	-	-	-	-	-	820.0					820.0										Flow taken directly from the Sand Creek Drainage Basin Planning Study
	1.1	-	-	-	-	-	-	820.0					820.0										Flow taken directly from the Sand Creek Drainage Basin Planning Study
	1.2	-	-	-	-	-	-	1037.0					1037.0										Flow taken directly from the Sand Creek Drainage Basin Planning Study
	1.3	-	-	-	-	-	-	1100.0					1100.0										Flow taken directly from the Sand Creek Drainage Basin Planning Study
	1.4	-	-	-	-	-	-	500.0					500.0										Flow taken directly from the LOMR for Sand Creek Center Tributary Street conveyance to DP 5
	1.5											244.0	244.0										Second Draiangeway Channel conveyance to Sand Creek at DP 1
	1.6											42.1	42.1										Existing Concrete Channel Channel conveyance to Sand Creek at DP 1.1

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.

COMPOSITE % IMPERVIOUS & COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Solace
Location: El Paso County

Project Name: Solace Apartments
Project No.: 25174.00
Calculated By: AAM
Checked By:
Date: 3/12/21

Basin ID	Total Area (ac)	Streets (100% Impervious)				Roofs (90% Impervious)				Light Industrial (80% Impervious)				Lawns (0% Impervious)				Basins Total Weighted C		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
A1	0.50	0.90	0.96	0.29	58.0%	0.73	0.81	0.11	19.8%	0.59	0.70	0.00	0.0%	0.08	0.35	0.10	0.0%	0.70	0.81	77.8%
A2	0.47	0.90	0.96	0.36	76.6%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.11	0.0%	0.71	0.82	76.6%
A3	0.45	0.90	0.96	0.35	77.8%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.10	0.0%	0.72	0.82	77.8%
A4	0.15	0.90	0.96	0.00	0.0%	0.73	0.81	0.15	90.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.73	0.81	90.0%
A5	0.13	0.90	0.96	0.00	0.0%	0.73	0.81	0.13	90.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.73	0.81	90.0%
A6	1.51	0.90	0.96	0.53	35.1%	0.73	0.81	0.38	22.6%	0.59	0.70	0.00	0.0%	0.08	0.35	0.60	0.0%	0.53	0.68	57.7%
A7	0.58	0.90	0.96	0.24	41.4%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.34	0.0%	0.42	0.60	41.4%
A8	0.30	0.90	0.96	0.16	53.3%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.14	0.0%	0.52	0.68	53.3%
A9	1.33	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	1.33	0.0%	0.08	0.35	0.0%
B1	0.37	0.90	0.96	0.29	78.4%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.08	0.0%	0.72	0.83	78.4%
B2	0.35	0.90	0.96	0.33	94.3%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.02	0.0%	0.85	0.93	94.3%
B3	0.35	0.90	0.96	0.25	71.4%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.10	0.0%	0.67	0.79	71.4%
B4	0.03	0.90	0.96	0.00	0.0%	0.73	0.81	0.03	90.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.73	0.81	90.0%
B5	0.26	0.90	0.96	0.00	0.0%	0.73	0.81	0.26	90.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.73	0.81	90.0%
B6	0.73	0.90	0.96	0.43	58.9%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.30	0.0%	0.56	0.71	58.9%
B7	0.47	0.90	0.96	0.00	0.0%	0.73	0.81	0.21	40.2%	0.59	0.70	0.00	0.0%	0.08	0.35	0.26	0.0%	0.37	0.56	40.2%
B8	0.25	0.90	0.96	0.00	0.0%	0.73	0.81	0.25	90.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.73	0.81	90.0%
B9	0.19	0.90	0.96	0.00	0.0%	0.73	0.81	0.19	90.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.00	0.0%	0.73	0.81	90.0%
B10	0.38	0.90	0.96	0.21	55.3%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.17	0.0%	0.53	0.69	55.3%
B11	0.74	0.90	0.96	0.00	0.0%	0.73	0.81	0.29	35.3%	0.59	0.70	0.00	0.0%	0.08	0.35	0.45	0.0%	0.33	0.53	35.3%
B12	1.08	0.90	0.96	0.66	61.1%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.42	0.0%	0.58	0.72	61.1%
B13	0.58	0.90	0.96	0.33	56.9%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.25	0.0%	0.55	0.70	56.9%
B13A	0.48	0.90	0.96	0.00	0.0%	0.73	0.81	0.11	20.6%	0.59	0.70	0.00	0.0%	0.08	0.35	0.37	0.0%	0.23	0.46	20.6%
B14	0.49	0.90	0.96	0.29	59.2%	0.73	0.81	0.05	9.2%	0.59	0.70	0.00	0.0%	0.08	0.35	0.15	0.0%	0.63	0.76	68.4%
B15	0.27	0.90	0.96	0.19	70.4%	0.73	0.81	0.02	6.7%	0.59	0.70	0.00	0.0%	0.08	0.35	0.06	0.0%	0.71	0.81	77.0%
B16	0.15	0.90	0.96	0.00	0.0%	0.73	0.81	0.11	66.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.04	0.0%	0.56	0.69	66.0%
B17	0.99	0.90	0.96	0.40	40.4%	0.73	0.81	0.01	0.9%	0.59	0.70	0.00	0.0%	0.08	0.35	0.58	0.0%	0.42	0.60	41.3%
B18	0.47	0.90	0.96	0.24	51.1%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.23	0.0%	0.50	0.66	51.1%

Basin ID	Total Area (ac)	Streets (100% Impervious)				Roofs (90% Impervious)				Light Industrial (80% Impervious)				Lawns (0% Impervious)				Basins Total Weighted C		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
B19	1.92	0.90	0.96	0.44	22.9%	0.73	0.81	0.16	7.5%	0.59	0.70	0.00	0.0%	0.08	0.35	1.32	0.0%	0.32	0.53	30.4%
B20	0.26	0.90	0.96	0.13	50.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.13	0.0%	0.49	0.66	50.0%
B21	2.46	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	2.46	0.0%	0.08	0.35	0.0%
C1	0.74	0.90	0.96	0.19	25.7%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.55	0.0%	0.29	0.51	25.7%
C2	0.80	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.80	0.0%	0.08	0.35	0.0%
D1	0.95	0.90	0.96	0.13	13.7%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.82	0.0%	0.19	0.43	13.7%
F1	0.92	0.90	0.96	0.33	35.9%	0.73	0.81	0.21	20.5%	0.59	0.70	0.00	0.0%	0.08	0.35	0.38	0.0%	0.52	0.67	56.4%
F2	0.14	0.90	0.96	0.11	78.6%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.03	0.0%	0.72	0.83	78.6%
F3	0.73	0.90	0.96	0.44	60.3%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.29	0.0%	0.57	0.72	60.3%
F4	0.68	0.90	0.96	0.02	2.9%	0.73	0.81	0.21	27.8%	0.59	0.70	0.00	0.0%	0.08	0.35	0.45	0.0%	0.30	0.51	30.7%
F5	3.88	0.90	0.96	0.79	20.4%	0.73	0.81	0.66	15.3%	0.59	0.70	0.00	0.0%	0.08	0.35	2.43	0.0%	0.36	0.55	35.7%
F6	0.35	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.35	0.0%	0.08	0.35	0.0%
F7	0.53	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	0.00	0.0%	0.08	0.35	0.53	0.0%	0.08	0.35	0.0%
OS1	17.73	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	17.73	80.0%	0.08	0.35	0.00	0.0%	0.59	0.70	80.0%
OS2	8.93	0.90	0.96	0.00	0.0%	0.73	0.81	0.00	0.0%	0.59	0.70	8.93	90.0%	0.08	0.35	0.00	0.0%	0.59	0.70	90.0%
TOTAL (A1-D1)	21.18																			40.9%
TOTAL (F1-F7)	7.23																			36.8%
TOTAL (OS1-OS2)	26.66																			83.3%
TOTAL	55.07																			60.9%

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Solace
Location: El Paso County

Project Name: Solace Apartments
Project No.: 25174.00
Calculated By: AAM
Checked By:
Date: 3/12/21

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
A1	0.50	B	78%	0.70	0.81	48	2.0%	4.0	212	1.1%	20.0	2.1	1.7	5.7	260.0	14.5	5.7
A2	0.47	B	77%	0.71	0.82	78	2.5%	4.6	207	1.2%	20.0	2.2	1.6	6.2	285.0	14.6	6.2
A3	0.45	B	78%	0.72	0.82	54	1.3%	4.7	185	1.5%	20.0	2.4	1.3	5.9	239.0	14.0	5.9
A4	0.15	B	90%	0.73	0.81	20	1.0%	3.0	120	1.0%	20.0	2.0	1.0	4.0	140.0	11.6	5.0
A5	0.13	B	90%	0.73	0.81	20	1.0%	3.0	120	1.0%	20.0	2.0	1.0	4.0	140.0	11.6	5.0
A6	1.51	B	58%	0.53	0.68	110	1.9%	8.8	217	1.2%	20.0	2.1	1.7	10.5	327.0	18.2	10.5
A7	0.58	B	41%	0.42	0.60	86	2.2%	8.8	261	1.5%	20.0	2.4	1.8	10.6	347.0	21.4	10.6
A8	0.30	B	53%	0.52	0.68	20	2.0%	3.7	316	1.5%	20.0	2.4	2.2	5.9	336.0	19.5	5.9
A9	1.33	B	0%	0.08	0.35	152	7.0%	11.9	194	1.3%	15.0	1.7	1.9	13.9	346.0	29.2	13.9
B1	0.37	B	78%	0.72	0.83	56	2.3%	3.9	171	1.3%	20.0	2.3	1.3	5.1	227.0	13.9	5.1
B2	0.35	B	94%	0.85	0.93	44	1.9%	2.4	215	1.9%	20.0	2.8	1.3	3.7	259.0	11.1	5.0
B3	0.35	B	71%	0.67	0.79	33	2.3%	3.4	140	1.0%	20.0	2.0	1.2	4.6	173.0	15.1	5.0
B4	0.03	B	90%	0.73	0.81	20	1.0%	3.0	40	1.0%	20.0	2.0	0.3	3.3	60.0	11.0	5.0
B5	0.26	B	90%	0.73	0.81	20	1.0%	3.0	120	1.0%	20.0	2.0	1.0	4.0	140.0	11.6	5.0
B6	0.73	B	59%	0.56	0.71	70	3.6%	5.3	222	1.2%	20.0	2.1	1.7	7.1	292.0	18.0	7.1
B7	0.47	B	40%	0.37	0.56	88	7.3%	6.4	54	1.0%	15.0	1.5	0.6	7.0	142.0	19.8	7.0
B8	0.25	B	90%	0.73	0.81	20	1.0%	3.0	120	1.0%	20.0	2.0	1.0	4.0	140.0	11.6	5.0
B9	0.19	B	90%	0.73	0.81	20	1.0%	3.0	120	1.0%	20.0	2.0	1.0	4.0	140.0	11.6	5.0
B10	0.38	B	55%	0.53	0.69	43	3.2%	4.6	111	1.9%	20.0	2.8	0.7	5.2	154.0	17.4	5.2
B11	0.74	B	35%	0.33	0.53	140	5.0%	9.6	130	1.0%	15.0	1.5	1.4	11.1	270.0	21.6	11.1
B12	1.08	B	61%	0.58	0.72	71	2.3%	6.0	418	1.2%	20.0	2.1	3.2	9.2	489.0	19.3	9.2
B13	0.58	B	57%	0.55	0.70	87	4.9%	5.5	192	3.4%	20.0	3.7	0.9	6.4	279.0	17.4	6.4
B13A	0.48	B	21%	0.23	0.46	60	3.9%	7.8	197	1.0%	20.0	2.0	1.6	9.4	257.0	25.3	9.4
B14	0.49	B	68%	0.63	0.76	195	2.1%	9.2	23	1.0%	20.0	2.0	0.2	9.4	218.0	14.6	9.4
B15	0.27	B	77%	0.71	0.81	117	2.5%	5.7	6	1.0%	20.0	2.0	0.1	5.7	123.0	13.0	5.7
B16	0.15	B	66%	0.56	0.69	20	1.0%	4.4	120	1.0%	20.0	2.0	1.0	5.4	140.0	15.9	5.4
B17	0.99	B	41%	0.42	0.60	32	3.0%	4.8	494	1.5%	20.0	2.4	3.4	8.2	526.0	23.5	8.2
B18	0.47	B	51%	0.50	0.66	20	2.0%	3.9	494	1.5%	20.0	2.4	3.4	7.2	514.0	21.5	7.2
B19	1.92	B	30%	0.32	0.53	250	3.0%	15.5	178	1.0%	20.0	2.0	1.5	16.9	428.0	23.1	16.9
B20	0.26	B	50%	0.49	0.66	20	2.0%	3.9	280	1.0%	20.0	2.0	2.3	6.3	300.0	20.4	6.3

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Solace
Location: El Paso County

Project Name: Solace Apartments
Project No.: 25174.00
Calculated By: AAM
Checked By:
Date: 3/12/21

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
B21	2.46	B	0%	0.08	0.35	250	2.5%	21.5	736	1.0%	15.0	1.5	8.2	29.7	986.0	39.6	29.7
C1	0.74	B	26%	0.29	0.51	153	2.0%	14.4	95	1.8%	20.0	2.7	0.6	15.0	248.0	22.6	15.0
C2	0.80	B	0%	0.08	0.35	30	5.0%	5.9	30	5.0%	7.0	1.6	0.3	6.3	60.0	26.2	6.3
D1	0.95	B	14%	0.19	0.43	83	2.0%	11.9	155	3.3%	15.0	2.7	0.9	12.8	238.0	25.0	12.8
F1	0.92	B	56%	0.52	0.67	112	5.5%	6.3	196	1.8%	20.0	2.7	1.2	7.5	308.0	17.9	7.5
F2	0.14	B	79%	0.72	0.83	30	4.0%	2.4	257	1.1%	20.0	2.1	2.1	4.4	287.0	14.7	5.0
F3	0.73	B	60%	0.57	0.72	66	13.5%	3.3	331	1.5%	20.0	2.4	2.3	5.5	397.0	18.3	5.5
F4	0.68	B	31%	0.30	0.51	173	6.0%	10.5	97	1.0%	20.0	2.0	0.8	11.3	270.0	22.0	11.3
F5	3.88	B	36%	0.36	0.55	115	5.0%	8.5	283	1.7%	20.0	2.6	1.8	10.3	398.0	22.5	10.3
F6	0.35	B	0%	0.08	0.35	30	8.0%	5.1	30	8.0%	7.0	2.0	0.3	5.3	60.0	26.2	5.3
F7	0.53	B	0%	0.08	0.35	20	25.0%	2.8	516	2.0%	15.0	2.1	4.1	6.9	536.0	32.8	6.9
OS1	17.73	B	80%	0.59	0.70	100	1.9%	7.5	1236	1.8%	20.0	2.7	7.7	15.1	1336.0	20.0	15.1
OS2	8.93	B	90%	0.59	0.70	100	2.1%	7.2	425	1.9%	15.0	2.1	3.4	10.6	525.0	13.1	10.6

NOTES:

$$t_c = t_i + t_t$$ Equation 6-2

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$ Equation 6-4

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_o}$
K = NRCS conveyance factor (see Table 6-2).

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}}$$ Equation 6-3

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L_i = length of overland flow (ft)
S_o = average slope along the overland flow path (ft/ft).

$$t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$ Equation 6-5

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)
i = imperviousness (expressed as a decimal)
S_t = slope of the channelized flow path (ft/ft).

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

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

ubdivision: Solace
Location: El Paso County
sign Storm: 5-Year

Project Name: Solace Apartments
Project No.: 25174.00
Calculated By: AAM
Checked By:
Date: 3/12/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	1	F1	0.92	0.52	7.5	0.48	4.56	2.2								2.2	0.48	1.0	18	320	4.6	1.2	Future on-grade inlet Future pipe conveyance to DP 1.0
	2	F2	0.14	0.72	5.0	0.10	5.17	0.5					0.5	0.10	2.18					33	3.0	0.2	Future overland flow to DP 4 Infrastructure to South Detention Pond at DP 2
	3	F3	0.73	0.57	5.5	0.42	5.02	2.1								2.1	0.42	1.9	18	64	5.8	0.2	Future sump inlet Future pipe conveyance to DP 1.0
	4	A1	0.50	0.70	5.7	0.35	4.97	1.7					0.1	0.03	1.5	1.6	0.32	1.5	18	300 8	1.8 4.9	2.7 0.0	On-grade inlet, Carryover flow to DP 11 Piped to DP 1.0
	1.0								8.7	1.32	4.35	5.7				5.7	1.32	2.1	36	221	7.4	0.5	Sum of DP 1, DP 2, DP 3, & DP 4 Piped to DP 4P
	4P								8.7	1.32	4.35	5.7	5.7	1.32	0.5					185	1.1	2.9	Pond A Forebay Trickle channel conveyance to DP 6P
	5	A2	0.47	0.71	6.2	0.33	4.85	1.6					0.6	0.12	1.2	1.0	0.21	2.0	18	290 33	1.6 4.6	2.9 0.1	No. 16-valley inlet, Carryover flow to DP 10 Piped to DP 2.2
	6	A3	0.45	0.72	5.9	0.32	4.92	1.6					0.6	0.12	1.5	1.0	0.20	1.0	18	321 0	1.8 3.6	2.9 0.0	No. 16-valley inlet, Carryover flow to DP 10 Piped to DP 2.0
	7	F4	0.68	0.30	11.3	0.21	3.95	0.8								0.8	0.21	1.0	15	27	3.5	0.1	Future roof drains and area inlets Future pipe conveyance to DP 2.0
	2.0								11.4	0.41	3.93	1.6				1.6	0.41	1.0	18	14	4.3	0.1	Sum of DP 6 & DP 7 Piped to DP 2.1
	8	A4	0.15	0.73	5.0	0.11	5.17	0.6								0.6	0.11	1.0	15	105	3.1	0.6	Roof drains Piped to DP 2.1
	2.1								11.4	0.52	3.93	2.1				2.1	0.52	1.0	18	101	4.6	0.4	Sum of DP 8 & DP 2.0 Piped to DP 2.2
	2.2								11.8	0.73	3.88	2.8				2.8	0.73	1.0	24	105	4.9	0.4	Sum of DP 5 & DP 2.1 Piped to DP 2.3
	9	A5	0.13	0.73	5.0	0.09	5.17	0.5								0.5	0.09	1.0	15	7	3.0	0.0	Roof drains Piped to DP 2.3
	2.3								12.2	0.82	3.83	3.1				3.1	0.82	1.3	24	114	5.4	0.4	Sum of DP 9 & DP 2.2 Piped to DP 2.4
	10	A6	1.51	0.53	10.5	0.80	4.06	3.2	10.5	1.04	4.06	4.2				4.2	1.04	1.3	24	0	6.0	0.0	Sump Inlet. Sum of Carryover flows from DP 5, DP 6, and Sub-Basin A6 Piped to DP 2.4
	2.4								12.5	1.86	3.79	7.1				7.1	1.86	2.0	30	31	8.0	0.1	Sum of DP 9 & DP 2.2 Piped to DP 2.5
	11	A7	0.58	0.42	10.6	0.24	4.05	1.0	10.6	0.27	4.05	1.1				1.1	0.27	2.0	30	0	4.5	0.0	On-grade Inlet, Sum of carryover from DP 4 and Sub-Basin A7 Piped to DP 2.5
	2.5								12.6	2.13	3.78	8.1				8.1	2.13	2.0	36	44	8.0	0.1	Sum of DP 11 & DP 2.4 Piped to DP 2.6
	12	A8	0.30	0.52	5.9	0.16	4.92	0.8								0.8	0.16	2.0	30	0	4.0	0.0	On-grade inlet Piped to DP 2.6
	2.6								12.7	2.29	3.77	8.6				8.6	2.29	2.4	36	55	8.8	0.1	Sum of DP 12 & DP 2.5 Piped to DP 5P
	5P								12.7	2.29	3.77	8.6	8.6	2.29	0.5					45	1.1	0.7	Pond A Forebay Trickle channel conveyance to DP 6P
	6P	A9	1.33	0.08	13.9	0.11	3.64	0.4					0.4	0.11	2.18								Overland Flow Pond Conveyance to DP 6P
	6P								13.9	3.72	3.64	13.5											Pond outlet Structure Release detained flows into Sandcreek Drainageway
	13	F5	3.88	0.36	10.3	0.82	4.09	3.4					3.4	0.82	1.2					170	1.3	2.2	Future Phase 2 developed flows minus roof drains and future area inlet flows Pan conveyance to DP 14

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

ubdivision: Solace
Location: El Paso County
sign Storm: 5-Year

Project Name: Solace Apartments
Project No.: 25174.00
Calculated By: AAM
Checked By:
Date: 3/12/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	14	B1	0.37	0.72	5.1	0.27	5.13	1.4	12.4	1.09	3.80	4.1	2.4	0.64	1.1	1.7	0.45	1.0	18	89 0	1.6 4.3	0.9 0.0	Sum of carryover flows from DP 13 and Sub-Basin B1, No. 16-valley inlet, Carryover flow to DP 16 Piped to DP 3.0
	3.0								12.4	1.68	3.80	6.4				6.4	1.68	1.0	18	89	6.2	0.2	Flows captured by No. 16-Valley inlet and future building and area drains connecting directly to inlet. Piped to DP 3.1
	15	B2	0.35	0.85	5.0	0.30	5.17	1.6								1.6	0.30	2.0	18	75	5.4	0.2	On-grade inlet Piped to DP 3.1
	16	B3	0.35	0.67	5.0	0.23	5.17	1.2	13.4	0.87	3.69	3.2				3.2	0.87	1.0	18	0	5.2	0.0	Sum of carryover flow from DP 14 and Sub-Basin B3,On-grade inlet. Carryover flow to DP 19 Piped to DP 3.1
	3.1								13.4	2.85	3.69	10.5				10.5	2.85	0.5	30	30	5.4	0.1	Sum of DP 14, DP 15 & DP 16 Piped to DP 3.2
	17	B4	0.03	0.73	5.0	0.02	5.17	0.1								0.1	0.02	1.0	8	40	1.9	0.3	Roof drains Piped to DP 3.2
	3.2								13.5	2.87	3.68	10.6				10.6	2.87	0.5	30	163	5.4	0.5	Sum of DP 17 & DP 3.1 Piped to DP 3.3
	18	B5	0.26	0.73	5.0	0.19	5.17	1.0								1.0	0.19	1.0	8	40	3.8	0.2	Roof drains Piped to DP 3.3
	3.3								14.0	3.06	3.63	11.1				11.1	3.06	1.9	30	75	8.8	0.1	Sum of DP 18 & DP 3.2 Piped to DP 3.4
	19	B6	0.73	0.56	7.1	0.41	4.65	1.9					0.8	0.17	1.1	1.1	0.24	1.0	18	445 13	1.6 3.8	4.7 0.1	No. 16-valley inlet, Carryover flow to DP 27 Piped to DP 3.4
	3.4								14.1	3.29	3.61	11.9				11.9	3.29	1.0	30	29	7.2	0.1	Sum of DP 19 & DP 3.3 Piped to DP 3.5
	20	B7	0.47	0.37	7.0	0.17	4.66	0.8								0.8	0.17	1.0	15	60	3.5	0.3	Roof drains Piped to DP 3.5
	3.5								14.2	3.46	3.60	12.5				12.5	3.46	0.5	30	143	5.7	0.4	Sum of DP 20 & DP 3.4 Piped to DP 3.6
	21	B8	0.25	0.73	5.0	0.18	5.17	0.9								0.9	0.18	1.0	15	10	3.6	0.0	Roof drains Piped to DP 3.6
	3.6								14.6	3.64	3.56	13.0				13.0	3.64	0.5	30	191	5.8	0.6	Sum of DP 21 & DP 3.5 Piped to DP 3.7
	22	B9	0.19	0.73	5.0	0.14	5.17	0.7								0.7	0.14	1.0	15	15	3.4	0.1	Roof drains Piped to DP 3.7
	3.7								15.2	3.78	3.50	13.3				13.3	3.78	0.5	30	101	5.8	0.3	Sum of DP 22 & DP 3.6 Piped to DP 3.8
	23	B10	0.38	0.53	5.2	0.20	5.10	1.0								1.0	0.20	2.0	18	15	4.7	0.1	Sump Inlet Piped to DP 3.8
	3.8								15.5	3.98	3.48	13.8				13.8	3.98	0.5	36	46	5.8	0.1	Sum of DP 23 & DP 3.7 Piped to DP 4.2
	24	B13A	0.48	0.23	9.4	0.11	4.22	0.5								0.5	0.11	1.0	15	47	3.0	0.3	Roof drains Piped to DP 3.9
	25	B13	0.58	0.55	6.4	0.32	4.80	1.5					0.6	0.13	3.0	0.9	0.19	2.0	18	40 0	2.6 4.4	0.3 0.0	No. 16-valley inlet, Carryover flow to DP 28 Piped to DP 3.9
	3.9								9.7	0.30	4.18	1.2				1.2	0.30	2.0	18	41	4.9	0.1	Sum of DP 24 & DP 25 Piped to DP 4.1
	26	B11	0.74	0.33	11.1	0.25	3.98	1.0								1.0	0.25	1.0	15	39	3.7	0.2	Roof drains Piped to DP 4.0
	27	B12	1.08	0.58	9.2	0.63	4.25	2.7	11.8	0.80	3.89	3.1				3.1	0.80	1.0	18	0	5.2	0.0	Sump Inlet, sum of carryover from DP 19 and Sub-Basin B12 Piped to DP 4.0
	4.0								11.8	1.05	3.89	4.1				4.1	1.05	1.0	18	32	5.6	0.1	Sum of DP 26 & DP 27 Piped to DP 4.1
	28	B14	0.49	0.63	9.4	0.31	4.22	1.3	9.4	0.44	4.22	1.9				1.9	0.44	1.2	18	12	4.8	0.0	Sump Inlet, sum of carryover from DP 25 & Sub-Basin B14 Piped to DP 4.1

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

ubdivision: Solace
Location: El Paso County
sign Storm: 5-Year

Project Name: Solace Apartments
Project No.: 25174.00
Calculated By: AAM
Checked By:
Date: 3/12/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	4.1								11.9	1.79	3.87	6.9				6.9	1.79	1.0	24	44	6.3	0.1	Sum of DP 28, DP 3.9, & DP 4.0 Piped to DP 4.2
	4.2								15.6	5.78	3.46	20.0				20.0	5.78	0.5	36	158	6.4	0.4	Sum of DP 3.8 & DP 4.1 Piped to DP 4.4
	29	B16	0.15	0.56	5.4	0.08	5.06	0.4								0.4	0.08	1.0	15	47	2.8	0.3	Roof drains Piped to DP 4.3
	30	B15	0.27	0.71	5.7	0.19	4.96	0.9								0.9	0.19	2.0	18	0	4.6	0.0	Sump Inlet Piped to DP 4.3
	4.3								5.7	0.27	4.96	1.3				1.3	0.27	2.0	18	34	5.1	0.1	Sum of DP 29 & DP 30 Piped to DP 4.4
	4.4								16.0	6.05	3.42	20.7				20.7	6.05	0.8	36	311	7.7	0.7	Sum of DP 4.2 & DP 4.3 Piped to DP 4.5
	31	B17	0.99	0.42	8.2	0.41	4.43	1.8								1.8	0.41	2.0	18	13	5.6	0.0	On-grade inlet Piped to DP 4.5
	4.5								16.7	6.46	3.36	21.7				21.7	6.46	0.5	42	32	6.5	0.1	Sum of DP 31 & DP 4.4 Piped to DP 2.6
	32	B18	0.47	0.50	7.2	0.23	4.62	1.1								1.1	0.23	0.5	42	0	2.7	0.0	On-grade inlet Piped to DP 4.6
	4.6								16.8	6.69	3.35	22.4				22.4	6.69	0.5	42	52	6.6	0.1	Sum of DP 32 & DP 4.5 Piped to DP 35
	35								16.8	6.7	3.35	22.4	22.4	6.69	0.5					336	1.1	5.3	Pond B forebay Trickle channel conveyance to DP 37
	33	B19	1.92	0.32	16.9	0.62	3.34	2.1								2.1	0.62	1.0	18	55	4.5	0.2	On-grade Inlet Piped to DP 4.7
	34	B20	0.26	0.49	6.3	0.13	4.83	0.6								0.6	0.13	1.0	24	0	3.1	0.0	On-grade Inlet Piped to DP 4.7
	4.7								17.1	0.75	3.32	2.5				2.5	0.75	1.0	24	52	4.7	0.2	Sum of DP 33 & DP 34 Piped to DP 2.6
	36								17.1	0.8	3.32	2.5	2.5	0.75	0.5					106	1.1	1.7	Pond B forebay Trickle channel conveyance to DP 37
	37	B21	2.46	0.08	29.7	0.20	2.50	0.5					0.5	0.20	2.18								Overland Flow Pond Conveyance to DP 37
	37								22.0	7.64	2.94	22.5											Pond outlet Structure Release detained flows into Sandcreek Drainageway
	38	F6	0.35	0.08	5.3	0.03	5.07	0.2					0.2	0.03	5.0					0	4.5	0.0	Future overland flow Sheet flow offsite per historic condition
	39	F7	0.53	0.08	6.9	0.04	4.69	0.2					0.2	0.04	2.0					0	2.8	0.0	Future overland flow Existing swale conveyance offsite per historic condition
	40	C1	0.74	0.29	15.0	0.22	3.52	0.8					0.8	0.22	1.0					183	2.0	1.5	Future overland flow to DP 40 Existing swale conveyance offsite per historic condition
	41	C2	0.80	0.08	6.3	0.06	4.83	0.3					0.3	0.06	4.57					0	4.3	0.0	Overland flow Sheet flow offsite per historic condition
	42	D1	0.95	0.19	12.8	0.18	3.76	0.7					0.7	0.18	3.3					0	3.6	0.0	Overland flow Overflow channel to the Sandcreek Drainageway
	43	OS1	17.73	0.59	15.1	10.46	3.51	36.7					36.7	10.46	3.2					225	3.6	1.0	Surface runoff from Basin OS1, captured by existing channel and proposed overflow channel at DP 43 Channel conveyance to Sand Creek at DP 5.1
	44	OS2	8.93	0.59	10.6	5.27	4.04	21.3					21.3	5.27	3.2					147	2.7	0.9	Surface runoff from Basin OS2 Diverted to swale west of site at DP 44
	5.0	-	-	-	-	-	-	-															5-Year Flows were not analyzed as part of the Sand Creek Drainage Basin Planning Study.
	5.1	-	-	-	-	-	-	-															5-Year Flows were not analyzed as part of the Sand Creek Drainage Basin Planning Study.

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

ubdivision: Solace
Location: El Paso County
ign Storm: 5-Year

Project Name: Solace Apartments
Project No.: 25174.00
Calculated By: AAM
Checked By:
Date: 3/12/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	5.2	-	-	-	-	-	-	-															5-Year Flows were not analyzed as part of the Sand Creek Drainage Basin Planning Study.
	5.3	-	-	-	-	-	-	-															5-Year Flows were not analyzed as part of the Sand Creek Drainage Basin Planning Study.

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Solace
Location: El Paso County
Design Storm: 100-Year

Project Name: Solace Apartments
Project No.: 25174.00
Calculated By: AAM
Checked By:
Date: 3/12/21

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	*I* (in/hr)	Q (cfs)	tc (min)	C*A (ac)	*I* (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	1	F1	0.92	0.67	7.5	0.62	7.66	4.7								4.7	0.62	1.0	18	320	5.8	0.9	Future on-grade inlet Future pipe conveyance to DP 1.0
	2	F2	0.14	0.83	5.0	0.12	8.68	1.0					1.0	0.12	2.18					33	3.0	0.2	Future overland flow to DP 4 Infrastructure to South Detention Pond at DP 2
	3	F3	0.73	0.72	5.5	0.52	8.43	4.4								4.4	0.52	1.9	18	64	7.1	0.2	Future sump inlet Future pipe conveyance to DP 1.0
	4	A1	0.50	0.81	5.7	0.40	8.35	3.3					1.0	0.12	1.5	2.3	0.28	1.5	18	300 8	1.8 5.5	2.7 0.0	On-grade inlet, Carryover flow to DP 11 Piped to DP 1.0
	1.0								8.4	1.54	7.36	11.3				11.3	1.54	2.1	36	221	9.0	0.4	Sum of DP 1, DP 2, DP 3, & DP 4 Piped to DP 4P
	4P								8.4	1.54	7.36	11.3	11.3	1.54	0.5					185	1.1	2.9	Pond A Forebay Trickle channel conveyance to DP 6P
	5	A2	0.47	0.82	6.2	0.38	8.14	3.1					1.6	0.20	1.2	1.5	0.18	2.0	18	290 33	1.6 5.2	2.9 0.1	No. 16-valley inlet, Carryover flow to DP 10 Piped to DP 2.2
	6	A3	0.45	0.82	5.9	0.37	8.26	3.1					1.6	0.19	1.5	1.5	0.18	1.0	18	321 0	1.8 4.1	2.9 0.0	No. 16-valley inlet, Carryover flow to DP 10 Piped to DP 2.0
	7	F4	0.68	0.51	11.3	0.35	6.63	2.3								2.3	0.35	1.0	15	27	4.8	0.1	Future roof drains and area inlets Future pipe conveyance to DP 2.0
	2.0								11.4	0.53	6.61	3.5				3.5	0.53	1.0	18	14	5.3	0.0	Sum of DP 6 & DP 7 Piped to DP 2.1
	8	A4	0.15	0.81	5.0	0.12	8.68	1.0								1.0	0.12	1.0	15	105	3.9	0.5	Roof drains Piped to DP 2.1
	2.1								11.4	0.65	6.60	4.3				4.3	0.65	1.0	18	101	5.6	0.3	Sum of DP 8 & DP 2.0 Piped to DP 2.2
	2.2								11.7	0.84	6.54	5.5				5.5	0.84	1.0	24	105	5.9	0.3	Sum of DP 5 & DP 2.1 Piped to DP 2.3
	9	A5	0.13	0.81	5.0	0.11	8.68	1.0								1.0	0.11	1.0	15	7	3.7	0.0	Roof drains Piped to DP 2.3
	2.3								12.0	0.95	6.47	6.1				6.1	0.95	1.3	24	114	6.6	0.3	Sum of DP 9 & DP 2.2 Piped to DP 2.4
	10	A6	1.51	0.68	10.5	1.03	6.82	7.0	10.5	1.41	6.82	9.6				9.6	1.41	1.3	24	0	7.6	0.0	Sump Inlet. Sum of Carryover flows from DP 5, DP 6, and Sub-Basin A6 Piped to DP 2.4
	2.4								12.3	2.36	6.41	15.1				15.1	2.36	2.0	30	31	9.8	0.1	Sum of DP 9 & DP 2.2 Piped to DP 2.5
	11	A7	0.58	0.60	10.6	0.35	6.79	2.4	10.6	0.47	6.79	3.2				3.2	0.47	2.0	30	0	6.4	0.0	On-grade Inlet, Sum of carryover from DP 4 and Sub-Basin A7 Piped to DP 2.5
	2.5								12.3	2.83	6.40	18.2				18.2	2.83	2.0	36	44	10.2	0.1	Sum of DP 11 & DP 2.4 Piped to DP 2.6
	12	A8	0.30	0.68	5.9	0.20	8.27	1.7								1.7	0.20	2.0	30	0	5.2	0.0	On-grade inlet Piped to DP 2.6
	2.6								12.4	3.03	6.39	19.4				19.4	3.03	2.4	36	55	11.2	0.1	Sum of DP 12 & DP 2.5 Piped to DP 5P
	5P								12.4	3.03	6.39	19.4	19.4	3.03	0.5					45	1.1	0.7	Pond A Forebay Trickle channel conveyance to DP 6P
	6P	A9	1.33	0.35	13.9	0.47	6.11	2.9					2.9	0.47	2.18								Overland Flow Pond Conveyance to DP 6P
	6P								13.9	5.04	6.11	30.8											Pond outlet Structure Release detained flows into Sandcreek Drainageway
	13	F5	2.00	0.59	9.7	1.18	7.00	8.3					8.3	1.18	1.2					170	1.3	2.2	Future Phase 2 developed flows minus roof drains and future area inlet flows Pan conveyance to DP 14
	14	B1	0.37	0.83	5.1	0.31	8.61	2.7	11.9	1.49	6.50	9.7	7.0	1.07	1.1	2.7	0.42	1.0	18	89 0	1.6 5.0	0.9 0.0	Sum of carryover flows from DP 13 and Sub-Basin B1, No. 16-valley inlet, Carryover flow to DP 16 Piped to DP 3.0
	3.0								11.9	1.40	6.50	9.1				9.1	1.40	1.0	18	89	6.7	0.2	Flows captured by No. 16-Valley inlet and future building and area drains connecting directly to inlet. Piped to DP 3.1

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Solace
Location: El Paso County
Design Storm: 100-Year

Project Name: Solace Apartments
Project No.: 25174.00
Calculated By: AAM
Checked By:
Date: 3/12/21

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	15	B2	0.35	0.93	5.0	0.32	8.68	2.8								2.8	0.32	2.0	18	75	6.4	0.2	On-grade inlet Piped to DP 3.1
	16	B3	0.35	0.79	5.0	0.28	8.68	2.4	12.8	1.35	6.31	8.5	0.3	0.05	1.1	8.2	1.30	1.0	18	89 0	1.6 6.6	0.9 0.0	Sum of carryover flow from DP 14 and Sub-Basin B3,On-grade inlet. Carryover flow to DP 19 Piped to DP 3.1
	3.1								12.8	3.02	6.31	19.0				19.0	3.02	0.5	30	30	6.3	0.1	Sum of DP 14, DP 15 & DP 16 Piped to DP 3.2
	17	B4	0.03	0.81	5.0	0.02	8.68	0.2								0.2	0.02	1.0	8	40	2.3	0.3	Roof drains Piped to DP 3.2
	3.2								12.9	3.04	6.29	19.1				19.1	3.04	0.5	30	163	6.3	0.4	Sum of DP 17 & DP 3.1 Piped to DP 3.3
	18	B5	0.26	0.81	5.0	0.21	8.68	1.8								1.8	0.21	1.0	8	40	5.2	0.1	Roof drains Piped to DP 3.3
	3.3								13.3	3.25	6.21	20.2				20.2	3.25	1.9	30	75	10.4	0.1	Sum of DP 18 & DP 3.2 Piped to DP 3.4
	19	B6	0.73	0.71	7.1	0.52	7.81	4.1	8.0	0.57	7.50	4.3	2.5	0.33	1.1	1.8	0.24	1.0	18	445 13	1.6 4.4	4.7 0.0	No. 16-valley inlet, Carryover flow to DP 27 Piped to DP 3.4
	3.4								13.5	3.49	6.19	21.6				21.6	3.49	1.0	30	29	8.5	0.1	Sum of DP 19 & DP 3.3 Piped to DP 3.5
	20	B7	0.47	0.56	7.0	0.26	7.83	2.0								2.0	0.26	1.0	15	60	4.6	0.2	Roof drains Piped to DP 3.5
	3.5								13.5	3.75	6.17	23.2				23.2	3.75	0.5	30	143	6.6	0.4	Sum of DP 20 & DP 3.4 Piped to DP 3.6
	21	B8	0.25	0.81	5.0	0.20	8.68	1.7								1.7	0.20	1.0	15	10	4.4	0.0	Roof drains Piped to DP 3.6
	3.6								13.9	3.95	6.11	24.1				24.1	3.95	0.5	30	191	6.6	0.5	Sum of DP 21 & DP 3.5 Piped to DP 3.7
	22	B9	0.19	0.81	5.0	0.15	8.68	1.3								1.3	0.15	1.0	15	15	4.0	0.1	Roof drains Piped to DP 3.7
	3.7								14.4	4.10	6.02	24.7				24.7	4.10	0.5	30	101	6.7	0.3	Sum of DP 22 & DP 3.6 Piped to DP 3.8
	23	B10	0.38	0.69	5.2	0.26	8.56	2.2								2.2	0.26	2.0	18	15	5.9	0.0	Sump Inlet Piped to DP 3.8
	3.8								14.6	4.36	5.98	26.1				26.1	4.36	0.5	36	46	6.9	0.1	Sum of DP 23 & DP 3.7 Piped to DP 4.2
	24	B13A	0.48	0.46	9.4	0.22	7.08	1.6								1.6	0.22	1.0	15	47	4.3	0.2	Roof drains Piped to DP 3.9
	25	B13	0.58	0.70	6.4	0.40	8.06	3.2					1.7	0.21	3.0	1.5	0.19	2.0	18	40 0	2.6 5.2	0.3 0.0	No. 16-valley inlet, Carryover flow to DP 28 Piped to DP 3.9
	3.9								9.6	0.41	7.04	2.9				2.9	0.41	2.0	18	41	6.4	0.1	Sum of DP 24 & DP 25 Piped to DP 4.1
	26	B11	0.74	0.53	11.1	0.39	6.68	2.6								2.6	0.39	1.0	15	39	4.9	0.1	Roof drains Piped to DP 4.0
	27	B12	1.08	0.72	9.2	0.78	7.13	5.6	12.7	1.11	6.33	7.1				7.1	1.11	1.0	18	0	6.4	0.0	Sump Inlet, sum of carryover from DP 19 and Sub-Basin B12 Piped to DP 4.0
	4.0								12.7	1.50	6.33	9.5				9.5	1.50	1.0	18	32	6.7	0.1	Sum of DP 26 & DP 27 Piped to DP 4.1
	28	B14	0.49	0.76	9.4	0.37	7.08	2.6	9.4	0.58	7.08	4.1				4.1	0.58	1.2	18	12	5.9	0.0	Sump Inlet, sum of carryover from DP 25 & Sub-Basin B14 Piped to DP 4.1
	4.1								12.8	2.49	6.31	15.7				15.7	2.49	1.0	24	44	7.8	0.1	Sum of DP 28, DP 3.9, & DP 4.0 Piped to DP 4.2
	4.2								14.7	6.85	5.96	40.8				40.8	6.85	0.5	36	158	7.5	0.4	Sum of DP 3.8 & DP 4.1 Piped to DP 4.4
	29	B16	0.15	0.69	5.4	0.10	8.49	0.8								0.8	0.10	1.0	15	47	3.6	0.2	Roof drains Piped to DP 4.3

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Solace
Location: El Paso County
Design Storm: 100-Year

Project Name: Solace Apartments
Project No.: 25174.00
Calculated By: AAM
Checked By:
Date: 3/12/21

Description		DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			
	Design Point	Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
																							Sump Inlet
	30	B15	0.27	0.81	5.7	0.22	8.33	1.8								1.8	0.22	2.0	18	0	5.6	0.0	Piped to DP 4.3
																							Sum of DP 29 & DP 30
	4.3								5.7	0.32	8.33	2.7				2.7	0.32	2.0	18	34	6.4	0.1	Piped to DP 4.4
																							Sum of DP 4.2 & DP 4.3
	4.4								15.1	7.17	5.90	42.3				42.3	7.17	0.8	36	311	9.1	0.6	Piped to DP 4.5
													0.2	0.02	1.0					292	1.5	3.2	On-grade inlet, carryover flow to DP 33
	31	B17	0.99	0.60	8.2	0.60	7.43	4.5								4.3	0.58	2.0	18	13	7.2	0.0	Piped to DP 4.5
																							Sum of DP 31 & DP 4.4
	4.5								15.6	7.75	5.81	45.0				45.0	7.75	0.5	42	32	7.8	0.1	Piped to DP 2.6
																							On-grade inlet
	32	B18	0.47	0.66	7.2	0.31	7.75	2.4								2.4	0.31	0.5	42	0	3.4	0.0	Piped to DP 4.6
																							Sum of DP 32 & DP 4.5
	4.6								15.7	8.06	5.80	46.7				46.7	8.06	0.5	42	52	7.9	0.1	Piped to DP 35
													46.7	8.06	0.5					336	1.1	5.3	Pond B forebay
	35								15.7	8.1	5.8	46.7											Trickle channel conveyance to DP 37
																							Sum of carryover from DP 31 and Sub-basin B19,On-grade Inlet
	33	B19	1.92	0.53	16.9	1.01	5.60	5.7	16.9	1.03	5.60	5.8				5.8	1.03	1.0	18	55	6.0	0.2	Piped to DP 4.7
																							On-grade Inlet
	34	B20	0.26	0.66	6.3	0.17	8.12	1.4								1.4	0.17	1.0	24	0	3.9	0.0	Piped to DP 4.7
																							Sum of DP 33 & DP 34
	4.7								17.1	1.20	5.58	6.7				6.7	1.20	1.0	24	52	6.2	0.1	Piped to DP 2.6
													6.7	1.20	0.5					106	1.1	1.7	Pond B forebay
	36								17.1	1.2	5.6	6.7											Trickle channel conveyance to DP 37
													3.6	0.86	2.18								Overland Flow
	37	B21	2.46	0.35	29.7	0.86	4.19	3.6															Pond Conveyance to DP 37
																							Pond outlet Structure
	37								21.0	10.12	5.06	51.3											Release detained flows into Sandcreek Drainageway
													1.0	0.12	5.0					0	4.5	0.0	Future overland flow
	38	F6	0.35	0.35	5.3	0.12	8.52	1.0															Sheet flow offsite per historic condition
													1.5	0.19	2.0					0	2.8	0.0	Future overland flow
	39	F7	0.53	0.35	6.9	0.19	7.87	1.5															Existing swale conveyance offsite per historic condition
													2.2	0.37	1.0					183	2.0	1.5	Future overland flow to DP 40
	40	C1	0.74	0.51	15.0	0.37	5.91	2.2															Existing swale conveyance offsite per historic condition
													2.3	0.28	4.57					0	4.3	0.0	Overland flow
	41	C2	0.80	0.35	6.3	0.28	8.12	2.3															Sheet flow offsite per historic condition
													2.6	0.41	3.3					0	3.6	0.0	Overland flow
	42	D1	0.95	0.43	12.8	0.41	6.31	2.6															Overflow channel to the Sandcreek Drainageway
													73.1	12.41	3.2					225	3.6	1.0	Surface runoff from Basin OS1, captured by existing channel and proposed overflow channel at DP 43
	43	OS1	17.73	0.70	15.1	12.41	5.89	73.1															Channel conveyance to Sand Creek at DP 5.1
													42.4	6.25	3.2					147	2.7	0.9	Surface runoff from Basin OS2
	44	OS2	8.93	0.70	10.6	6.25	6.78	42.4															Diverted to swale west of site at DP 44
													820.0										Flow taken directly from the Sand Creek Drainage Basin Planning Study
	5.0	-	-	-	-	-	-	820.0															
													820.0										Flow taken directly from the Sand Creek Drainage Basin Planning Study
	5.1	-	-	-	-	-	-	820.0															
													1037.0										Flow taken directly from the Sand Creek Drainage Basin Planning Study
	5.2	-	-	-	-	-	-	1037.0															
													1100.0										Flow taken directly from the Sand Creek Drainage Basin Planning Study
	5.3	-	-	-	-	-	-	1100.0															

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.

Scenario: 5 year
Current Time Step: 0.000 h
Conduit FlexTable: Combined Pipe/Node Report

Upstream Structure	Label	Flow (cfs)	Diameter (in)	Slope (Calculated) (ft/ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Velocity (ft/s)	Upstream Structure Headloss Coefficient	Length (User Defined) (ft)
DP09-2	CO-1	2.10	12.0	0.010	6,263.75	6,263.66	6,267.82	6,268.25	6,264.37	6,264.34	6,264.63	6,264.55	4.76	1.000	8.8
DP09-1	CO-2	2.10	12.0	0.010	6,263.46	6,262.84	6,268.25	6,267.71	6,264.08	6,263.91	6,264.34	6,264.02	4.71	1.000	62.5
DP01-2	P01-1	22.40	42.0	0.005	6,246.24	6,245.98	6,252.97	6,249.87	6,247.69	6,247.33	6,248.24	6,248.00	6.55	0.050	52.0
DP01-11	P01-10	11.90	30.0	0.010	6,255.56	6,253.84	6,262.02	6,260.91	6,256.72	6,255.06	6,257.16	6,255.45	7.24	1.020	171.7
DP01-12	P01-11	11.10	24.0	0.010	6,256.81	6,256.06	6,264.38	6,262.02	6,258.00	6,257.05	6,258.50	6,257.85	7.18	0.050	74.6
DP01-13	P01-12	10.60	24.0	0.010	6,258.65	6,257.01	6,265.62	6,264.38	6,259.82	6,257.97	6,260.30	6,258.75	7.09	0.640	163.6
DP01-14	P01-13	10.50	24.0	0.010	6,259.07	6,258.85	6,265.81	6,265.62	6,260.23	6,260.13	6,260.71	6,260.51	7.09	1.020	21.8
DP01-15	P01-14	9.60	18.0	0.010	6,259.32	6,259.20	6,265.70	6,265.81	6,260.82	6,260.72	6,261.28	6,261.18	6.74	0.050	11.8
DP01-16	P01-15	6.40	18.0	0.010	6,260.28	6,259.59	6,265.15	6,265.70	6,261.26	6,260.84	6,261.69	6,261.10	6.23	0.000	69.2
DP01-3	P01-2	21.70	42.0	0.005	6,246.60	6,246.44	6,252.79	6,252.97	6,248.03	6,247.78	6,248.57	6,248.42	6.48	1.020	32.2
DP01-4	P01-3	20.70	36.0	0.007	6,248.21	6,246.80	6,255.53	6,252.79	6,249.67	6,248.58	6,250.24	6,248.93	7.49	1.320	188.4
DP01-5	P01-4	20.70	36.0	0.005	6,249.02	6,248.41	6,257.20	6,255.53	6,250.48	6,250.42	6,251.05	6,250.69	6.44	1.020	122.5
DP01-6	P01-5	20.00	36.0	0.005	6,250.01	6,249.22	6,257.99	6,257.20	6,251.45	6,251.06	6,252.00	6,251.36	6.40	1.020	158.1
DP01-7	P01-6	13.80	36.0	0.010	6,250.87	6,250.41	6,258.31	6,257.99	6,252.05	6,252.01	6,252.49	6,252.21	7.44	1.020	46.0
DP01-8	P01-7	13.30	30.0	0.005	6,251.88	6,251.37	6,259.77	6,258.31	6,253.11	6,252.56	6,253.59	6,253.08	5.80	0.400	101.1
DP01-9	P01-8	13.00	30.0	0.005	6,252.23	6,252.08	6,258.40	6,259.77	6,253.44	6,253.30	6,253.91	6,253.76	5.75	0.400	30.0
DP01-10	P01-9	13.00	30.0	0.008	6,253.64	6,252.43	6,260.91	6,258.40	6,254.85	6,253.48	6,255.32	6,254.17	6.68	0.450	161.0
DP02-2	P02-1	8.60	24.0	0.030	6,255.29	6,253.65	6,262.08	6,256.99	6,256.34	6,254.31	6,256.75	6,255.72	9.98	0.050	54.9
DP02-3	P02-2	8.10	24.0	0.010	6,256.39	6,255.94	6,262.08	6,262.08	6,257.40	6,256.78	6,257.80	6,257.43	6.64	0.050	44.3
DP02-4	P02-3	7.10	18.0	0.010	6,257.20	6,256.89	6,262.72	6,262.08	6,258.23	6,257.81	6,258.70	6,258.42	6.36	0.100	31.2
DP02-5	P02-4	3.10	18.0	0.010	6,258.54	6,257.40	6,264.18	6,262.72	6,259.21	6,258.28	6,259.47	6,258.41	5.18	0.100	113.6
DP02-6	P02-5	2.80	18.0	0.010	6,259.78	6,258.74	6,266.02	6,264.18	6,260.42	6,259.27	6,260.66	6,259.66	5.02	0.520	104.5
DP02-7	P02-6	2.10	18.0	0.010	6,260.42	6,259.98	6,265.64	6,266.02	6,260.97	6,260.54	6,261.17	6,260.73	4.66	0.400	43.6
DP02-8	P02-7	2.10	18.0	0.010	6,261.19	6,260.62	6,267.06	6,265.64	6,261.74	6,261.07	6,261.94	6,261.41	4.65	0.050	56.6
DP02-9	P02-8	1.60	18.0	0.010	6,261.55	6,261.39	6,266.82	6,267.06	6,262.02	6,261.79	6,262.20	6,262.07	4.30	0.000	15.9
DP03-2	P03-1	4.30	18.0	0.031	6,259.72	6,255.40	6,267.19	6,258.76	6,260.52	6,255.89	6,260.83	6,257.03	8.58	0.400	137.2
DP-03-3	P03-2	4.30	18.0	0.010	6,261.36	6,260.52	6,266.61	6,267.19	6,262.16	6,261.19	6,262.47	6,261.68	5.64	1.520	84.2
DP03-4	P03-3(1)	2.20	18.0	0.010	6,264.44	6,262.84	6,269.46	6,267.71	6,265.00	6,263.91	6,265.21	6,263.95	4.70	0.050	160.0
MH-5	P03-3(2)	4.30	18.0	0.010	6,262.64	6,261.56	6,267.71	6,266.61	6,263.44	6,262.64	6,263.75	6,262.79	5.72	1.500	104.2
DP03-5	P03-4	2.20	18.0	0.010	6,265.17	6,264.64	6,270.32	6,269.46	6,265.73	6,265.11	6,265.94	6,265.45	4.69	0.000	53.3
DP04-1	P04-1	6.90	24.0	0.010	6,251.65	6,251.21	6,256.47	6,257.99	6,252.58	6,251.98	6,252.94	6,252.58	6.32	1.520	44.0
DP04-2	P04-2	1.20	18.0	0.010	6,252.26	6,251.85	6,257.41	6,256.47	6,253.13	6,253.13	6,253.15	6,253.14	3.95	0.000	41.0
DP05-1	P05-1	1.60	18.0	0.015	6,261.02	6,260.02	6,265.37	6,265.81	6,261.50	6,260.72	6,261.67	6,260.78	4.95	0.400	66.9
DP05-2	P05-2	1.60	18.0	0.020	6,261.70	6,261.22	6,266.72	6,265.37	6,262.18	6,261.56	6,262.35	6,262.00	5.49	0.000	24.1
DP06-1	P06-1	4.10	18.0	0.020	6,252.49	6,251.85	6,257.48	6,256.47	6,253.27	6,253.13	6,253.57	6,253.23	7.18	0.000	32.0
DP07-1	P07-1	1.90	18.0	0.020	6,252.09	6,251.85	6,256.68	6,256.47	6,253.12	6,253.13	6,253.15	6,253.15	5.76	0.000	12.1
DP08-1	P08-01	1.00	18.0	0.020	6,261.57	6,260.91	6,266.14	6,266.02	6,261.94	6,261.17	6,262.08	6,261.53	4.79	0.000	33.0
DP10-1	P10-1	0.00	18.0	0.050	6,261.97	6,261.60	6,266.90	6,266.61	6,262.64	6,262.64	6,262.64	6,262.64	0.00	0.000	7.4
DP11-2	P11-1	2.50	18.0	0.007	6,245.02	6,244.65	6,250.01	6,246.66	6,245.75	6,245.77	6,245.88	6,245.82	4.38	0.050	49.8
DP11-3	P11-2	2.10	18.0	0.008	6,245.65	6,245.22	6,249.80	6,250.01	6,246.20	6,245.70	6,246.40	6,245.99	4.26	0.000	54.4
DP12-1	P12-1	1.80	18.0	0.020	6,248.05	6,247.80	6,252.95	6,252.79	6,248.55	6,248.58	6,248.74	6,248.64	5.68	0.000	12.6
DP13-1	P13-1	1.30	18.0	0.040	6,251.86	6,250.52	6,256.31	6,257.20	6,252.29	6,251.06	6,252.44	6,251.14	6.59	0.000	33.6
DP14-1	P14-1	1.00	18.0	0.040	6,252.89	6,252.37	6,257.83	6,258.31	6,253.26	6,252.60	6,253.40	6,253.11	6.12	0.000	12.9
DP15-1	P15-1	1.10	18.0	0.067	6,257.43	6,256.56	6,261.74	6,262.02	6,257.82	6,257.17	6,257.96	6,257.21	7.52	0.000	13.0
Structure - (81) (STORM)	Pipe - (66) (STORM)	2.70	36.0	0.010	6,243.00	6,242.44	6,247.85	6,245.78	6,243.51	6,242.85	6,243.69	6,243.18	4.61	0.000	56.3
Structure - (93) (STORM)	Pipe - (75) (STORM)	1.30	36.0	0.010	6,250.10	6,249.18	6,257.50	6,252.53	6,250.45	6,249.47	6,250.57	6,249.68	3.71	0.000	92.0

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Scenario: 100 year
Current Time Step: 0.000 h
Conduit FlexTable: Combined Pipe/Node Report

Upstream Structure	Label	Flow (cfs)	Diameter (in)	Slope (Calculated) (ft/ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Velocity (ft/s)	Upstream Structure Headloss Coefficient	Length (User Defined) (ft)
DP09-2	CO-1	4.40	12.0	0.010	6,263.75	6,263.66	6,267.82	6,268.25	6,266.76	6,266.62	6,267.25	6,267.11	5.60	1.000	8.8
DP09-1	CO-2	4.40	12.0	0.010	6,263.46	6,262.84	6,268.25	6,267.71	6,266.14	6,265.18	6,266.62	6,265.67	5.60	1.000	62.5
DP01-2	P01-1	46.70	42.0	0.005	6,246.24	6,245.98	6,252.97	6,249.87	6,248.37	6,248.05	6,249.27	6,249.02	7.89	0.050	52.0
DP01-11	P01-10	21.60	30.0	0.010	6,255.56	6,253.84	6,262.02	6,260.91	6,257.14	6,255.65	6,257.82	6,256.15	8.47	1.020	171.7
DP01-12	P01-11	20.20	24.0	0.010	6,256.81	6,256.06	6,264.38	6,262.02	6,258.42	6,257.83	6,259.28	6,258.56	8.16	0.050	74.6
DP01-13	P01-12	19.10	24.0	0.010	6,258.65	6,257.01	6,265.62	6,264.38	6,260.22	6,258.42	6,261.03	6,259.43	8.08	0.640	163.6
DP01-14	P01-13	19.00	24.0	0.010	6,259.07	6,258.85	6,265.81	6,265.62	6,260.79	6,260.74	6,261.47	6,261.33	8.10	1.020	21.8
DP01-15	P01-14	17.30	18.0	0.010	6,259.32	6,259.20	6,265.70	6,265.81	6,261.80	6,261.48	6,263.29	6,262.97	9.79	0.050	11.8
DP01-16	P01-15	9.10	18.0	0.010	6,260.28	6,259.59	6,265.15	6,265.70	6,262.40	6,261.88	6,262.81	6,262.29	5.15	0.000	69.2
DP01-3	P01-2	45.00	42.0	0.005	6,246.60	6,246.44	6,252.79	6,252.97	6,248.69	6,248.47	6,249.57	6,249.41	7.81	1.020	32.2
DP01-4	P01-3	42.30	36.0	0.007	6,248.21	6,246.80	6,255.53	6,252.79	6,250.33	6,249.58	6,251.31	6,250.18	8.92	1.320	188.4
DP01-5	P01-4	42.30	36.0	0.005	6,249.02	6,248.41	6,257.20	6,255.53	6,252.11	6,251.62	6,252.67	6,252.17	5.98	1.020	122.5
DP01-6	P01-5	40.80	36.0	0.005	6,250.01	6,249.22	6,257.99	6,257.20	6,253.27	6,252.68	6,253.79	6,253.20	5.77	1.020	158.1
DP01-7	P01-6	26.10	36.0	0.010	6,250.87	6,250.41	6,258.31	6,257.99	6,253.87	6,253.80	6,254.08	6,254.01	8.86	1.020	46.0
DP01-8	P01-7	24.70	30.0	0.005	6,251.88	6,251.37	6,259.77	6,258.31	6,254.45	6,254.08	6,254.84	6,254.48	5.03	0.400	101.1
DP01-9	P01-8	24.10	30.0	0.005	6,252.23	6,252.08	6,258.40	6,259.77	6,254.71	6,254.61	6,255.08	6,254.98	6.61	0.400	30.0
DP01-10	P01-9	24.10	30.0	0.008	6,253.64	6,252.43	6,260.91	6,258.40	6,255.31	6,254.86	6,256.05	6,255.24	7.78	0.450	161.0
DP02-2	P02-1	19.40	24.0	0.030	6,255.29	6,253.65	6,262.08	6,256.99	6,256.87	6,255.46	6,257.70	6,256.11	12.42	0.050	54.9
DP02-3	P02-2	18.20	24.0	0.010	6,256.39	6,255.94	6,262.08	6,262.08	6,257.93	6,257.31	6,258.69	6,258.29	8.06	0.050	44.3
DP02-4	P02-3	15.10	18.0	0.010	6,257.20	6,256.89	6,262.72	6,262.08	6,259.00	6,258.30	6,260.13	6,259.49	8.54	0.100	31.2
DP02-5	P02-4	6.10	18.0	0.010	6,258.54	6,257.40	6,264.18	6,262.72	6,259.49	6,259.11	6,259.91	6,259.30	6.18	0.100	113.6
DP02-6	P02-5	5.50	18.0	0.010	6,259.78	6,258.74	6,266.02	6,264.18	6,260.68	6,259.51	6,261.06	6,260.07	6.00	0.520	104.5
DP02-7	P02-6	4.30	18.0	0.010	6,260.42	6,259.98	6,265.64	6,266.02	6,261.22	6,260.88	6,261.53	6,261.12	5.66	0.400	43.6
DP02-8	P02-7	4.30	18.0	0.010	6,261.19	6,260.62	6,267.06	6,265.64	6,261.98	6,261.29	6,262.30	6,261.79	5.66	0.050	56.6
DP02-9	P02-8	3.50	18.0	0.010	6,261.55	6,261.39	6,266.82	6,267.06	6,262.26	6,262.00	6,262.54	6,262.42	5.36	0.000	15.9
DP03-2	P03-1	11.30	18.0	0.031	6,259.72	6,255.40	6,267.19	6,258.76	6,261.00	6,256.24	6,261.77	6,258.14	11.05	0.400	137.2
DP-03-3	P03-2	11.30	18.0	0.010	6,261.36	6,260.52	6,266.61	6,267.19	6,262.74	6,261.80	6,263.43	6,262.57	6.39	1.520	84.2
DP03-4	P03-3(1)	4.70	18.0	0.010	6,264.44	6,262.84	6,269.46	6,267.71	6,265.37	6,265.18	6,265.63	6,265.29	5.78	0.050	160.0
MH-5	P03-3(2)	9.10	18.0	0.010	6,262.64	6,261.56	6,267.71	6,266.61	6,264.56	6,263.78	6,264.98	6,264.19	5.15	1.500	104.2
DP03-5	P03-4	4.70	18.0	0.010	6,265.17	6,264.64	6,270.32	6,269.46	6,266.00	6,265.34	6,266.34	6,265.86	5.77	0.000	53.3
DP04-1	P04-1	15.70	24.0	0.010	6,251.65	6,251.21	6,256.47	6,257.99	6,254.01	6,253.80	6,254.40	6,254.19	5.00	1.520	44.0
DP04-2	P04-2	2.90	18.0	0.010	6,252.26	6,251.85	6,257.41	6,256.47	6,254.63	6,254.60	6,254.67	6,254.64	1.64	0.000	41.0
DP05-1	P05-1	2.80	18.0	0.015	6,261.02	6,260.02	6,265.37	6,265.81	6,261.66	6,261.48	6,261.90	6,261.52	5.81	0.400	66.9
DP05-2	P05-2	2.80	18.0	0.020	6,261.70	6,261.22	6,266.72	6,265.37	6,262.33	6,261.68	6,262.58	6,262.26	6.44	0.000	24.1
DP06-1	P06-1	9.50	18.0	0.020	6,252.49	6,251.85	6,257.48	6,256.47	6,254.86	6,254.60	6,255.31	6,255.05	5.38	0.000	32.0
DP07-1	P07-1	4.10	18.0	0.020	6,252.09	6,251.85	6,256.68	6,256.47	6,254.62	6,254.60	6,254.70	6,254.68	2.32	0.000	12.1
DP08-1	P08-01	1.50	18.0	0.020	6,261.57	6,260.91	6,266.14	6,266.02	6,262.03	6,261.23	6,262.20	6,261.68	5.39	0.000	33.0
DP10-1	P10-1	2.30	18.0	0.050	6,261.97	6,261.60	6,266.90	6,266.61	6,263.79	6,263.78	6,263.81	6,263.81	1.30	0.000	7.4
DP11-2	P11-1	6.70	18.0	0.007	6,245.02	6,244.65	6,250.01	6,246.66	6,248.16	6,247.96	6,248.39	6,248.18	3.79	0.050	49.8
DP11-3	P11-2	5.80	18.0	0.008	6,245.65	6,245.22	6,249.80	6,250.01	6,248.34	6,248.17	6,248.51	6,248.34	3.28	0.000	54.4
DP12-1	P12-1	4.30	18.0	0.020	6,248.05	6,247.80	6,252.95	6,252.79	6,249.60	6,249.58	6,249.70	6,249.68	2.43	0.000	12.6
DP13-1	P13-1	2.70	18.0	0.040	6,251.86	6,250.52	6,256.31	6,257.20	6,252.58	6,252.68	6,252.74	6,252.71	8.16	0.000	33.6
DP14-1	P14-1	2.20	18.0	0.040	6,252.89	6,252.37	6,257.83	6,258.31	6,254.08	6,254.08	6,254.11	6,254.11	7.72	0.000	12.9
DP15-1	P15-1	1.80	18.0	0.067	6,257.43	6,256.56	6,261.74	6,262.02	6,257.93	6,257.83	6,258.12	6,257.85	8.71	0.000	13.0
Structure - (81) (STORM)	Pipe - (66) (STORM)	3.30	36.0	0.010	6,243.00	6,242.44	6,247.85	6,245.78	6,248.73	6,248.73	6,248.73	6,248.73	0.47	0.000	56.3
Structure - (93) (STORM)	Pipe - (75) (STORM)	3.20	36.0	0.010	6,250.10	6,249.18	6,257.50	6,252.53	6,254.22	6,254.22	6,254.23	6,254.22	0.45	0.000	92.0

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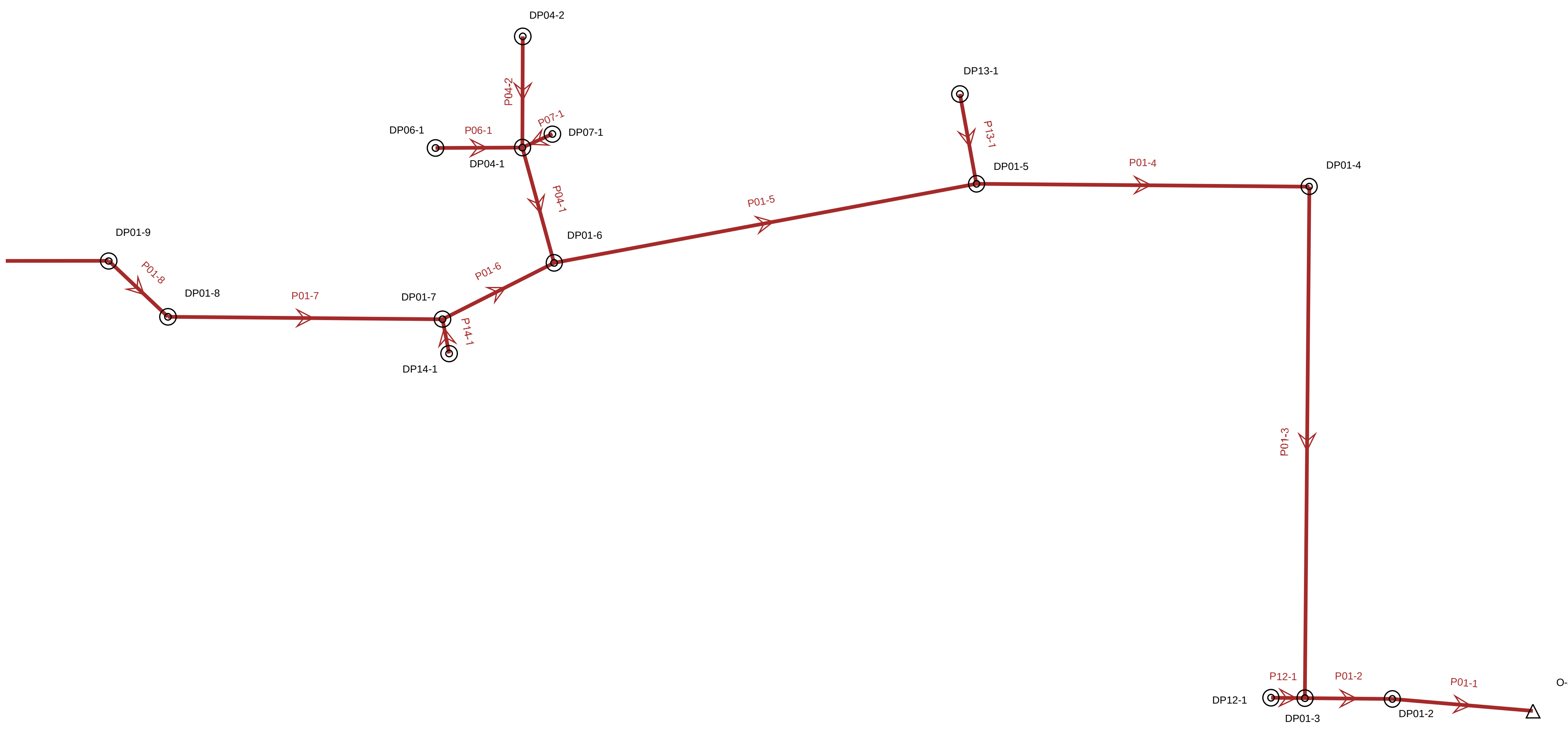
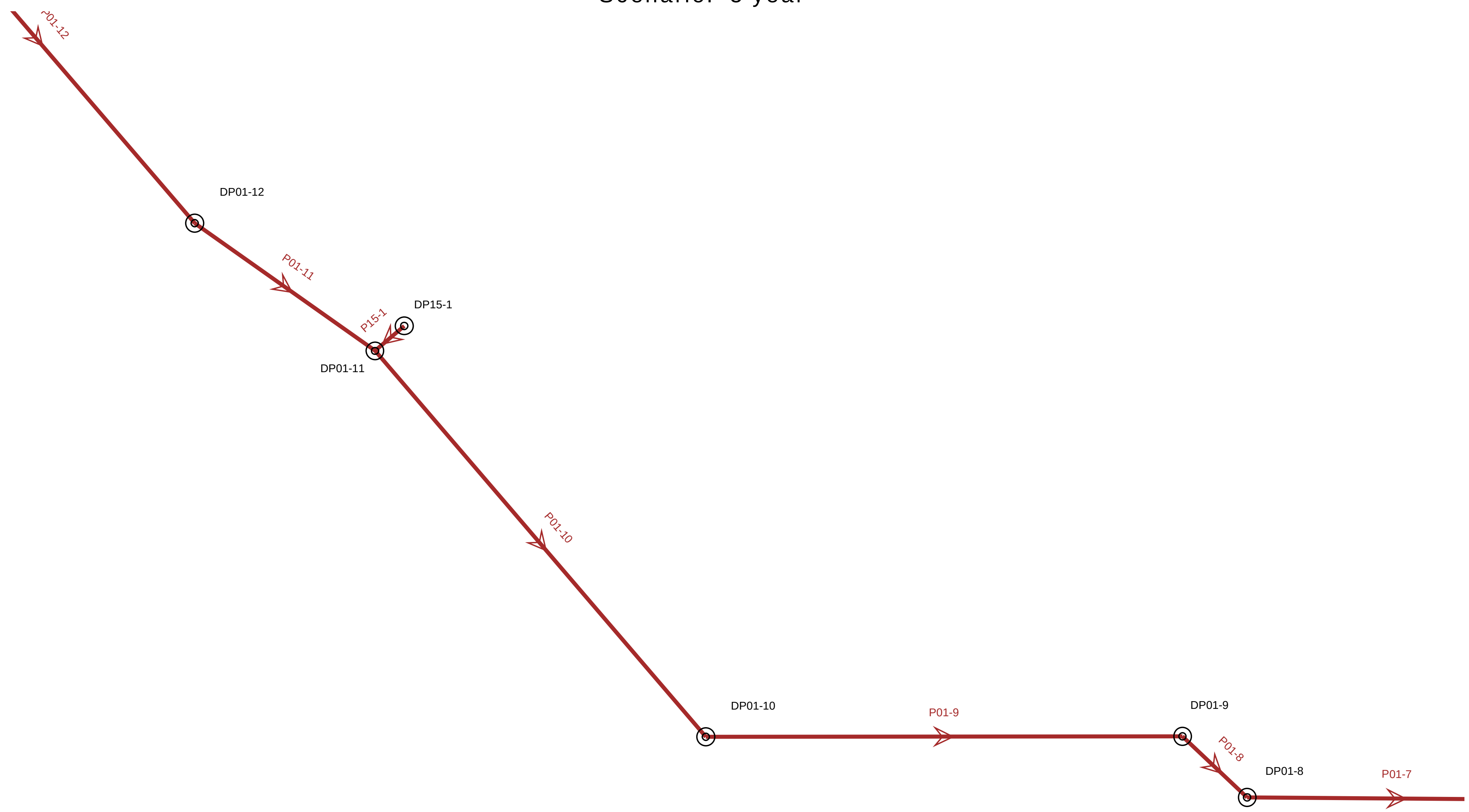
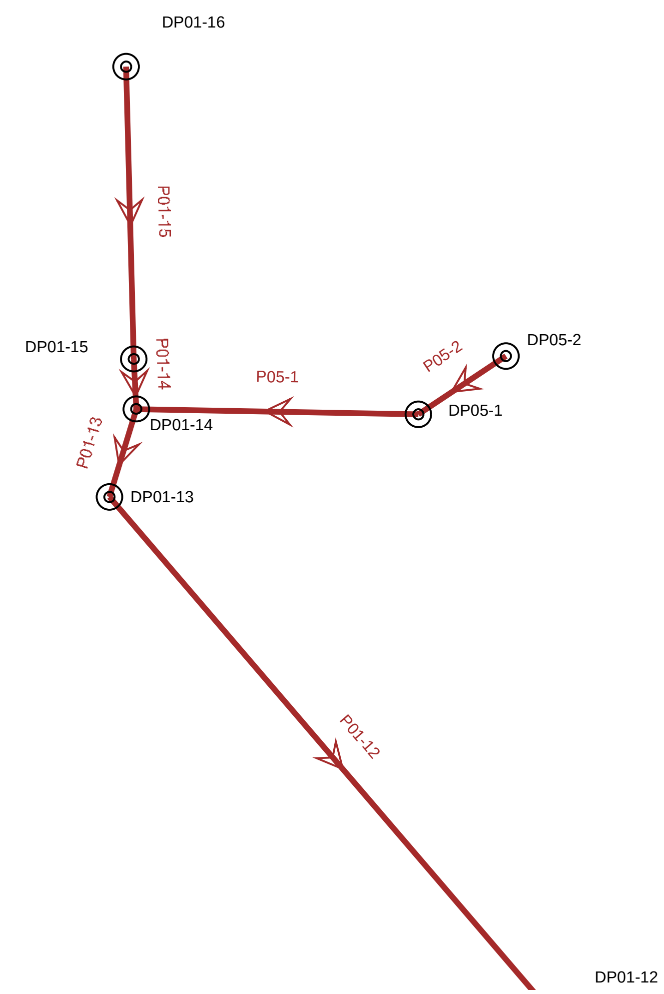
Scenario: 5 year



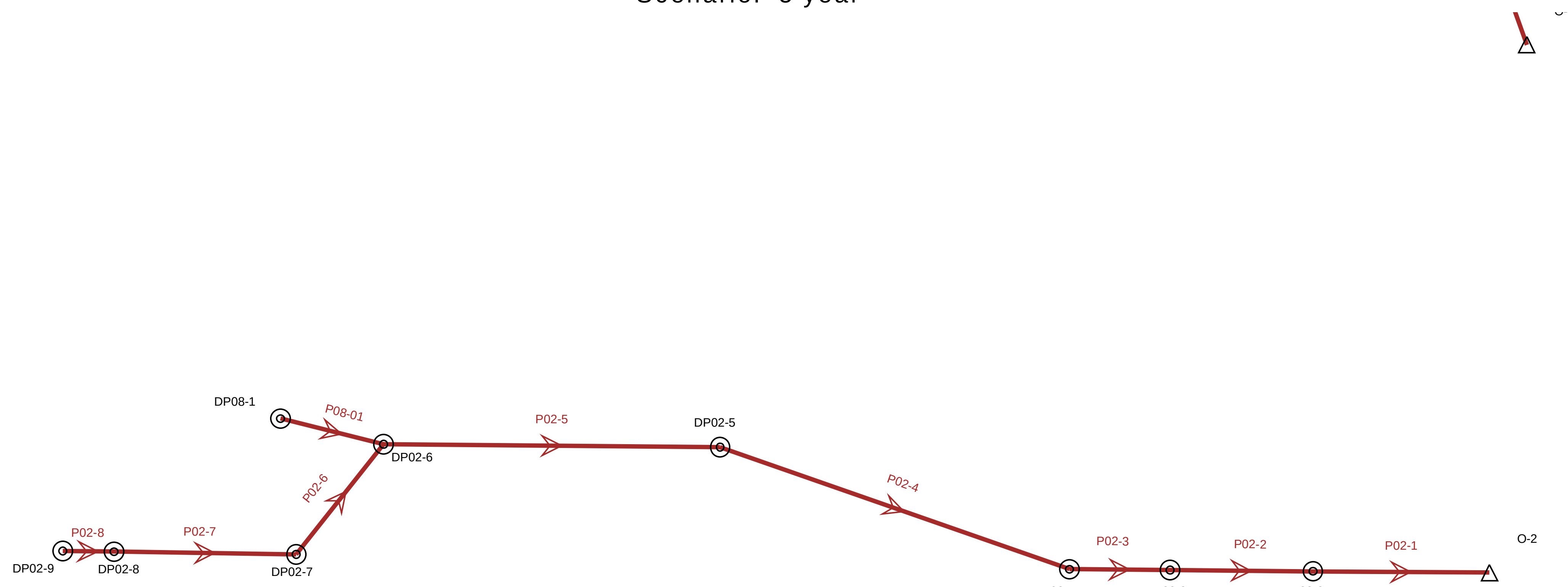
Scenario: 5 year



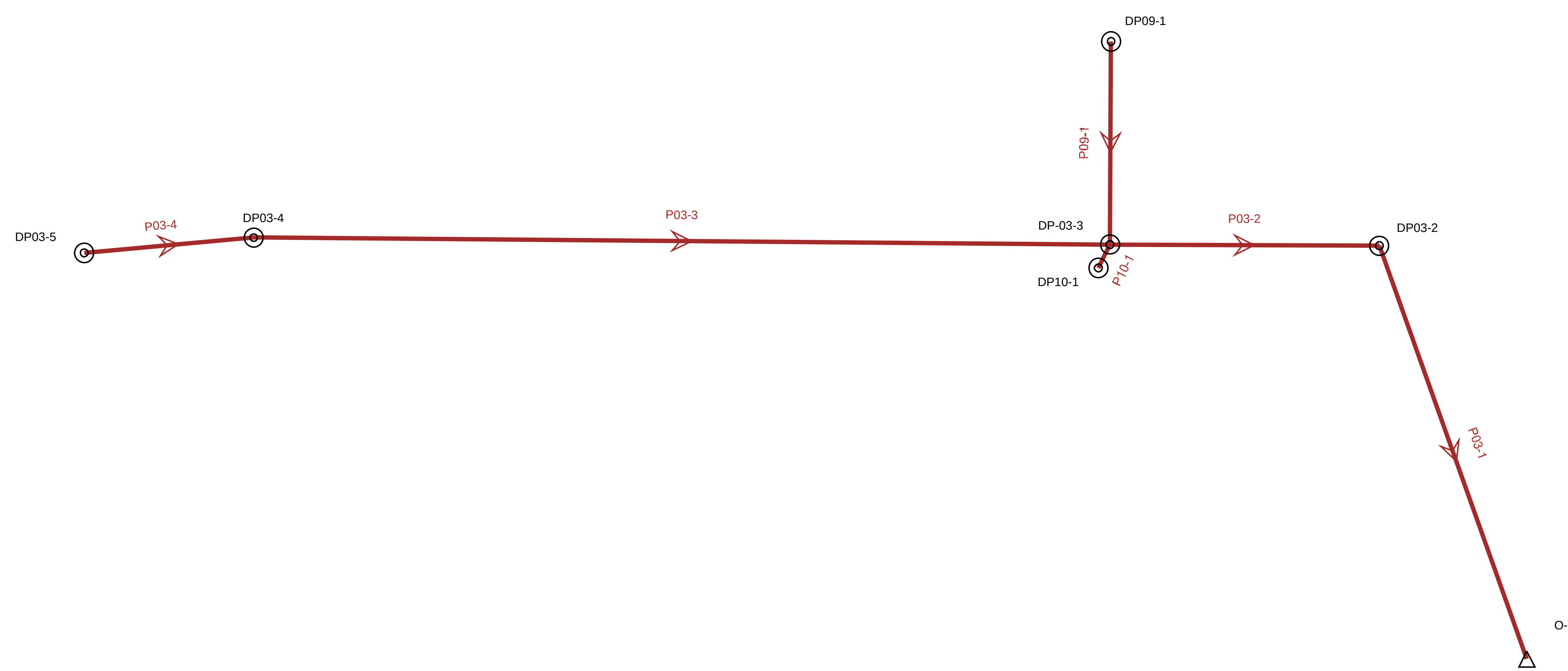
Scenario: 5 year



Scenario: 5 year



Scenario: 5 year



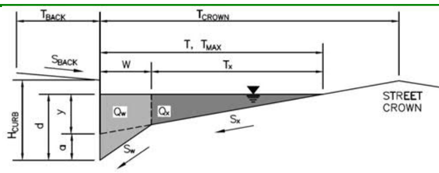
Version 4.06 Released August 2018

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

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

Project: Solace Apartments

Inlet ID: A1



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0		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} =	0.016		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.025		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 =	0.010		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

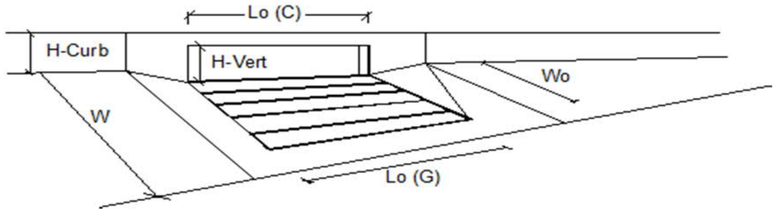
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**11.9**	**39.5**	**cfs**

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 4.06 Released August 2018



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 =	1	1	
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 =**	**1.6**	**2.3**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**1.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**93**	**71**	**%**

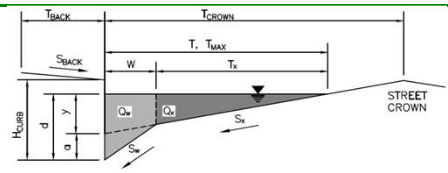
Version 4.06 Released August 2018

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

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

Project: Solace Apartments

Inlet ID: A2



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	4.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	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 =	0.012	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

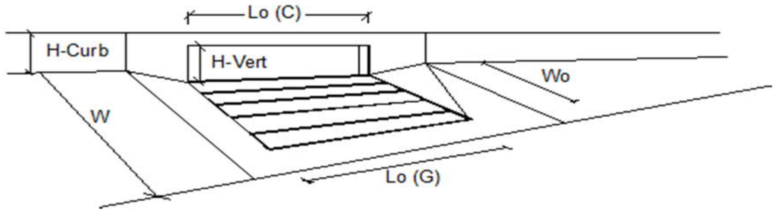
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**13.7**	**13.7**	**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 4.06 Released August 2018



			MINOR	MAJOR	
Design Information (Input)	Denver No. 16 Valley Grate		MINOR	MAJOR	
Type of Inlet		Type =	Denver No. 16 Valley Grate		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	N/A	N/A	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**1.0**	**1.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.6**	**1.6**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**63**	**48**	**%**

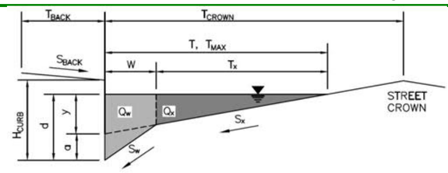
Version 4.06 Released August 2018

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

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

Project: Solace Apartments

Inlet ID: A3



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	4.0		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} =	0.016		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0		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} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

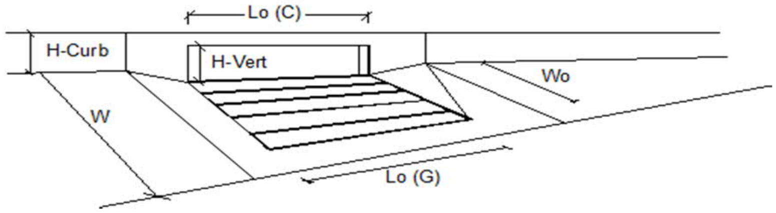
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**17.7**	**17.7**	**cfs**

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 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Valley Grate)	Type =	Denver No. 16 Valley Grate		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	N/A	N/A	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.0**	**1.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.6**	**1.6**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**63**	**48**	**%**

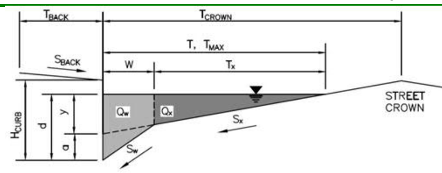
Version 4.06 Released August 2018

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

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

Project: Solace Apartments

Inlet ID: A6



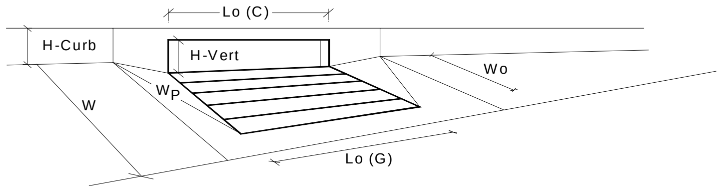
Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	2.0		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} =	0.016		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0		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} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	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 4.06 Released August 2018



		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 =	4.7	6.4	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) =	10.00	10.00	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} =	0.23	0.37	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.45	0.61	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.85	0.96	
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 =	**4.3**	**10.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	4.2	9.6	cfs

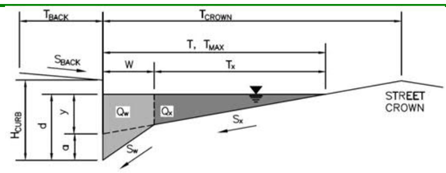
Version 4.06 Released August 2018

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

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

Project: Solace Apartments

Inlet ID: A7



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	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 =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

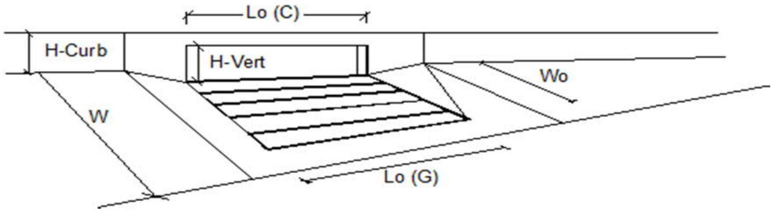
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**16.9**	**20.0**	**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 4.06 Released August 2018



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 =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	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 =**	**1.1**	**3.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**100**	**%**

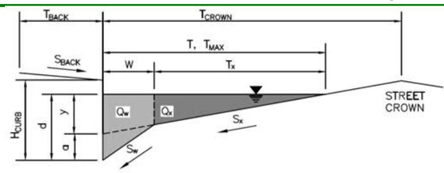
Version 4.06 Released August 2018

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

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

Project: Solace Apartments

Inlet ID: A8



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	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 =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

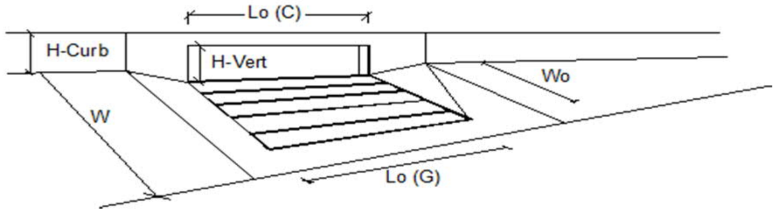
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)				check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**16.9**	**20.0**	**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 4.06 Released August 2018



Design Information (Input)		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 =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	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 =**	**0.8**	**1.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**100**	**%**

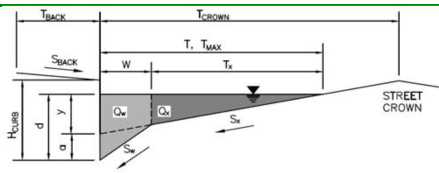
Version 4.06 Released August 2018

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

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

Project: Solace Apartments

Inlet ID: B1



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	4.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	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 =	0.013	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

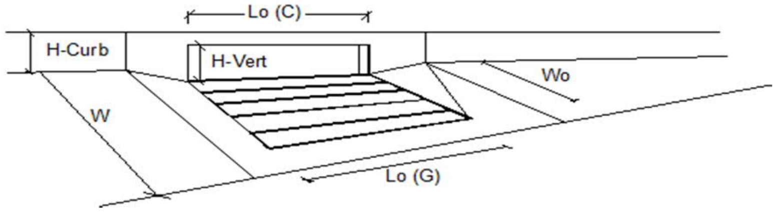
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**14.3**	**14.3**	**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 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet — Denver No. 16 Valley Grate	Type =	Denver No. 16 Valley Grate		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	N/A	N/A	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.7**	**2.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**2.4**	**7.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**42**	**28**	**%**

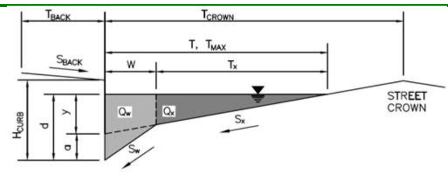
Version 4.06 Released August 2018

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

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

Project: Solace Apartments

Inlet ID: B2



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	4.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.025	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 =	0.028	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

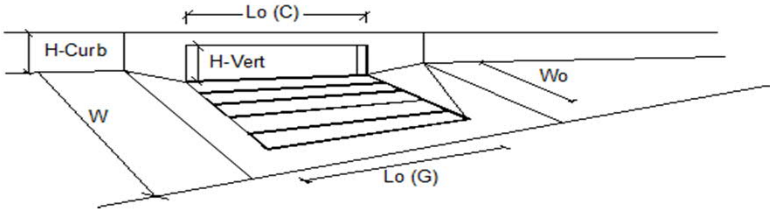
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**15.7**	**65.7**	**cfs**

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 4.06 Released August 2018



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 =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	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 =**	**1.6**	**2.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**100**	**%**

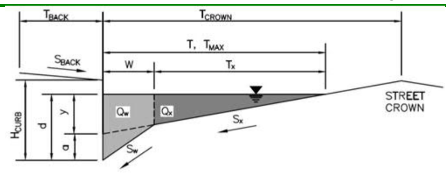
Version 4.06 Released August 2018

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

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

Project: Solace Apartments

Inlet ID: B3



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	4.0		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} =	0.016		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0		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 =	0.013		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

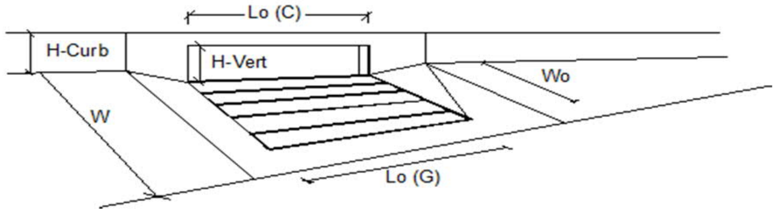
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**15.7**	**30.1**	**cfs**

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 4.06 Released August 2018



			MINOR	MAJOR	
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 =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	15.00	15.00	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 =**	**3.2**	**8.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.3**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**96**	**%**

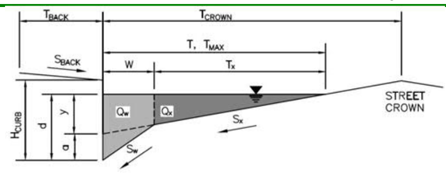
Version 4.06 Released August 2018

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

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

Project: **Solace Apartments**

Inlet ID: **B6**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	4.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	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 =	0.012	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)				check = yes

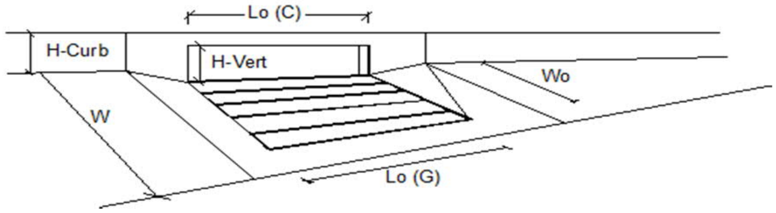
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**13.7**	**13.7**	**cfs**

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 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Valley Grate		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	N/A	N/A	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.1**	**1.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.8**	**2.5**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**59**	**42**	**%**

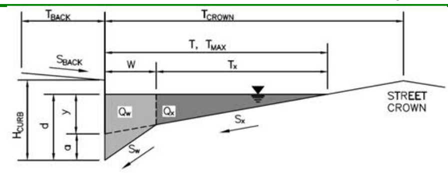
Version 4.06 Released August 2018

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

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

Project: **Solace Apartments**

Inlet ID: **B10**



Gutter Geometry (Enter data in the blue cells)

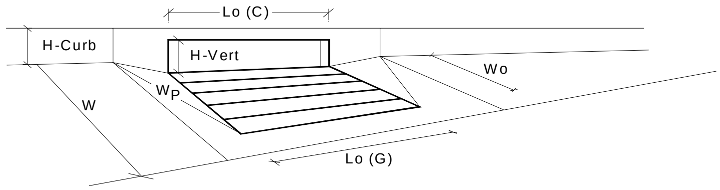
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	4.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	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 4.06 Released August 2018



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 =	3.5	4.2	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} =	0.13	0.19	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.45	0.54	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.99	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 =	**1.2**	**2.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.0	2.2	cfs

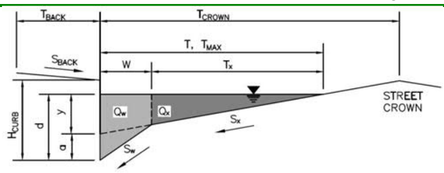
Version 4.06 Released August 2018

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

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

Project: **Solace Apartments**

Inlet ID: **B13**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	4.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	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 =	0.034	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)				check = yes

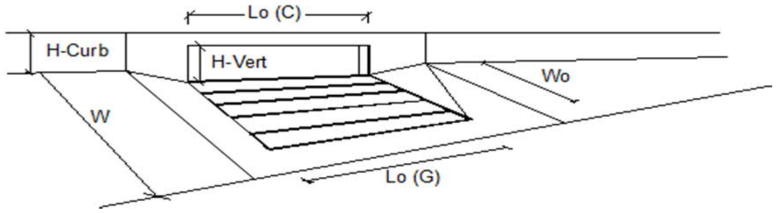
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**17.1**	**23.1**	**cfs**

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 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Valley Grate		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	0.50	0.50	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	N/A	N/A	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.9**	**1.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.6**	**1.7**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**62**	**46**	**%**

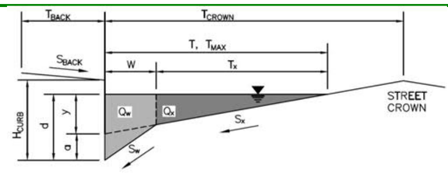
Version 4.06 Released August 2018

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

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

Project: Solace Apartments

Inlet ID: B12



Gutter Geometry (Enter data in the blue cells)

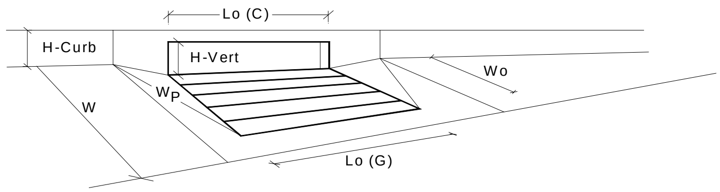
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	4.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.030	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	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 4.06 Released August 2018



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' 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 =	4.8	6.8	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} =	0.23	0.40	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.62	0.88	
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 =	**3.2**	**7.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.1	7.1	cfs

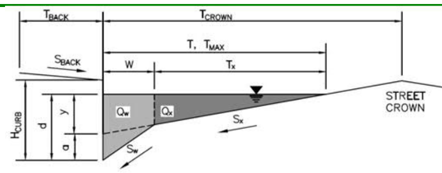
Version 4.06 Released August 2018

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

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

Project: Solace Apartments

Inlet ID: B14



Gutter Geometry (Enter data in the blue cells)

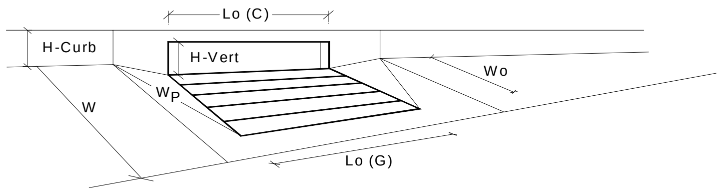
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	4.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.027	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	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 4.06 Released August 2018



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' 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	5.4	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} =	0.23	0.28	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.61	0.69	
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 =	**3.1**	**4.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.9	4.1	cfs

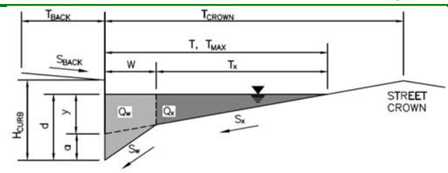
Version 4.06 Released August 2018

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

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

Project: Solace Apartments

Inlet ID: B15



Gutter Geometry (Enter data in the blue cells)

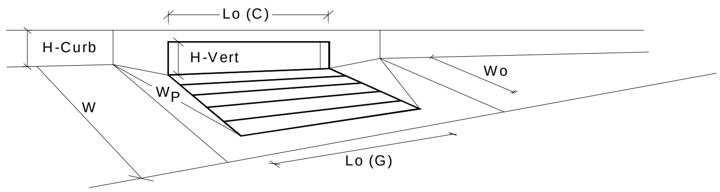
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	4.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	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} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	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 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Valley Grate)	Type =	Denver No. 16 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	3.2	4.3	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.294	0.381	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.38	0.51	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**0.9**	**1.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.9	1.8	cfs

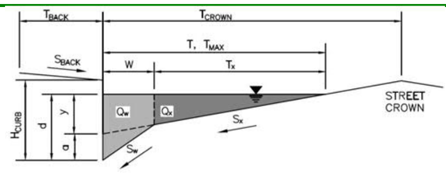
Version 4.06 Released August 2018

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

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

Project: **Solace Apartments**

Inlet ID: **B17**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	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 =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

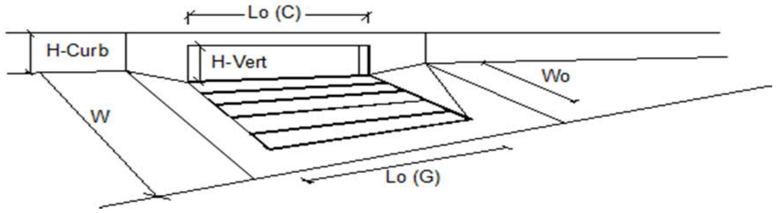
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**16.9**	**20.0**	**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 4.06 Released August 2018



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 =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	10.00	10.00	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 =**	**1.8**	**4.3**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.2**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**96**	**%**

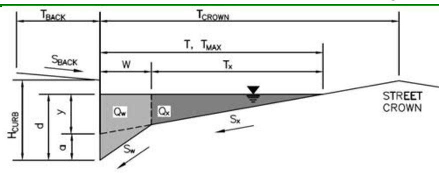
Version 4.06 Released August 2018

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

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

Project: Solace Apartments

Inlet ID: B18



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	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 =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

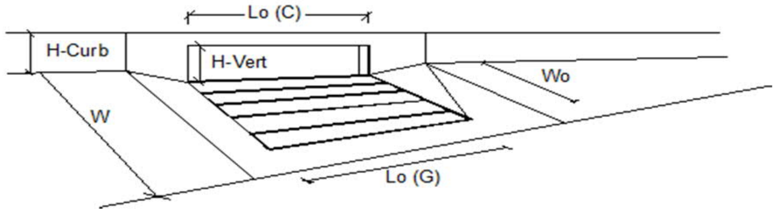
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**16.9**	**20.0**	**cfs**

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 4.06 Released August 2018



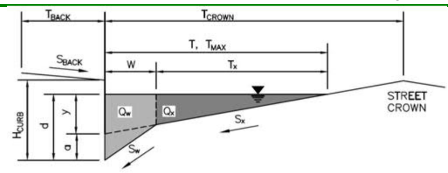
Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	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 =**	**1.1**	**2.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**100**	**%**

Version 4.06 Released August 2018

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

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

Project: **Solace Apartments**
Inlet ID: **B19**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	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 =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

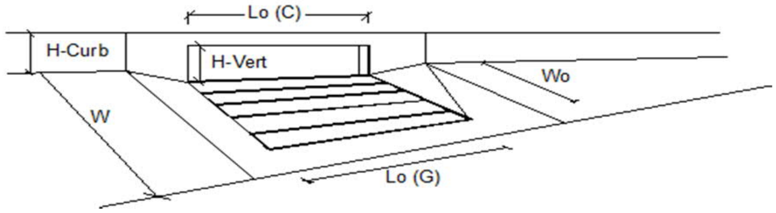
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**13.8**	**16.3**	**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 4.06 Released August 2018



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 =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	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 =**	**2.1**	**5.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**100**	**%**

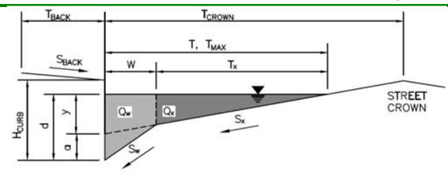
Version 4.06 Released August 2018

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

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

Project: Solace Apartments

Inlet ID: B20



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	20.0		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} =	0.016		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0		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 =	1.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)				check = yes

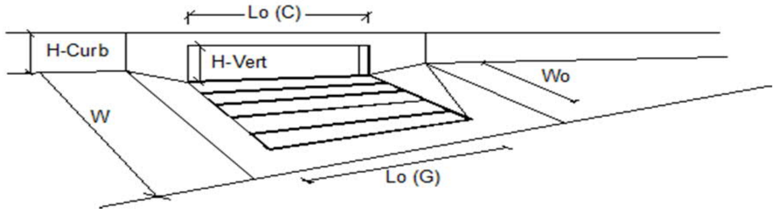
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**6.2**	**46.5**	**cfs**

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 4.06 Released August 2018



Design Information (Input)		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 =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	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 =**	**0.6**	**1.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**100**	**%**

APPENDIX C

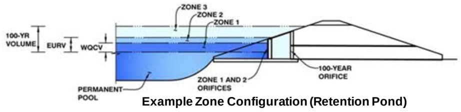
WATER QUALITY AND DETENTION CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: Solace Apartments

Basin ID: Pond A



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB			
Watershed Area =	7.89	acres		
Watershed Length =	790	ft		
Watershed Length to Centroid =	340	ft		
Watershed Slope =	0.020	ft/ft		
Watershed Imperviousness =	49.43%	percent		
Percentage Hydrologic Soil Group A =	1.0%	percent		
Percentage Hydrologic Soil Group B =	99.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.135	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.417	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.382	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.546	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.691	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.887	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.26 in.) =	1.052	acre-feet	2.26	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.247	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.654	acre-feet		inches
Approximate 2-yr Detention Volume =	0.314	acre-feet		
Approximate 5-yr Detention Volume =	0.430	acre-feet		
Approximate 10-yr Detention Volume =	0.570	acre-feet		
Approximate 25-yr Detention Volume =	0.626	acre-feet		
Approximate 50-yr Detention Volume =	0.657	acre-feet		
Approximate 100-yr Detention Volume =	0.732	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.135	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.282	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.315	acre-feet
Total Detention Basin Volume =	0.732	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

Depth Increment = ft

6251

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	10	0.000		
ELEV:6252	--	1.00	--	--	--	909	0.021	459	0.011
ELEV:6253	--	2.00	--	--	--	4,500	0.103	3,164	0.073
ELEV:6254	--	3.00	--	--	--	8,857	0.203	9,842	0.226
ELEV:6255	--	4.00	--	--	--	13,976	0.321	21,259	0.488
ELEV:6256	--	5.00	--	--	--	17,609	0.404	37,051	0.851
ELEV:6257	--	6.00	--	--	--	20,879	0.479	56,295	1.292
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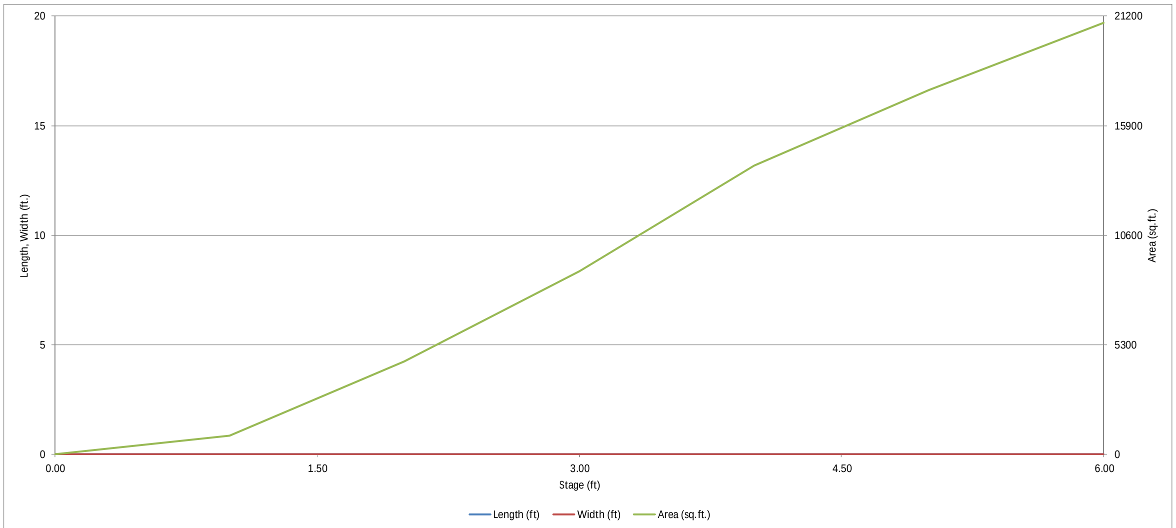
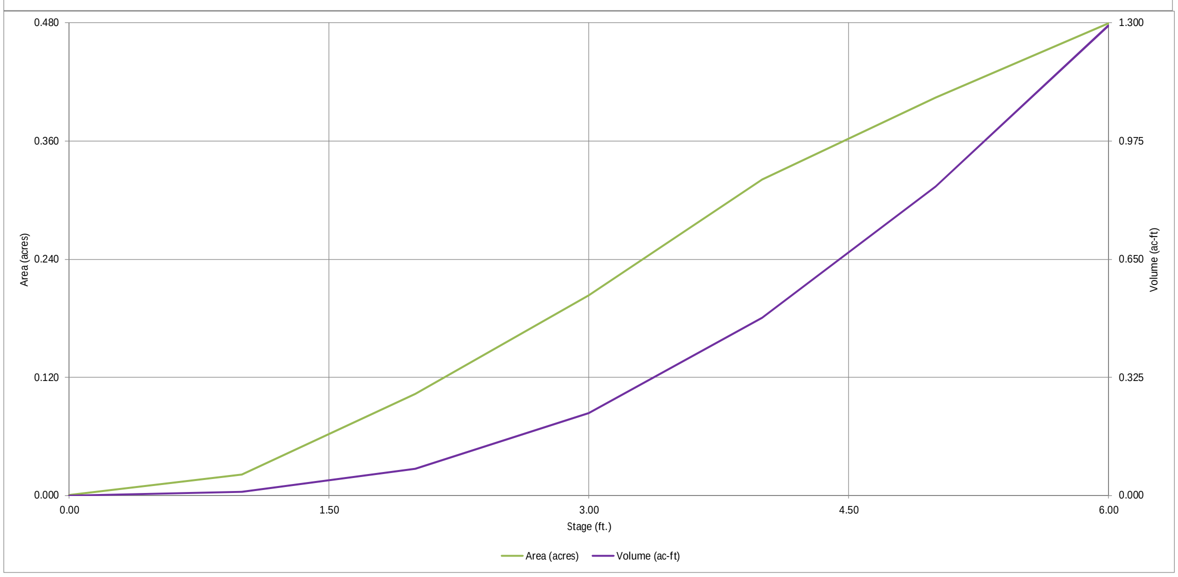
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				


20
15
10
5
0
21200
15900
10600
5300
0
Length, Width (ft.)
Area (sq.ft.)
0.00
1.50
3.00
4.50
6.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

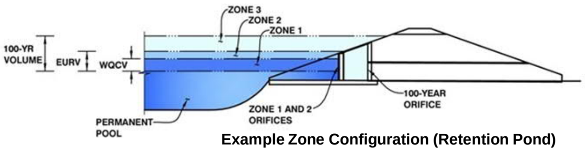

0.480
0.360
0.240
0.120
0.000
1.300
0.975
0.650
0.325
0.000
Area (acres)
Volume (ac-ft)
0.00
1.50
3.00
4.50
6.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: Solace Apartments

Basin ID: Pond A



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.49	0.135	Orifice Plate
Zone 2 (EURV)	3.77	0.282	Circular Orifice
Zone 3 (100-year)	4.70	0.315	Weir&Pipe (Restrict)
Total (all zones)		0.732	

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

			Calculated Parameters for Underdrain		
Underdrain Orifice Invert Depth =		ft (distance below the filtration media surface)	Underdrain Orifice Area =		ft^2
Underdrain Orifice Diameter =		inches	Underdrain Orifice Centroid =		feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

			Calculated Parameters for Plate		
Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	2.49	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	8.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.70	1.40	2.10				
Orifice Area (sq. inches)	0.40	0.45	0.52	0.52				

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected		Calculated Parameters for Vertical Orifice	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	2.49	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.00	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	3.77	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.02	N/A	feet
Vertical Orifice Diameter =	0.38	N/A	inches				

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe)

	Zone 3 Weir	Not Selected		Calculated Parameters for Overflow Weir	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.77	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	3.77	N/A	feet
Overflow Weir Front Edge Length =	4.00	N/A	feet	Overflow Weir Slope Length =	3.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	28.73	N/A	
Horiz. Length of Weir Sides =	3.00	N/A	feet	Overflow Grate Open Area w/o Debris =	8.40	N/A	ft^2
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	4.20	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.29	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.20	N/A	feet
Restrictor Plate Height Above Pipe Invert =	4.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	0.98	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

			Calculated Parameters for Spillway		
Spillway Invert Stage=	5.47	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.31	feet
Spillway Crest Length =	40.00	feet	Stage at Top of Freeboard =	6.78	feet
Spillway End Slopes =	10.00	H:V	Basin Area at Top of Freeboard =	0.48	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.29	acre-ft

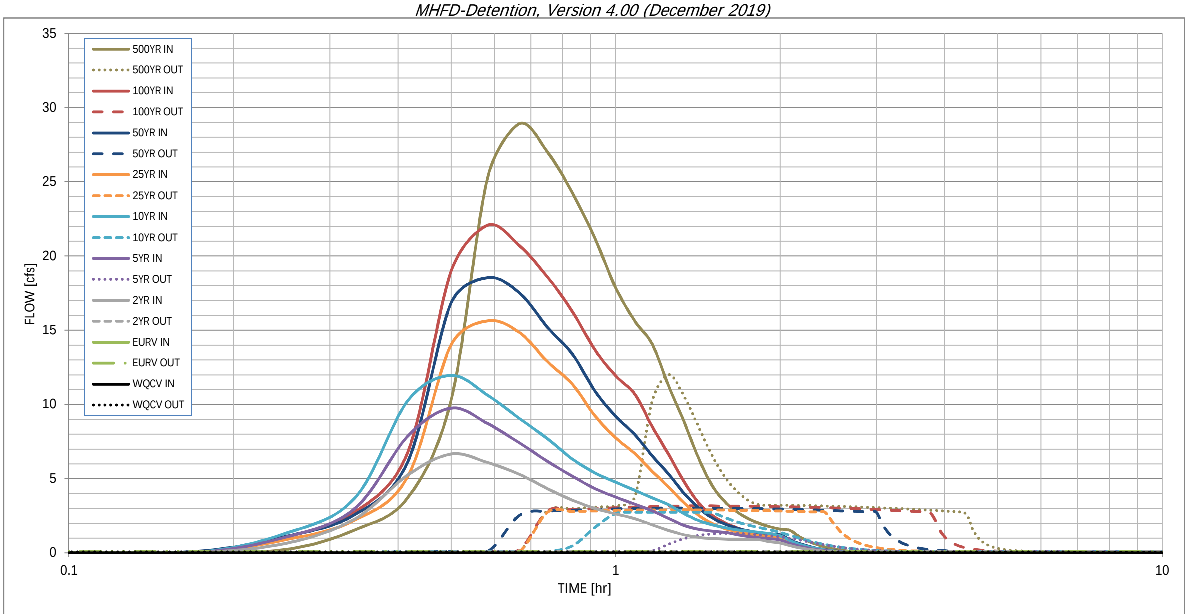
Routed Hydrograph Results

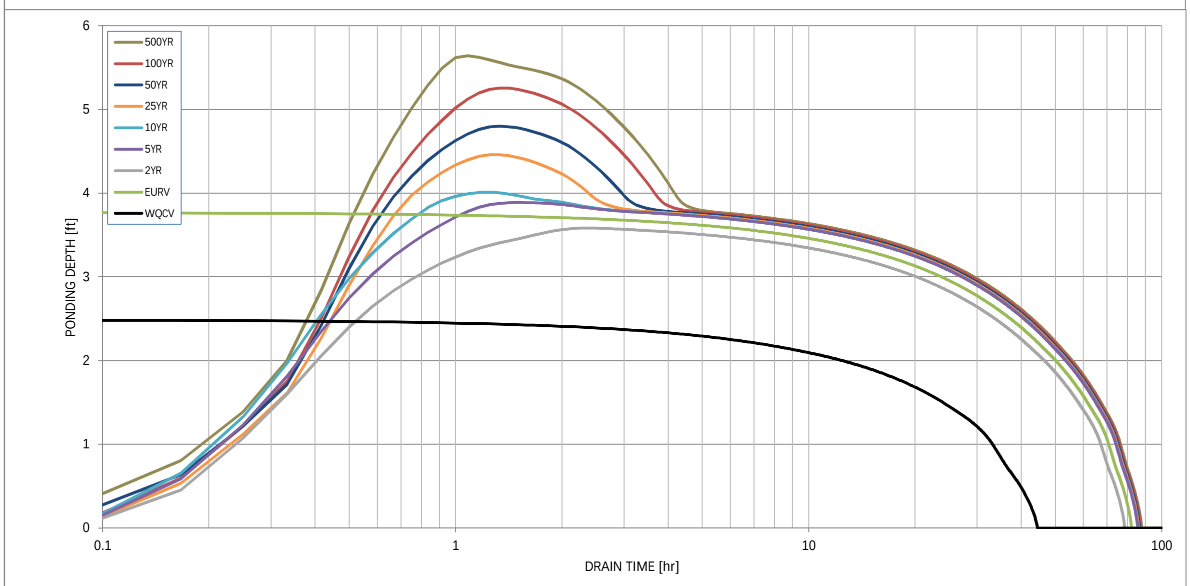
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

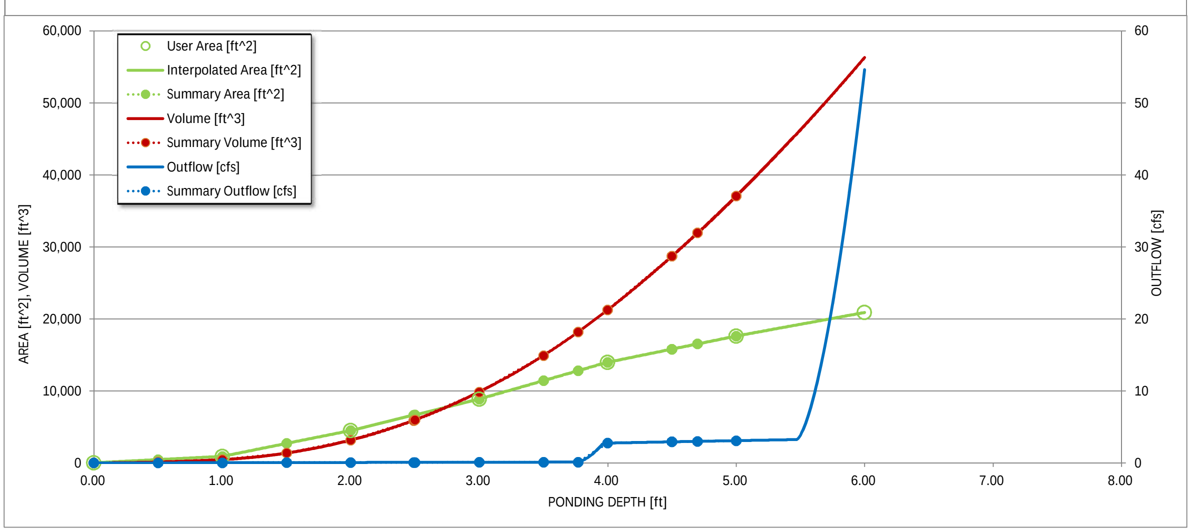
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.26	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.135	0.417	0.382	0.546	0.691	0.887	1.052	1.247	1.654
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.382	0.546	0.691	0.887	1.052	1.247	1.654
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.9	2.7	4.0	7.2	9.1	11.2	15.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.12	0.34	0.51	0.91	1.15	1.42	1.99
Peak Inflow Q (cfs) =	N/A	N/A	6.7	9.8	12.0	15.6	18.5	22.1	28.9
Peak Outflow Q (cfs) =	0.1	0.1	0.1	1.3	2.7	2.9	3.0	3.2	12.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.7	0.4	0.3	0.3	0.8
Structure Controlling Flow =	Plate	Overflow Weir 1	Vertical Orifice 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.3	0.3	0.3	0.4	0.4
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	70	67	71	69	67	66	65	62
Time to Drain 99% of Inflow Volume (hours) =	42	76	73	78	77	76	75	75	74
Maximum Ponding Depth (ft) =	2.49	3.77	3.58	3.89	4.01	4.46	4.80	5.26	5.64
Area at Maximum Ponding Depth (acres) =	0.15	0.29	0.27	0.31	0.32	0.36	0.39	0.42	0.45
Maximum Volume Stored (acre-ft) =	0.135	0.417	0.364	0.450	0.491	0.641	0.768	0.954	1.125

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.01	0.24
	0:15:00	0.00	0.00	0.66	1.08	1.34	0.90	1.12	1.10	1.55
	0:20:00	0.00	0.00	2.29	2.99	3.69	2.21	2.58	2.76	3.72
	0:25:00	0.00	0.00	5.25	7.86	10.25	5.16	6.14	6.79	10.27
	0:30:00	0.00	0.00	6.66	9.76	11.95	14.01	16.83	18.97	25.29
	0:35:00	0.00	0.00	6.09	8.72	10.62	15.64	18.54	22.08	28.92
	0:40:00	0.00	0.00	5.30	7.42	9.07	14.86	17.52	20.71	27.03
	0:45:00	0.00	0.00	4.33	6.18	7.70	12.90	15.22	18.61	24.26
	0:50:00	0.00	0.00	3.56	5.17	6.33	11.37	13.40	16.27	21.18
	0:55:00	0.00	0.00	3.00	4.33	5.39	9.24	10.91	13.68	17.88
	1:00:00	0.00	0.00	2.63	3.76	4.77	7.76	9.21	11.94	15.65
	1:05:00	0.00	0.00	2.32	3.29	4.23	6.71	7.99	10.71	14.07
	1:10:00	0.00	0.00	1.90	2.84	3.72	5.49	6.56	8.51	11.25
	1:15:00	0.00	0.00	1.52	2.33	3.25	4.44	5.31	6.64	8.87
	1:20:00	0.00	0.00	1.22	1.86	2.66	3.38	4.03	4.82	6.43
	1:25:00	0.00	0.00	1.05	1.60	2.19	2.55	3.05	3.40	4.58
	1:30:00	0.00	0.00	0.98	1.47	1.90	1.99	2.37	2.55	3.46
	1:35:00	0.00	0.00	0.93	1.39	1.70	1.65	1.95	2.04	2.77
	1:40:00	0.00	0.00	0.91	1.23	1.56	1.42	1.67	1.70	2.30
	1:45:00	0.00	0.00	0.89	1.11	1.47	1.27	1.49	1.46	1.99
	1:50:00	0.00	0.00	0.88	1.02	1.40	1.18	1.36	1.30	1.76
	1:55:00	0.00	0.00	0.76	0.96	1.30	1.11	1.28	1.19	1.61
	2:00:00	0.00	0.00	0.67	0.88	1.16	1.07	1.22	1.13	1.53
	2:05:00	0.00	0.00	0.49	0.64	0.84	0.78	0.89	0.82	1.11
	2:10:00	0.00	0.00	0.36	0.46	0.60	0.56	0.64	0.59	0.80
	2:15:00	0.00	0.00	0.26	0.33	0.43	0.40	0.45	0.43	0.57
	2:20:00	0.00	0.00	0.18	0.23	0.30	0.28	0.32	0.30	0.40
	2:25:00	0.00	0.00	0.12	0.15	0.21	0.19	0.22	0.21	0.28
	2:30:00	0.00	0.00	0.08	0.10	0.14	0.13	0.15	0.14	0.19
	2:35:00	0.00	0.00	0.05	0.07	0.09	0.09	0.10	0.09	0.13
	2:40:00	0.00	0.00	0.03	0.04	0.05	0.05	0.06	0.05	0.07
	2:45:00	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.03	0.03
	2:50:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft ^{2}]	Area [acres]	Volume [ft ^{3}]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	10	0.000	0	0.000	0.00
	0.50	460	0.011	117	0.003	0.01
	1.00	909	0.021	459	0.011	0.02
	1.50	2,705	0.062	1,363	0.031	0.04
	2.00	4,500	0.103	3,164	0.073	0.05
WQCV	2.49	6,635	0.152	5,892	0.135	0.07
	2.50	6,678	0.153	5,959	0.137	0.07
	3.00	8,857	0.203	9,842	0.226	0.09
	3.50	11,416	0.262	14,911	0.342	0.10
EURV	3.77	12,799	0.294	18,180	0.417	0.11
	4.00	13,976	0.321	21,259	0.488	2.75
	4.50	15,792	0.363	28,701	0.659	2.92
	4.50	15,792	0.363	28,701	0.659	2.92
100 YR	4.70	16,519	0.379	31,932	0.733	2.99
	5.00	17,609	0.404	37,051	0.851	3.09

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Detention Pond A North Forebay Calculations

100 YR Discharge	11.3	CFS
WQCV Storage	0.135	AC-FT
Forebay Volume (2% pf WQCV)	0.0027	AC-FT
Forebay Release Volume (2% of 100 YR)	0.226	CFS

Weir Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. — Friday, Nov 6 2020

Pond A North Forebay Calculations

Rectangular Weir

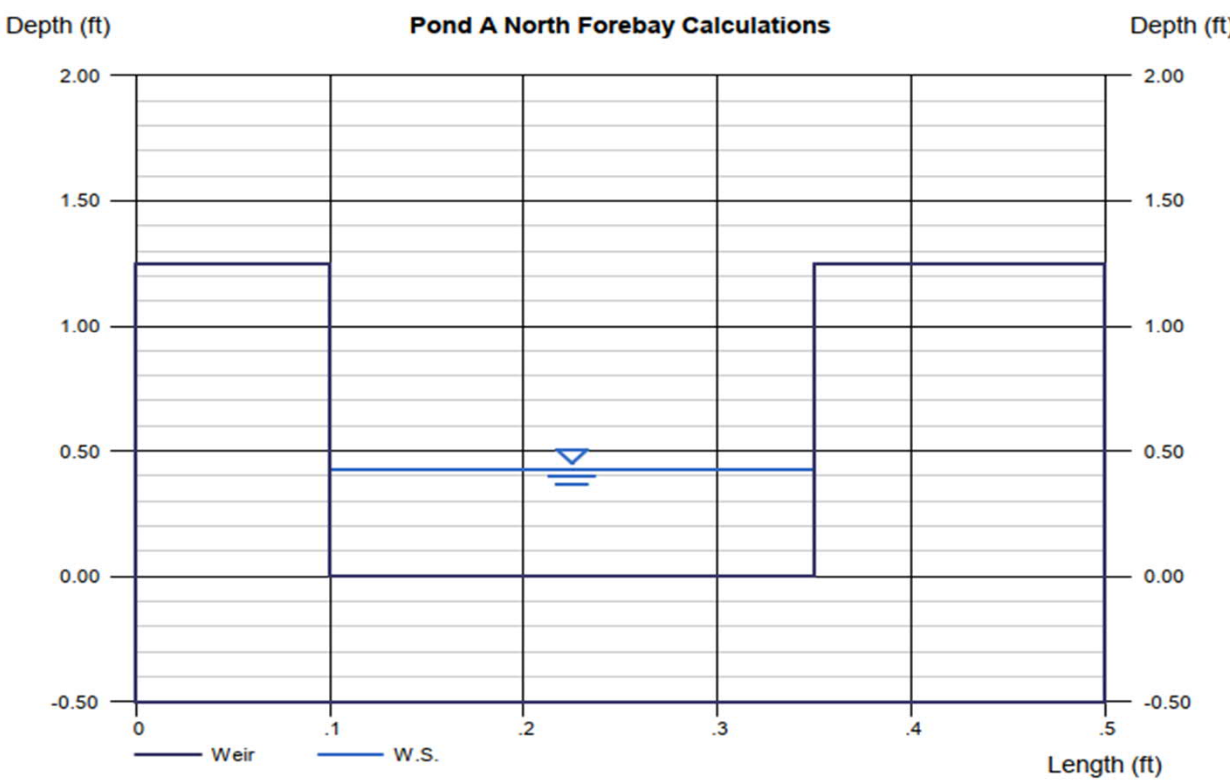
Crest	= Sharp
Bottom Length (ft)	= 0.25
Total Depth (ft)	= 1.25

Calculations

Weir Coeff. Cw	= 3.33
Compute by:	Known Q
Known Q (cfs)	= 0.23

Highlighted

Depth (ft)	= 0.42
Q (cfs)	= 0.230
Area (sqft)	= 0.11
Velocity (ft/s)	= 2.17
Top Width (ft)	= 0.25



Detention Pond A South Forebay Calculations

100 YR Discharge	19.4	CFS
WQCV Storage	0.135	AC-FT
Forebay Volume (2% pf WQCV)	0.0027	AC-FT
Forebay Release Volume (2% of 100 YR)	0.388	CFS

Weir Report

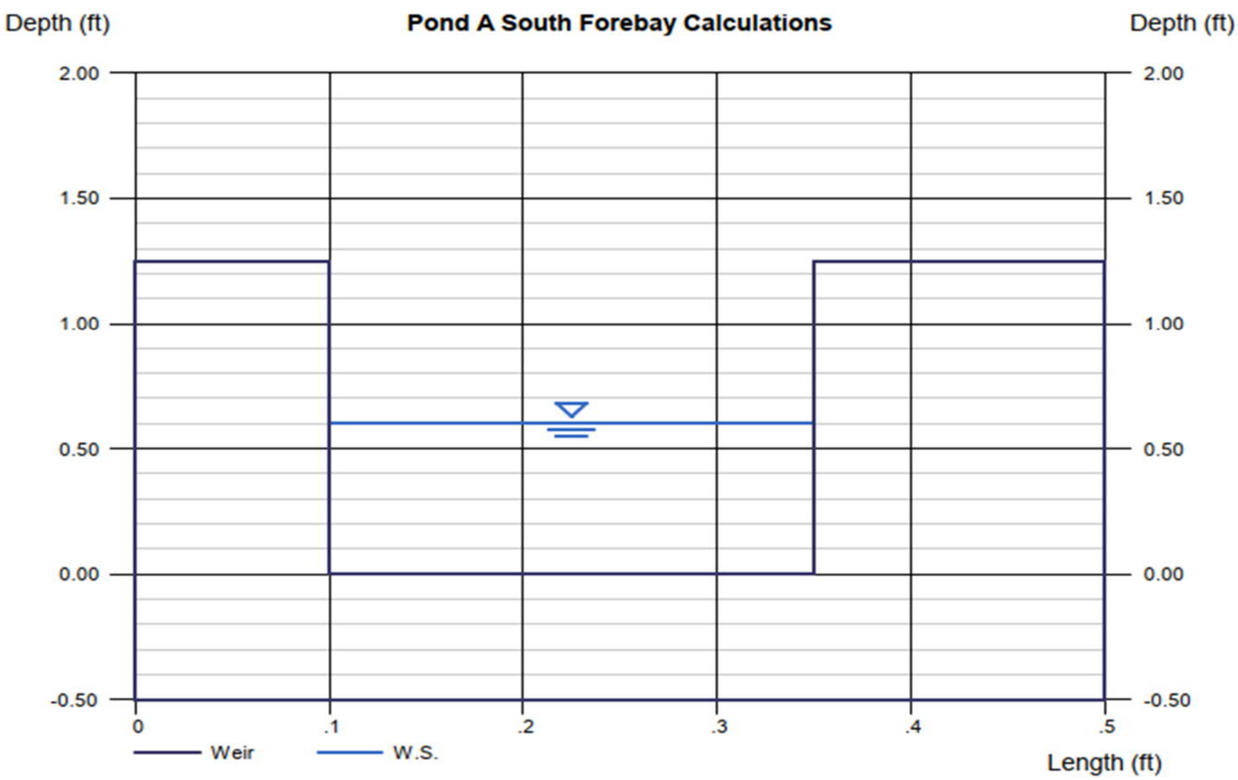
Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. — Friday, Nov 6 2020

Pond A South Forebay Calculations

Rectangular Weir
Crest = Sharp
Bottom Length (ft) = 0.25
Total Depth (ft) = 1.25

Calculations
Weir Coeff. Cw = 3.33
Compute by: Known Q
Known Q (cfs) = 0.39

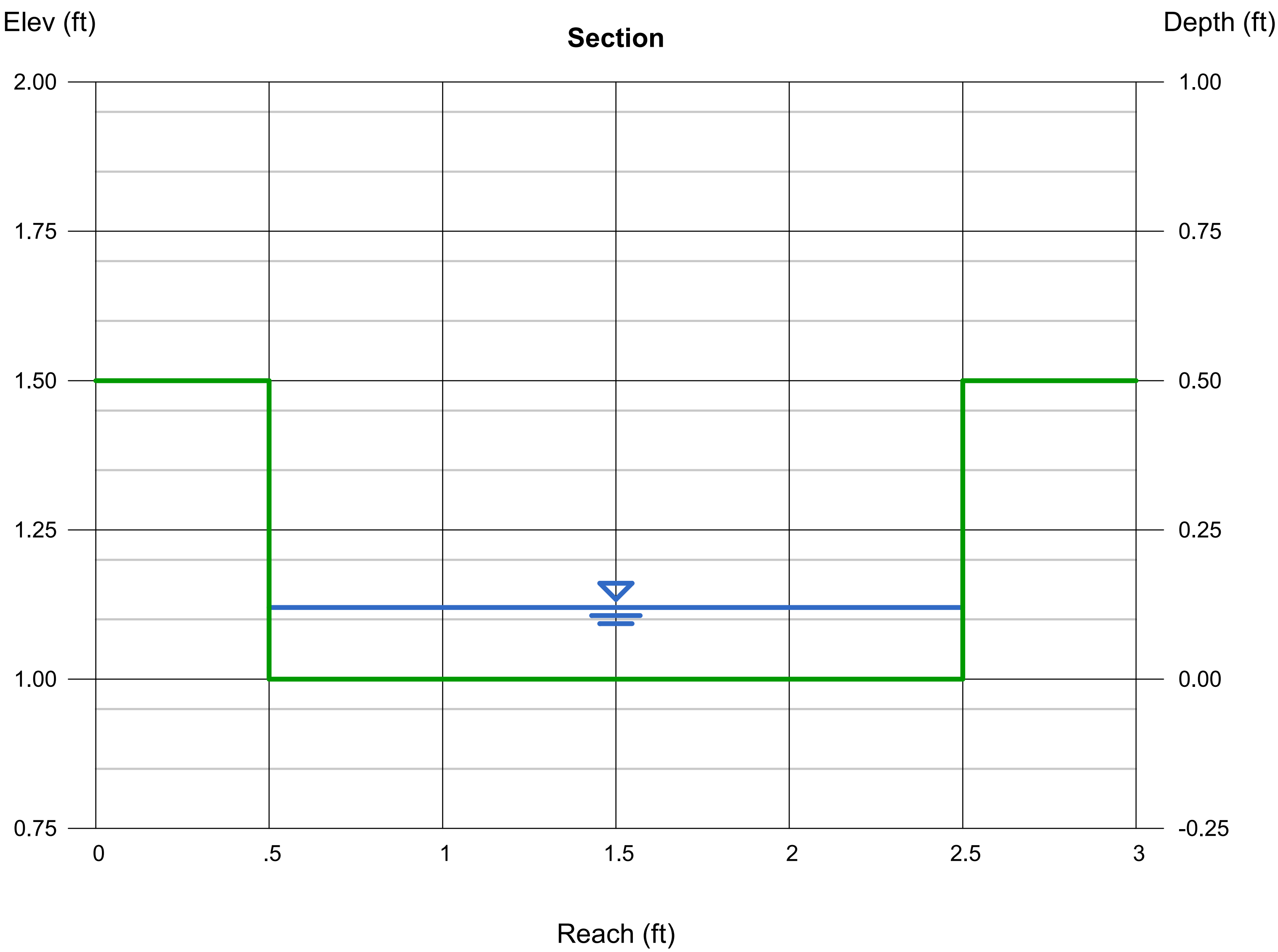
Highlighted
Depth (ft) = 0.60
Q (cfs) = 0.388
Area (sqft) = 0.15
Velocity (ft/s) = 2.58
Top Width (ft) = 0.25



Channel Report

Pond A Trickel Channel

Rectangular		**Highlighted**	
Bottom Width (ft)	= 2.00	Depth (ft)	= 0.12
Total Depth (ft)	= 0.50	Q (cfs)	= 0.610
		Area (sqft)	= 0.24
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 2.54
Slope (%)	= 1.00	Wetted Perim (ft)	= 2.24
N-Value	= 0.013	Crit Depth, Yc (ft)	= 0.15
		Top Width (ft)	= 2.00
Calculations		EGL (ft)	= 0.22
Compute by:	Known Q		
Known Q (cfs)	= 0.61		



Weir Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Nov 24 2020

Pond A Spillway

Trapezoidal Weir

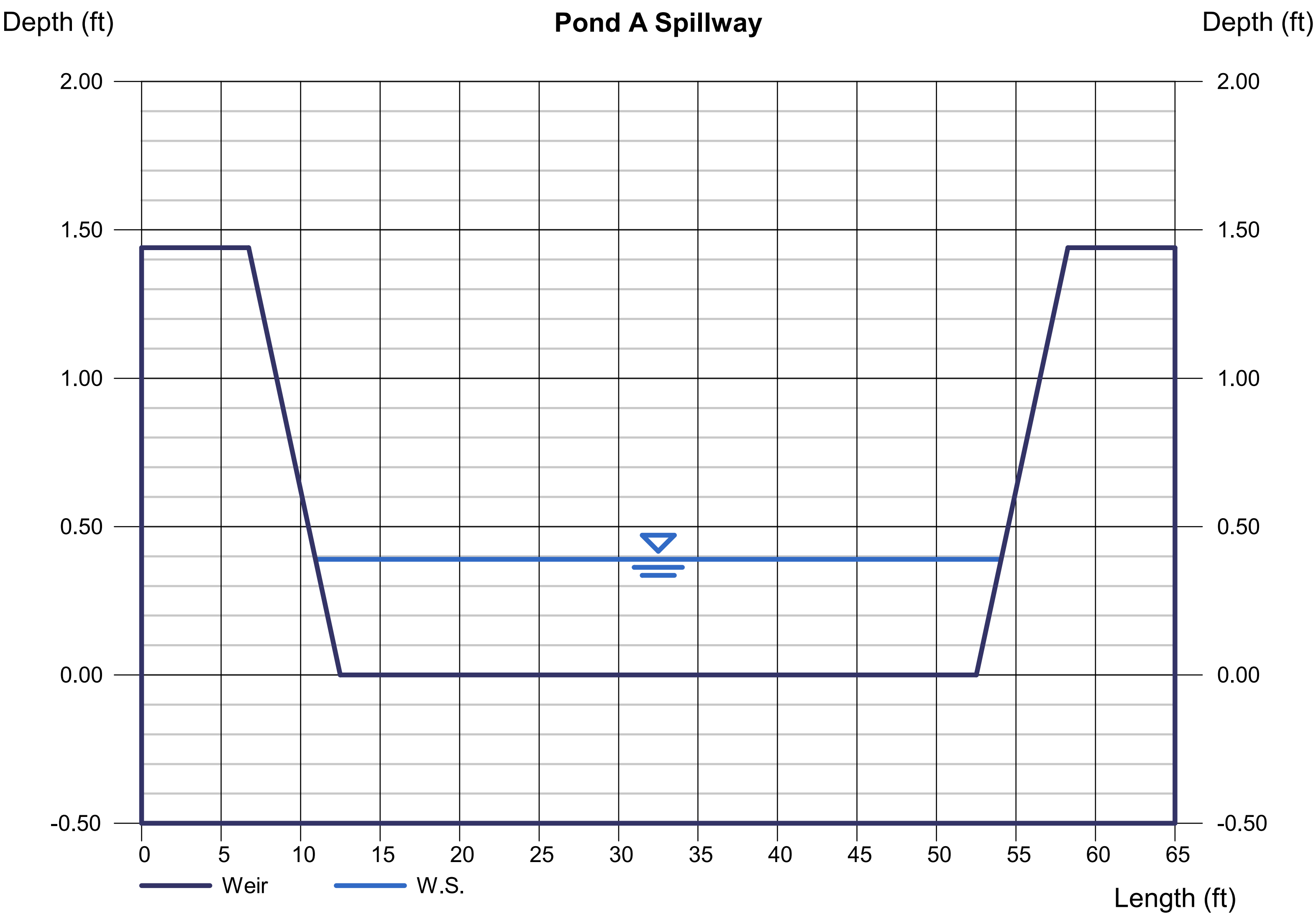
Crest	=	Sharp
Bottom Length (ft)	=	40.00
Total Depth (ft)	=	1.44
Side Slope (z:1)	=	4.00

Calculations

Weir Coeff. Cw	=	3.10
Compute by:		Known Q
Known Q (cfs)	=	30.80

Highlighted

Depth (ft)	=	0.39
Q (cfs)	=	30.80
Area (sqft)	=	16.21
Velocity (ft/s)	=	1.90
Top Width (ft)	=	43.12

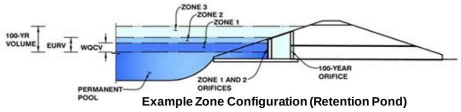


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: Solace Apartments

Basin ID: Pond B



Example Zone Configuration (Retention Pond)

Depth Increement = [ ] ft

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	17.50	acres
Watershed Length =	1,631	ft
Watershed Length to Centroid =	740	ft
Watershed Slope =	0.014	ft/ft
Watershed Imperviousness =	40.55%	percent
Percentage Hydrologic Soil Group A =	1.0%	percent
Percentage Hydrologic Soil Group B =	99.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.264	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.746	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.729	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.088	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.408	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.872	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.26 in.) =	2.246	acre-feet	2.26	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.702	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	3.634	acre-feet		inches
Approximate 2-yr Detention Volume =	0.550	acre-feet		
Approximate 5-yr Detention Volume =	0.767	acre-feet		
Approximate 10-yr Detention Volume =	1.052	acre-feet		
Approximate 25-yr Detention Volume =	1.176	acre-feet		
Approximate 50-yr Detention Volume =	1.240	acre-feet		
Approximate 100-yr Detention Volume =	1.412	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.264	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.482	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.666	acre-feet
Total Detention Basin Volume =	1.412	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

6243.17

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	10	0.000		
ELEV:6244	--	0.83	--	--	--	332	0.008	142	0.003
ELEV:6245	--	1.83	--	--	--	6,042	0.139	3,329	0.076
ELEV:6246	--	2.83	--	--	--	18,264	0.419	15,482	0.355
ELEV:6247	--	3.83	--	--	--	26,278	0.603	37,753	0.867
ELEV:6248	--	4.83	--	--	--	30,833	0.708	66,308	1.522
ELEV:6549	--	5.83	--	--	--	32,872	0.755	98,161	2.253
ELEV:6549.5	--	6.33	--	--	--	37,812	0.868	115,832	2.659
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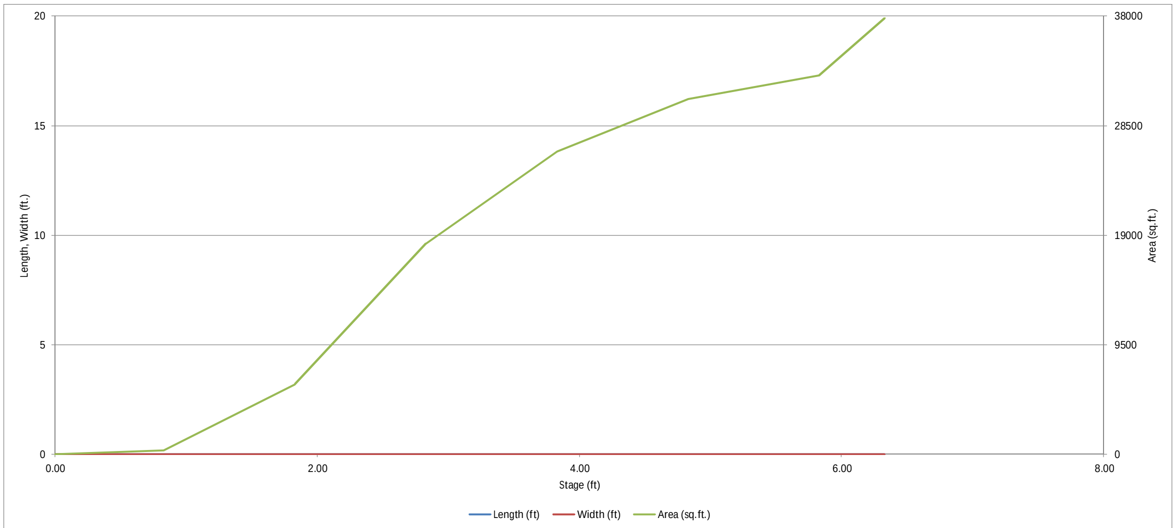
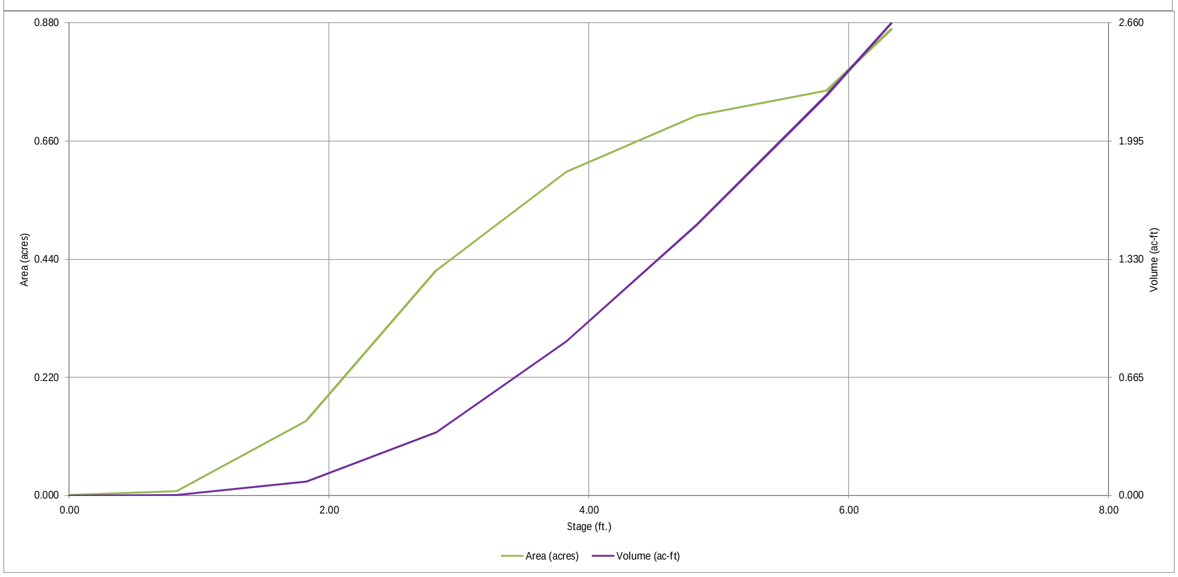

Length, Width (ft.)
Area (sq.ft.)
Stage (ft)
0
5
10
15
20
0
9500
19000
28500
38000
0.00
2.00
4.00
6.00
8.00
Length (ft)
Width (ft)
Area (sq.ft.)

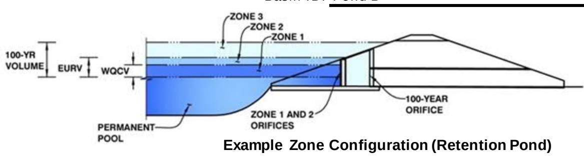

Area (acres)
Volume (ac-ft)
Stage (ft.)
0.000
0.220
0.440
0.660
0.880
0.000
0.665
1.330
1.995
2.660
0.00
2.00
4.00
6.00
8.00
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: Solace Apartments

Basin ID: Pond B



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.60	0.264	Orifice Plate
Zone 2 (EURV)	3.63	0.482	Circular Orifice
Zone 3 (100-year)	4.68	0.666	Weir&Pipe (Restrict)
Total (all zones)		1.412	

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.60	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	6.00	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.50	1.00	1.50	2.00			
Orifice Area (sq. inches)	0.55	0.55	0.55	0.55	0.55			

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	2.60	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	3.63	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	1.50	N/A	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	0.01	N/A	ft^2
Vertical Orifice Centroid =	0.06	N/A	feet

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.63	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	3.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.63	N/A	feet
Overflow Weir Slope Length =	3.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	28.73	N/A	
Overflow Grate Open Area w/o Debris =	8.40	N/A	ft^2
Overflow Grate Open Area w/ Debris =	4.20	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	4.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.29	N/A	ft^2
Outlet Orifice Centroid =	0.20	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	0.98	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.10	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	50.00	feet
Spillway End Slopes =	10.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.34	feet
Stage at Top of Freeboard =	7.44	feet
Basin Area at Top of Freeboard =	0.87	acres
Basin Volume at Top of Freeboard =	2.66	acre-ft

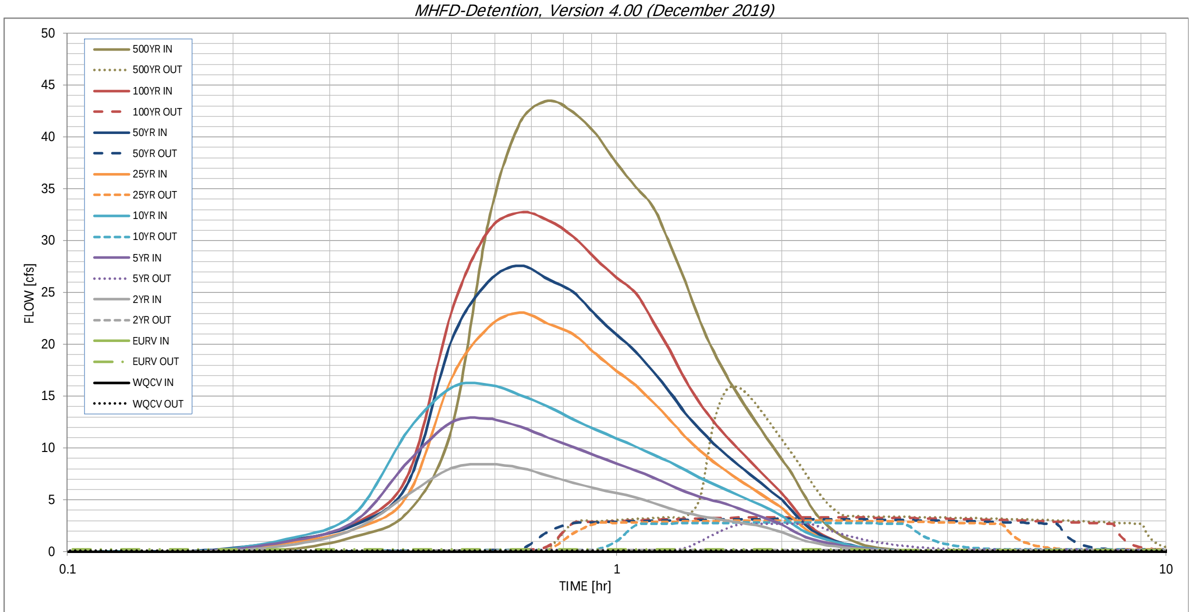
Routed Hydrograph Results

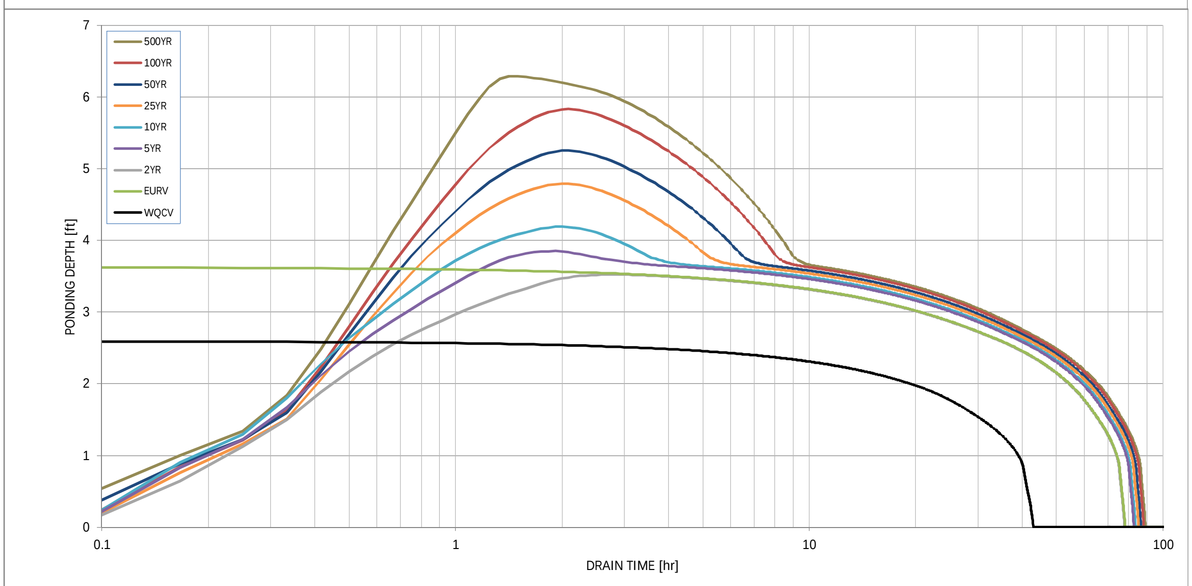
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

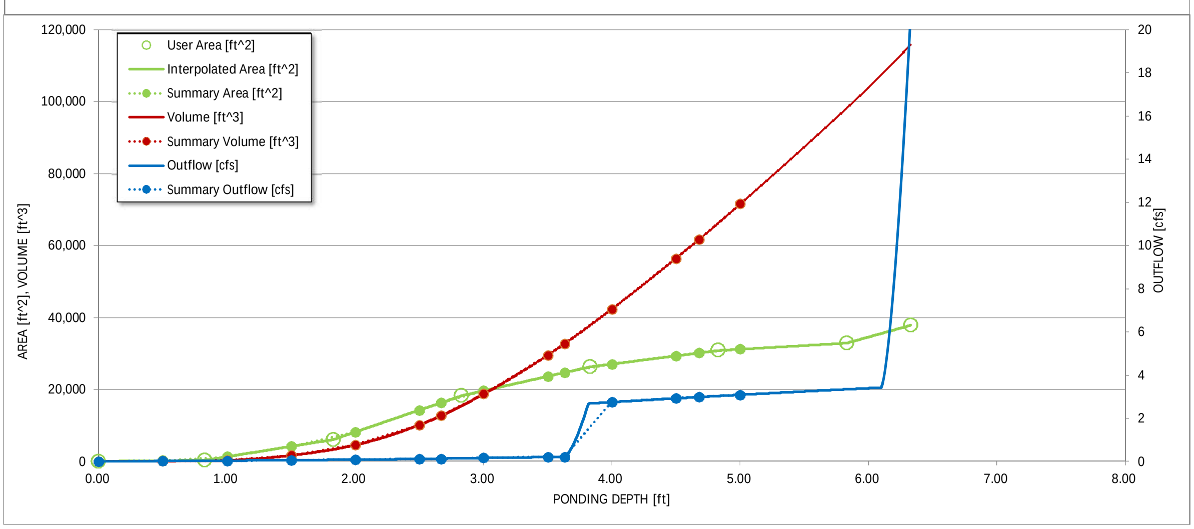
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.26	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.264	0.746	0.729	1.088	1.408	1.872	2.246	2.702	3.634
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.729	1.088	1.408	1.872	2.246	2.702	3.634
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.4	4.0	6.1	11.3	14.3	18.2	25.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.08	0.23	0.35	0.64	0.82	1.04	1.45
Peak Inflow Q (cfs) =	N/A	N/A	8.4	12.8	16.1	23.1	27.6	32.7	43.5
Peak Outflow Q (cfs) =	0.1	0.2	0.2	2.7	2.8	3.0	3.2	3.3	15.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.7	0.5	0.3	0.2	0.2	0.6
Structure Controlling Flow =	Vertical Orifice 1	Overflow Weir 1	Vertical Orifice 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.3	0.3	0.3	0.3	0.4	0.4
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	70	69	72	71	70	69	68	65
Time to Drain 99% of Inflow Volume (hours) =	41	74	74	77	77	78	78	79	77
Maximum Ponding Depth (ft) =	2.60	3.63	3.52	3.85	4.19	4.79	5.25	5.83	6.29
Area at Maximum Ponding Depth (acres) =	0.35	0.57	0.55	0.60	0.64	0.70	0.73	0.75	0.86
Maximum Volume Stored (acre-ft) =	0.266	0.750	0.689	0.873	1.091	1.494	1.824	2.253	2.616

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval: 5.00 min

SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.01	0.22
0:15:00	0.00	0.00	0.60	0.98	1.22	0.82	1.04	1.00	1.47
0:20:00	0.00	0.00	2.20	2.93	3.70	2.19	2.59	2.74	3.81
0:25:00	0.00	0.00	5.52	8.65	11.64	5.47	6.59	7.37	11.75
0:30:00	0.00	0.00	8.06	12.47	15.81	16.67	20.33	23.06	31.64
0:35:00	0.00	0.00	8.44	12.83	16.12	21.61	26.01	30.90	41.39
0:40:00	0.00	0.00	8.09	12.06	15.12	23.06	27.59	32.73	43.47
0:45:00	0.00	0.00	7.34	11.00	14.00	21.99	26.27	31.95	42.38
0:50:00	0.00	0.00	6.67	10.11	12.76	20.97	25.04	30.40	40.28
0:55:00	0.00	0.00	6.11	9.24	11.75	19.06	22.79	28.22	37.47
1:00:00	0.00	0.00	5.66	8.51	10.92	17.44	20.92	26.44	35.17
1:05:00	0.00	0.00	5.24	7.83	10.14	16.03	19.28	24.94	33.21
1:10:00	0.00	0.00	4.70	7.16	9.37	14.37	17.31	22.17	29.63
1:15:00	0.00	0.00	4.19	6.44	8.65	12.75	15.38	19.40	26.05
1:20:00	0.00	0.00	3.77	5.78	7.87	11.09	13.38	16.57	22.30
1:25:00	0.00	0.00	3.46	5.31	7.15	9.78	11.80	14.33	19.34
1:30:00	0.00	0.00	3.24	4.94	6.52	8.69	10.47	12.60	17.01
1:35:00	0.00	0.00	3.03	4.60	5.96	7.78	9.36	11.17	15.07
1:40:00	0.00	0.00	2.84	4.18	5.45	6.97	8.36	9.89	13.34
1:45:00	0.00	0.00	2.65	3.78	4.96	6.23	7.45	8.73	11.76
1:50:00	0.00	0.00	2.47	3.38	4.49	5.54	6.60	7.64	10.28
1:55:00	0.00	0.00	2.18	3.00	3.99	4.87	5.78	6.61	8.88
2:00:00	0.00	0.00	1.89	2.61	3.44	4.22	4.99	5.64	7.57
2:05:00	0.00	0.00	1.52	2.09	2.75	3.37	3.97	4.47	5.98
2:10:00	0.00	0.00	1.19	1.61	2.13	2.56	3.01	3.36	4.49
2:15:00	0.00	0.00	0.94	1.27	1.71	1.89	2.22	2.45	3.32
2:20:00	0.00	0.00	0.76	1.04	1.40	1.45	1.70	1.84	2.52
2:25:00	0.00	0.00	0.63	0.85	1.15	1.13	1.33	1.40	1.93
2:30:00	0.00	0.00	0.52	0.70	0.94	0.89	1.04	1.07	1.48
2:35:00	0.00	0.00	0.42	0.57	0.77	0.70	0.82	0.81	1.12
2:40:00	0.00	0.00	0.35	0.46	0.61	0.55	0.64	0.60	0.84
2:45:00	0.00	0.00	0.28	0.37	0.48	0.43	0.50	0.45	0.62
2:50:00	0.00	0.00	0.23	0.29	0.38	0.33	0.38	0.34	0.47
2:55:00	0.00	0.00	0.18	0.23	0.30	0.26	0.30	0.27	0.37
3:00:00	0.00	0.00	0.15	0.18	0.23	0.21	0.24	0.22	0.30
3:05:00	0.00	0.00	0.12	0.14	0.18	0.16	0.19	0.17	0.24
3:10:00	0.00	0.00	0.09	0.11	0.14	0.13	0.14	0.13	0.18
3:15:00	0.00	0.00	0.06	0.08	0.10	0.09	0.11	0.10	0.13
3:20:00	0.00	0.00	0.04	0.05	0.07	0.07	0.07	0.07	0.09
3:25:00	0.00	0.00	0.03	0.04	0.05	0.04	0.05	0.04	0.06
3:30:00	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.03
3:35:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.
The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft ^{2}]	Area [acres]	Volume [ft ^{3}]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	10	0.000	0	0.000	0.00
	0.50	204	0.005	53	0.001	0.01
	1.00	1,303	0.030	281	0.006	0.03
	1.50	4,158	0.095	1,646	0.038	0.05
	2.00	8,120	0.186	4,533	0.104	0.08
	2.50	14,231	0.327	10,120	0.232	0.11
WQCV	2.67	16,308	0.374	12,716	0.292	0.12
	3.00	19,626	0.451	18,702	0.429	0.16
	3.50	23,633	0.543	29,517	0.678	0.20
EURV	3.63	24,675	0.566	32,657	0.750	0.21
	4.00	27,052	0.621	42,286	0.971	2.75
	4.50	29,330	0.673	56,381	1.294	2.92
100-YEAR	4.68	30,150	0.692	61,735	1.417	2.98
	5.00	31,180	0.716	71,579	1.643	3.09

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Detention Pond B South Forebay Calculations

100 YR Discharge	6.7	CFS
WQCV Storage	0.264	AC-FT
Forebay Volume (2% pf WQCV)	0.00528	AC-FT
Forebay Release Volume (2% of 100 YR)	0.134	CFS

Weir Report

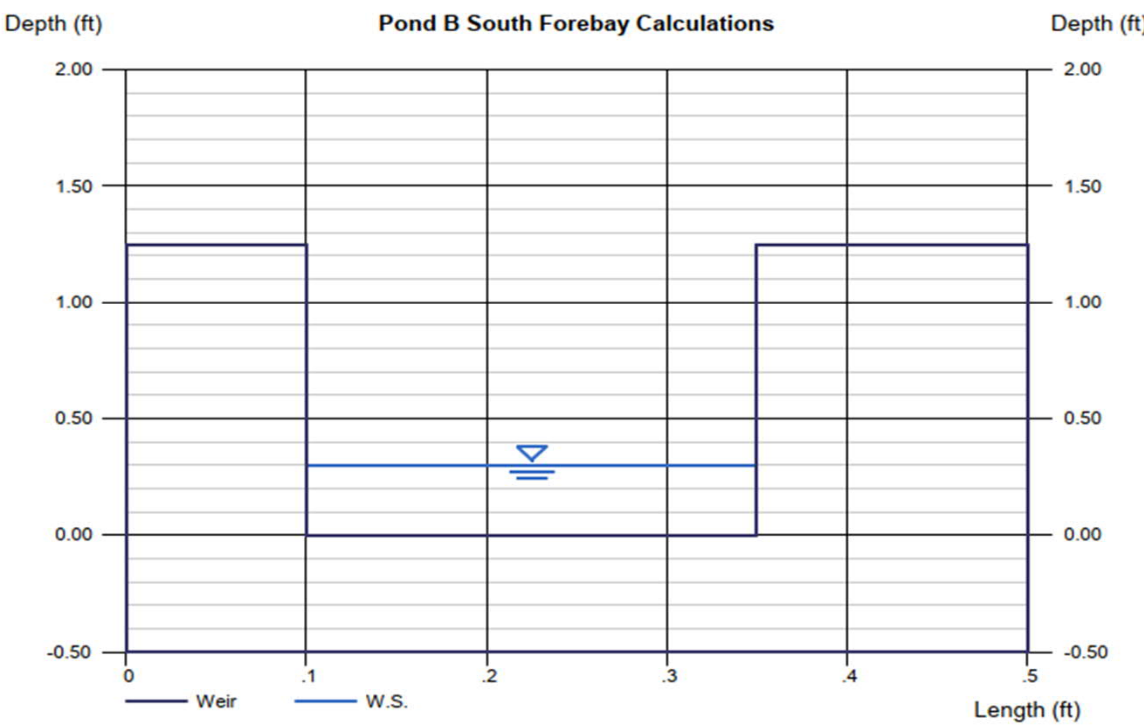
Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. — Wednesday, Nov 25 2020

Pond B South Forebay Calculations

Rectangular Weir
Crest = Sharp
Bottom Length (ft) = 0.25
Total Depth (ft) = 1.25

Calculations
Weir Coeff. Cw = 3.33
Compute by: Known Q
Known Q (cfs) = 0.13

Highlighted
Depth (ft) = 0.30
Q (cfs) = 0.134
Area (sqft) = 0.07
Velocity (ft/s) = 1.81
Top Width (ft) = 0.25



Detention Pond B North Forebay Calculations

100 YR Discharge	46.7	CFS
WQCV Storage	0.264	AC-FT
Forebay Volume (2% pf WQCV)	0.00528	AC-FT
Forebay Release Volume (2% of 100 YR)	0.934	CFS

Weir Report

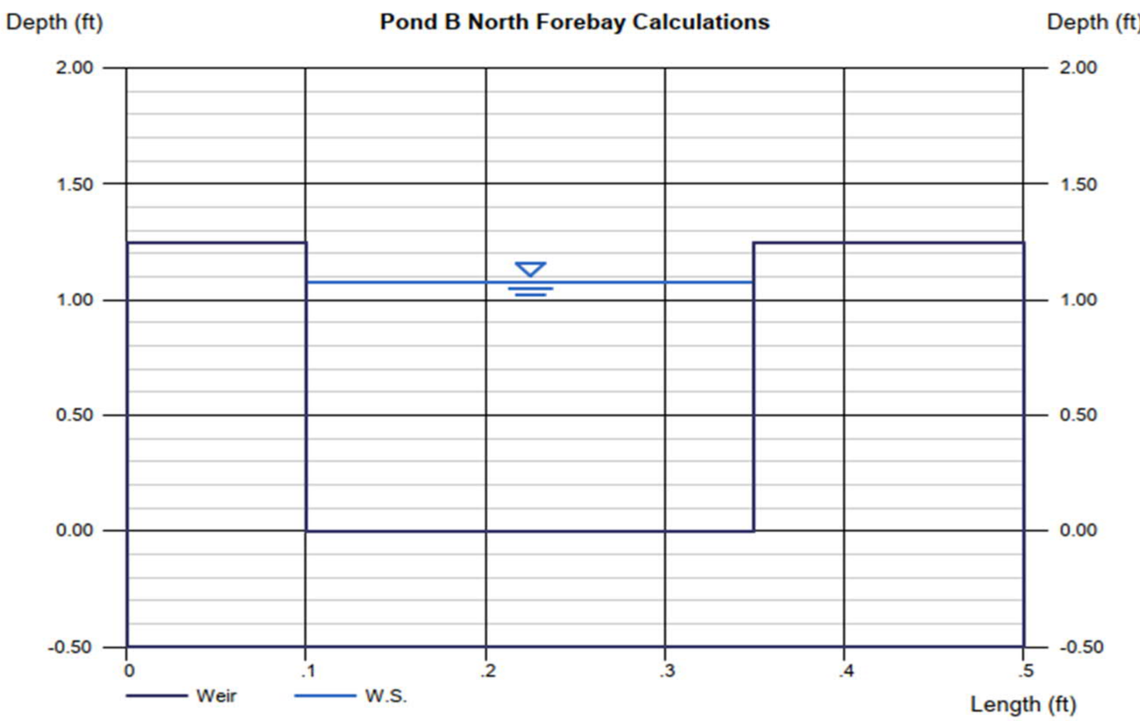
Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. — Wednesday, Nov 25 2020

Pond B North Forebay Calculations

Rectangular Weir
Crest = Sharp
Bottom Length (ft) = 0.25
Total Depth (ft) = 1.25

Calculations
Weir Coeff. Cw = 3.33
Compute by: Known Q
Known Q (cfs) = 0.93

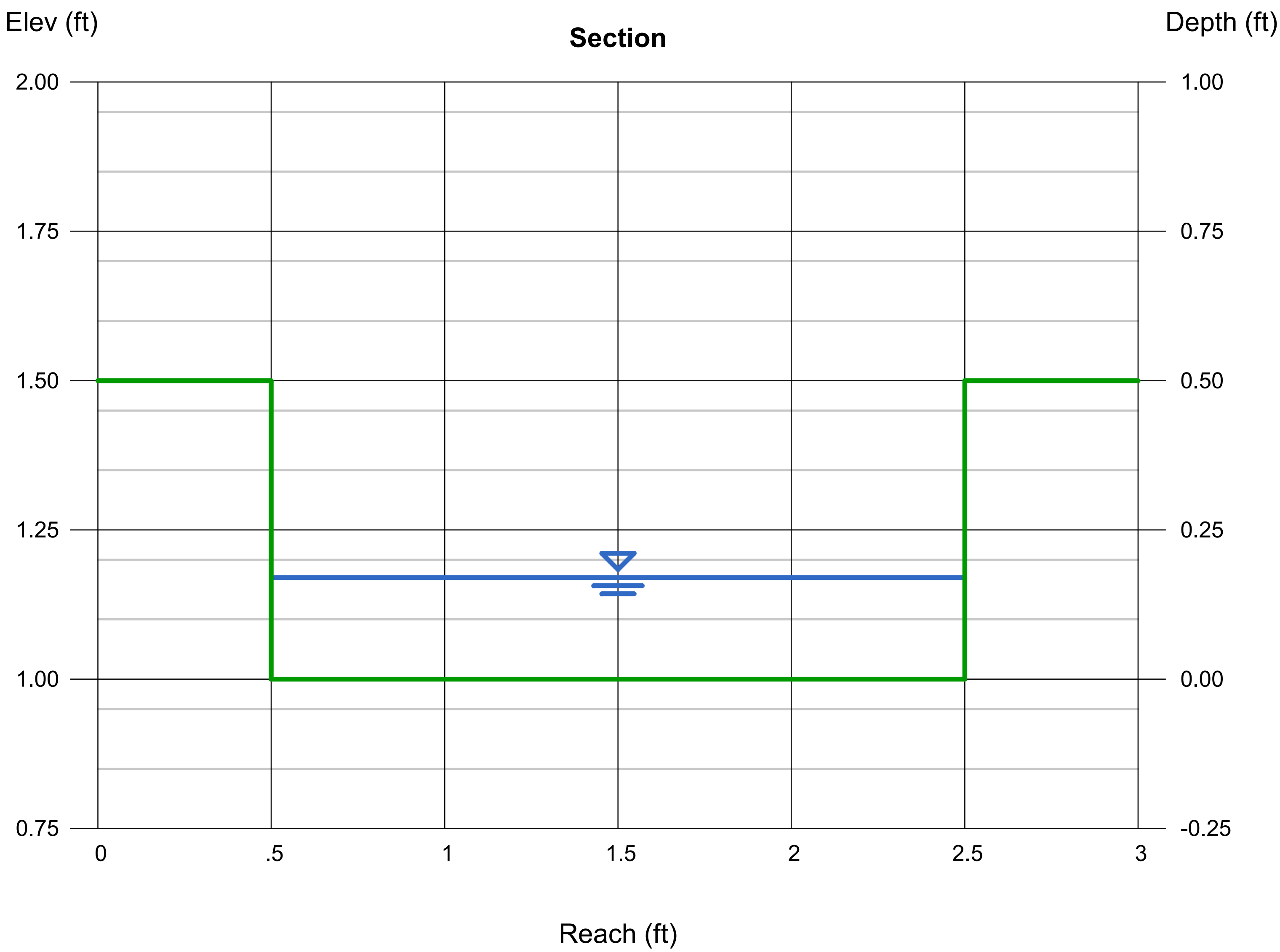
Highlighted
Depth (ft) = 1.08
Q (cfs) = 0.930
Area (sqft) = 0.27
Velocity (ft/s) = 3.46
Top Width (ft) = 0.25



Channel Report

Pond B Trickel Channel

Rectangular		**Highlighted**	
Bottom Width (ft)	= 2.00	Depth (ft)	= 0.17
Total Depth (ft)	= 0.50	Q (cfs)	= 1.060
		Area (sqft)	= 0.34
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 3.12
Slope (%)	= 1.00	Wetted Perim (ft)	= 2.34
N-Value	= 0.013	Crit Depth, Yc (ft)	= 0.21
		Top Width (ft)	= 2.00
Calculations		EGL (ft)	= 0.32
Compute by:	Known Q		
Known Q (cfs)	= 1.06		



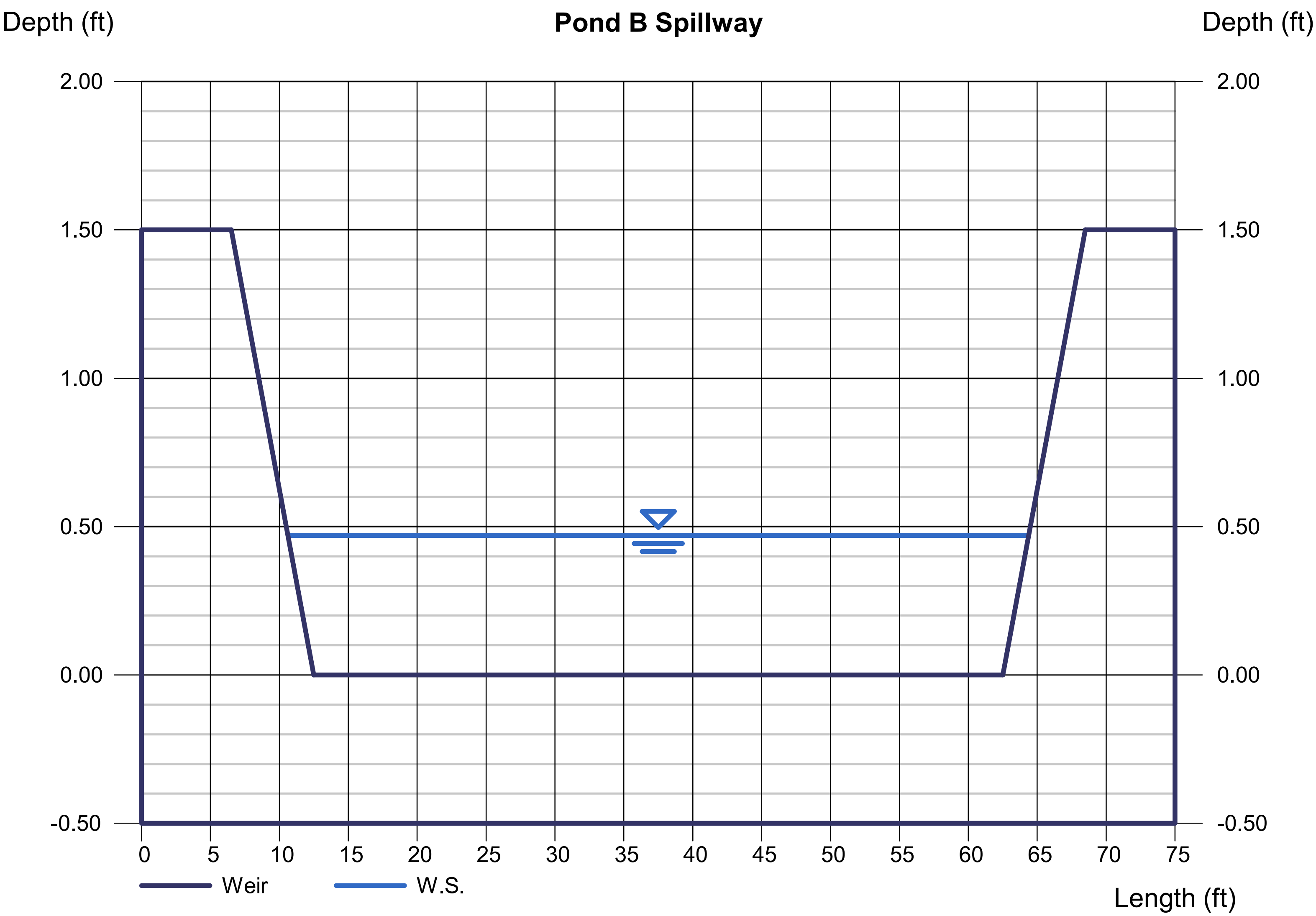
Weir Report

Pond B Spillway

Trapezoidal Weir
Crest = Sharp
Bottom Length (ft) = 50.00
Total Depth (ft) = 1.50
Side Slope (z:1) = 4.00

Calculations
Weir Coeff. Cw = 3.10
Compute by: Known Q
Known Q (cfs) = 51.30

Highlighted
Depth (ft) = 0.47
Q (cfs) = 51.30
Area (sqft) = 24.38
Velocity (ft/s) = 2.10
Top Width (ft) = 53.76



APPENDIX D

REFERENCE MATERIALS

Federal Emergency Management Agency
Washington, D.C. 20472

JAN 30 2007

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

The Honorable Sallie Clark
Chair, El Paso County
Board of Commissioners
27 East Vermijo Avenue
Colorado Springs, CO 80903

IN REPLY REFER TO:
Case No.: 05-08-0368P
Community Name: El Paso County, CO
Community No.: 080059
Effective Date of This Revision: MAY 23 2007

Dear Ms. Clark:

The Flood Insurance Study report and Flood Insurance Rate Map for your community have been revised by this Letter of Map Revision (LOMR). Please use the enclosed annotated map panel(s) revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals issued in your community.

Additional documents are enclosed which provide information regarding this LOMR. Please see the List of Enclosures below to determine which documents are included. Other attachments specific to this request may be included as referenced in the Determination Document. If you have any questions regarding floodplain management regulations for your community or the National Flood Insurance Program (NFIP) in general, please contact the Consultation Coordination Officer for your community. If you have any technical questions regarding this LOMR, please contact the Director, Federal Insurance and Mitigation Division of the Department of Homeland Security's Federal Emergency Management Agency (FEMA) in Denver, Colorado, at (303) 235-4830, or the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP). Additional information about the NFIP is available on our website at http://www.fema.gov/nfip.

Sincerely,

Patrick, F. Sacbibit, P.E., CFM, Project Engineer
Engineering Management Section
Mitigation Division

For: William R. Blanton Jr., CFM, Chief
Engineering Management Section
Mitigation Division

List of Enclosures:

- Letter of Map Revision Determination Document
- Annotated Flood Insurance Rate Map
- Annotated Flood Insurance Study Report

cc: The Honorable Lionel Rivera
Mayor, City of Colorado Springs

[redacted]
Regional Floodplain Administrator
Pikes Peak Regional Building Department

[redacted]
J. F. Sato and Associates, Inc.

[redacted]
Engineering and Surveying, Inc.

 | Issue Date: JAN 3 0 2007 | Effective Date: MAY 2 3 2007 | Case No.: 05-08-0368P | LOMR-APP

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT

COMMUNITY AND REVISION INFORMATION		PROJECT DESCRIPTION	BASIS OF REQUEST
COMMUNITY	El Paso County Colorado (Unincorporated Areas) COMMUNITY NO.: 080059	CHANNELIZATION CULVERT	FLOODWAY HYDRAULIC ANALYSIS NEW TOPOGRAPHIC DATA BASEMAP CHANGES
IDENTIFIER	Sand Creek Center Tributary and East Fork LOMR	APPROXIMATE LATITUDE & LONGITUDE: 38.846, -104.720 SOURCE: USGS QUADRANGLE DATUM: NAD 27	

ANNOTATED MAPPING ENCLOSURES			ANNOTATED STUDY ENCLOSURES
TYPE: FIRM*	NO.: 08041C0752 F	DATE: March 17, 1997	DATE OF EFFECTIVE FLOOD INSURANCE STUDY: August 23, 1999
TYPE: FIRM	NO.: 08041C0753 F	DATE: March 17, 1997	PROFILE(S): 206P
TYPE: FIRM	NO.: 08041C0754 F	DATE: March 17, 1997	FLOODWAY DATA TABLE: 5

Enclosures reflect changes to flooding sources affected by this revision.
* FIRM - Flood Insurance Rate Map; ** FBFM - Flood Boundary and Floodway Map; *** FHBM - Flood Hazard Boundary Map

FLOODING SOURCE(S) & REVISED REACH(ES)

Sand Creek Center Tributary – from approximately 1,350 feet upstream of East Frontage Road to just upstream of Galley Road

SUMMARY OF REVISIONS

Flooding Source	Effective Flooding	Revised Flooding	Increases	Decreases
Sand Creek Center Tributary	Zone AE	Zone AE	YES	YES
	Floodway	Floodway	YES	YES
	BFEs*	BFEs	NONE	YES
	Zone X (shaded)	Zone X (shaded)	YES	YES

* BFEs - Base Flood Elevations

DETERMINATION

This document provides the determination from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) regarding a request for a Letter of Map Revision (LOMR) for the area described above. Using the information submitted, we have determined that a revision to the flood hazards depicted in the Flood Insurance Study (FIS) report and/or National Flood Insurance Program (NFIP) map is warranted. This document revises the effective NFIP map, as indicated in the attached documentation. Please use the enclosed annotated map panels revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals in your community.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Patrick F. Sacbibit, P.E., CFM, Project Engineer
Engineering Management Section
Mitigation Division

109770 10.3.1.05080368 102-I-A-C

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

OTHER COMMUNITIES AFFECTED BY THIS REVISION

CID Number: 080060 **Name:** City of Colorado Springs, Colorado

AFFECTED MAP PANELS	AFFECTED PORTIONS OF THE FLOOD INSURANCE STUDY REPORT
TYPE: FIRM NO.: 08041C0753 F DATE: March 17, 1997 TYPE: FIRM NO.: 08041C0754 F DATE: March 17, 1997	DATE OF EFFECTIVE FLOOD INSURANCE STUDY: August 23, 1999 PROFILE(S): 205P, 206P, 209P, and 210P FLOODWAY DATA TABLE: 5

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Patrick F. Sacbibit, P.E., CFM, Project Engineer
Engineering Management Section
Mitigation Division

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION

APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION

We have made this determination pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (P.L. 93-234) and in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, P.L. 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. These criteria, including adoption of the FIS report and FIRM, and the modifications made by this LOMR, are the minimum requirements for continued NFIP participation and do not supersede more stringent State/Commonwealth or local requirements to which the regulations apply.

We provide the floodway designation to your community as a tool to regulate floodplain development. Therefore, the floodway revision we have described in this letter, while acceptable to us, must also be acceptable to your community and adopted by appropriate community action, as specified in Paragraph 60.3(d) of the NFIP regulations.

NFIP regulations Subparagraph 60.3(b)(7) requires communities to ensure that the flood-carrying capacity within the altered or relocated portion of any watercourse is maintained. This provision is incorporated into your community's existing floodplain management ordinances; therefore, responsibility for maintenance of the altered or relocated watercourse, including any related appurtenances such as bridges, culverts, and other drainage structures, rests with your community. We may request that your community submit a description and schedule of maintenance activities necessary to ensure this requirement.

COMMUNITY REMINDERS

We based this determination on the 1-percent-annual-chance flood discharges computed in the FIS for your community without considering subsequent changes in watershed characteristics that could increase flood discharges. Future development of projects upstream could cause increased flood discharges, which could cause increased flood hazards. A comprehensive restudy of your community's flood hazards would consider the cumulative effects of development on flood discharges subsequent to the publication of the FIS report for your community and could, therefore, establish greater flood hazards in this area.

Your community must regulate all proposed floodplain development and ensure that permits required by Federal and/or State/Commonwealth law have been obtained. State/Commonwealth or community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction or may limit development in floodplain areas. If your State/Commonwealth or community has adopted more restrictive or comprehensive floodplain management criteria, those criteria take precedence over the minimum NFIP requirements.

We will not print and distribute this LOMR to primary users, such as local insurance agents or mortgage lenders; instead, the community will serve as a repository for the new data. We encourage you to disseminate the information in this LOMR by preparing a news release for publication in your community's newspaper that describes the revision and explains how your community will provide the data and help interpret the NFIP maps. In that way, interested persons, such as property owners, insurance agents, and mortgage lenders, can benefit from the information.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Patrick F. Sacbibit, P.E., CFM, Project Engineer
Engineering Management Section
Mitigation Division

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Jeanine D. Petterson
Director, Federal Insurance and Mitigation Division
Federal Emergency Management Agency, Region VIII
Denver Federal Center, Building 710
P.O. Box 25267
Denver, CO 80225-0267
(303) 235-4830

STATUS OF THE COMMUNITY NFIP MAPS

We will not physically revise and republish the FIRM and FIS report for your community to reflect the modifications made by this LOMR at this time. When changes to the previously cited FIRM panel(s) and FIS report warrant physical revision and republication in the future, we will incorporate the modifications made by this LOMR at that time.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Patrick F. Sacbibit, P.E., CFM, Project Engineer
Engineering Management Section
Mitigation Division

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

PUBLIC NOTIFICATION OF REVISION

PUBLIC NOTIFICATION

FLOODING SOURCE	LOCATION OF REFERENCED ELEVATION	BFE (FEET NGVD 29)		MAP PANEL NUMBER(S)
		EFFECTIVE	REVISED	
Sand Creek Center Tributary	Approximately 1,350 feet upstream of East Frontage Road	6,170	6,165	08041C0753 F
	Just downstream of Terminal Avenue	6,216	6,213	08041C0754 F

Within 90 days of the second publication in the local newspaper, a citizen may request that we reconsider this determination. Any request for reconsideration must be based on scientific or technical data. Therefore, this letter will be effective only after the 90-day appeal period has elapsed and we have resolved any appeals that we receive during this appeal period. Until this LOMR is effective, the revised BFEs presented in this LOMR may be changed.

A notice of changes will be published in the *Federal Register*. This information also will be published in your local newspaper on or about the dates listed below.

LOCAL NEWSPAPER Name: *El Paso County News*
Dates: 02/14/2007 02/21/2007

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at http://www.fema.gov/nfip.

Patrick F. Sacbibit, P.E., CFM, Project Engineer
Engineering Management Section
Mitigation Division

CHANGES ARE MADE IN DETERMINATIONS OF BASE FLOOD ELEVATIONS FOR THE CITY OF COLORADO SPRINGS AND THE UNINCORPORATED AREAS OF EL PASO COUNTY, COLORADO, UNDER THE NATIONAL FLOOD INSURANCE PROGRAM

On March 17, 1997, the Department of Homeland Security's Federal Emergency Management Agency identified Special Flood Hazard Areas (SFHAs) in the City of Colorado Springs and in the unincorporated areas of El Paso County, Colorado, through issuance of a Flood Insurance Rate Map (FIRM). The Mitigation Division has determined that modification of the elevations of the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood) for certain locations in these communities is appropriate. The modified Base Flood Elevations (BFEs) revise the FIRM for the communities.

The changes are being made pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (Public Law 93-234) and are in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, Public Law 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65.

A hydraulic analysis was performed to incorporate new topographic data for Sand Creek Center Tributary from just upstream of Airport Road to just upstream of Galley Road and for Sand Creek East Fork from approximately 970 feet downstream of Powers Boulevard to just downstream of Stewart Avenue. This has resulted in a revised delineation of the regulatory floodway, increases and decreases in SFHA width, and increased and decreased BFEs for both aforementioned flooding sources. The table below indicates existing and modified BFEs for selected locations along the affected lengths of the flooding source(s) cited above.

Location	Existing BFE (feet)*	Modified BFE (feet)*
Sand Creek Center Tributary:		
[1]Approximately 150 feet upstream of Airport Road	6,109	6,108
[1]Approximately 1,250 feet upstream of East Frontage Road	6,168	6,164
[2]Approximately 1,350 feet upstream of East Frontage Road	6,170	6,165
[2]Just downstream of Terminal Avenue	6,216	6,213
Sand Creek East Fork:		
[1]Approximately 810 feet downstream of Powers Boulevard	6,099	6,096
[1]Approximately 140 feet downstream of Stewart Avenue	6,206	6,205

*National Geodetic Vertical Datum, rounded to nearest whole foot
[1]City of Colorado Springs
[2]Unincorporated areas of El Paso County

Under the above-mentioned Acts of 1968 and 1973, the Mitigation Division must develop criteria for floodplain management. To participate in the National Flood Insurance Program (NFIP), the community must use the modified BFEs to administer the floodplain management measures of the NFIP. These modified BFEs will also be used to calculate the appropriate flood insurance premium rates for new buildings and their contents and for the second layer of insurance on existing buildings and contents.

Upon the second publication of notice of these changes in this newspaper, any person has 90 days in which he or she can request, through the Chief Executive Officer of the community, that the Mitigation Division reconsider the determination. Any request for reconsideration must be based on knowledge of changed conditions or new scientific or technical data. All interested parties are on notice that until the 90-day period elapses, the Mitigation Division's determination to modify the BFEs may itself be changed.

Any person having knowledge or wishing to comment on these changes should immediately notify:

The Honorable Sallie Clark
Chair, El Paso County
Board of Commissioners
27 East Vermijo Avenue
Colorado Springs, CO 80903

OR

The Honorable Lionel Rivera
Mayor, City of Colorado Springs
P.O. Box 1575
Colorado Springs, CO 80901

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
						FEET (NGVD)		
Sand Creek East Fork								
A	1,100	100	455	11.9	6,038.7	6,038.7	6,038.7	0.0
B	2,400	100	446	12.2	6,054.3	6,054.3	6,054.3	0.0
C	3,330	100	450	12.0	6,069.9	6,069.9	6,069.9	0.0
D	4,240	100	449	12.1	6,085.1	6,085.1	6,085.1	0.0
E	4,870	102	446	12.0	6,095.1	6,095.1	6,095.1	0.0
F	6,188	70	489	10.9	6,118.5	6,118.5	6,118.5	0.0
G	7,403	71	396	13.5	6,136.0	6,136.0	6,136.0	0.0
H	7,931	148	507	10.5	6,158.8	6,158.8	6,158.8	0.0
I	8,943	98	444	12.0	6,169.0	6,169.0	6,169.0	0.0
J	9,666	86	423	12.6	6,177.0	6,177.0	6,177.0	0.0
K	10,721	81	415	12.8	6,193.3	6,193.3	6,193.3	0.0
L	11,347	166	526	10.1	6,207.3	6,207.3	6,207.3	0.0
M	11,375	173	632	8.4	6,207.9	6,207.9	6,207.9	0.0
N	12,610	367	699	7.6	6,228.8	6,228.8	6,228.9	0.1
O	13,720	188	570	10.0	6,241.7	6,241.7	6,241.7	0.0
P	14,805	125	479	11.1	6,257.9	6,257.9	6,257.9	0.0
Q	14,885	125	601	8.9	6,259.9	6,259.9	6,259.9	1.0
R	15,850	228	582	9.2	6,268.7	6,268.7	6,268.7	0.0
S	16,325	300	678	7.9	6,277.3	6,277.3	6,277.5	0.2
T	16,995	321	690	7.7	6,291.4	6,291.4	6,292.0	0.6
U	17,065	326	667	8.0	6,291.4	6,291.4	6,292.1	0.7
V	17,915	388	1,598	3.3	6,293.4	6,293.4	6,294.0	0.6
W	18,995	367	683	7.8	6,307.2	6,307.2	6,307.6	0.4
X	20,525	413	706	7.5	6,326.4	6,326.4	6,327.1	0.7
Y	22,125	255	620	8.6	6,348.7	6,348.7	6,348.8	0.1
Z	23,105	397	706	7.6	6,359.9	6,359.9	6,359.9	0.0
AA	24,835	431	705	7.4	6,383.7	6,383.7	6,383.7	0.0
AB	26,505	353	667	7.8	6,401.0	6,401.0	6,401.5	0.5

Revised Data

Revised by LOMR dated OCT 07 2004

[1] Feet above confluence with Sand Creek

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

SAND CREEK EAST FORK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET (NGVD))	WITH FLOODWAY (FEET (NGVD))	INCREASE
Sand Creek Center Tributary				Revised Data				
A	940	40	92	8.6	6,106.5	6,106.5	6,106.5	0.0
B	990	40	118	6.7	6,107.2	6,107.2	6,107.2	0.0
C	2,238	91	120	6.6	6,120.2	6,120.2	6,120.2	0.0
D	3,948	46	95	8.0	6,138.3	6,138.3	6,138.3	0.0
E	4,547	170	159	4.8	6,147.4	6,147.4	6,147.4	0.0
F	5,539	52	97	7.8	6,156.8	6,156.8	6,156.8	0.0
G	7,191	63	104	7.3	6,176.2	6,176.2	6,176.2	0.0
H	7,940	52	98	7.8	6,189.6	6,189.6	6,189.6	0.0
I	8,527	40	[illegible]	[illegible]	6,197.6	6,197.6	6,197.6	0.0
J	9,366	17	42	9.0	6,213.4	6,213.4	6,213.4	0.0
K	10,055	232	278	4.0	6,221.9	6,221.9	6,221.9	0.0
L	10,627	539	469	2.4	6,230.6	6,230.6	6,230.6	0.0
M	11,321	31	79	9.1	6,241.1	6,241.1	6,241.1	0.0
N	11,648	60	99	7.3	6,244.6	6,244.6	6,245.4	0.8
O	12,840	29	85	9.6	6,253.8	6,253.8	6,253.8	0.0
P	13,730	27	83	9.9	6,273.6	6,273.6	6,273.6	0.0
Q	14,592	26	68	9.3	6,299.7	6,299.7	6,299.7	0.0
R	14,670	40	61	6.9	6,304.2	6,304.2	6,305.2	1.0
S	15,050	20	63	10.1	6,307.6	6,307.6	6,308.1	0.5
T	15,460	25	68	9.5	6,310.8	6,310.8	6,311.4	0.6
U	15,750	20	41	7.8	6,319.6	6,319.6	6,319.6	0.0
V	16,670	20	39	8.1	6,346.0	6,346.0	6,346.0	0.0

Flow rate = 792 cfs

Flow rate = 822 cfs

[1] Feet Above confluence with Sand Creek East Fork

FEDERAL EMERGENCY MANAGEMENT AGENCY

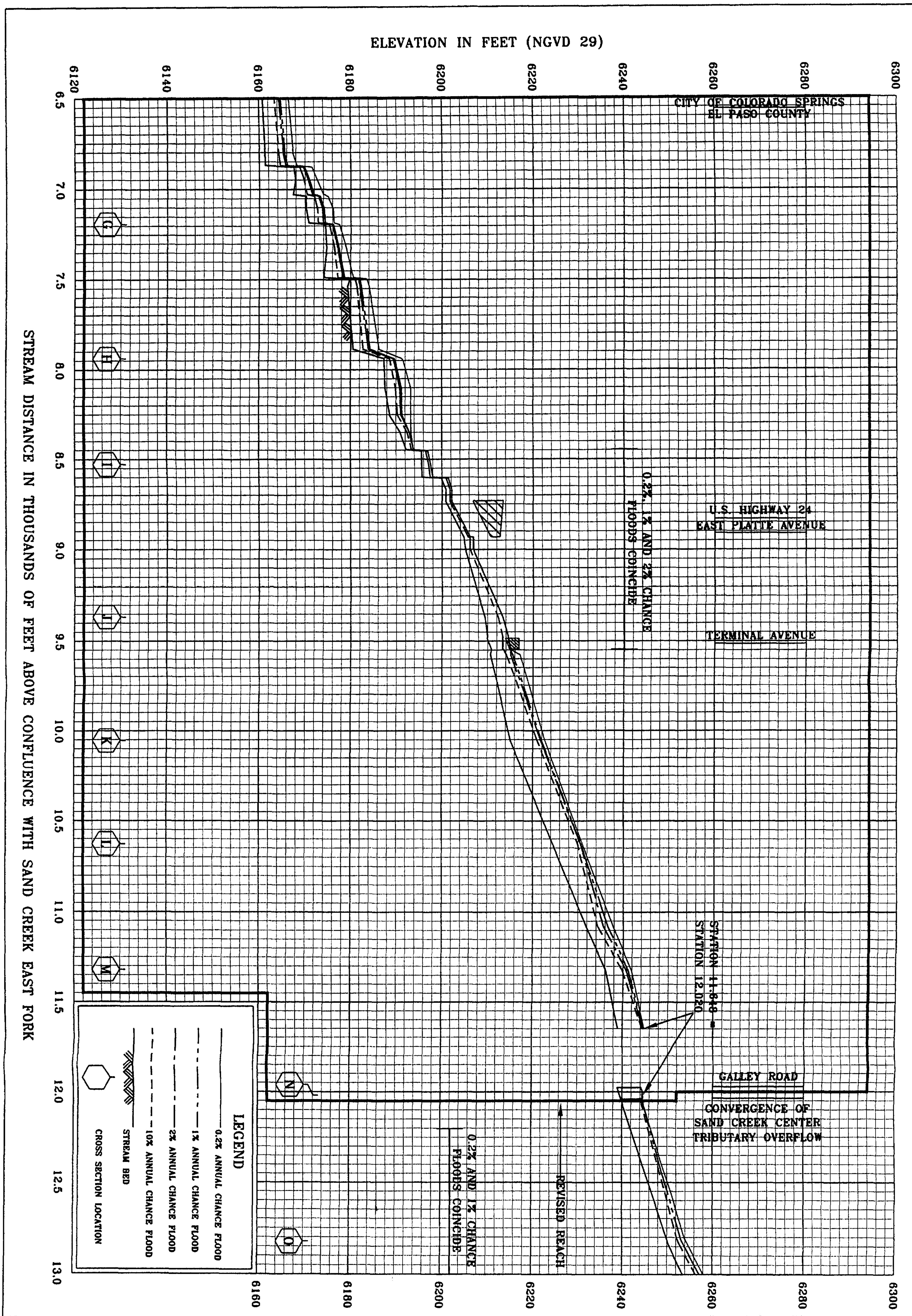
EL PASO COUNTY, CO

AND INCORPORATED AREAS

FLOODWAY DATA

Sand Creek Center Tributary

TABLE 5



206P

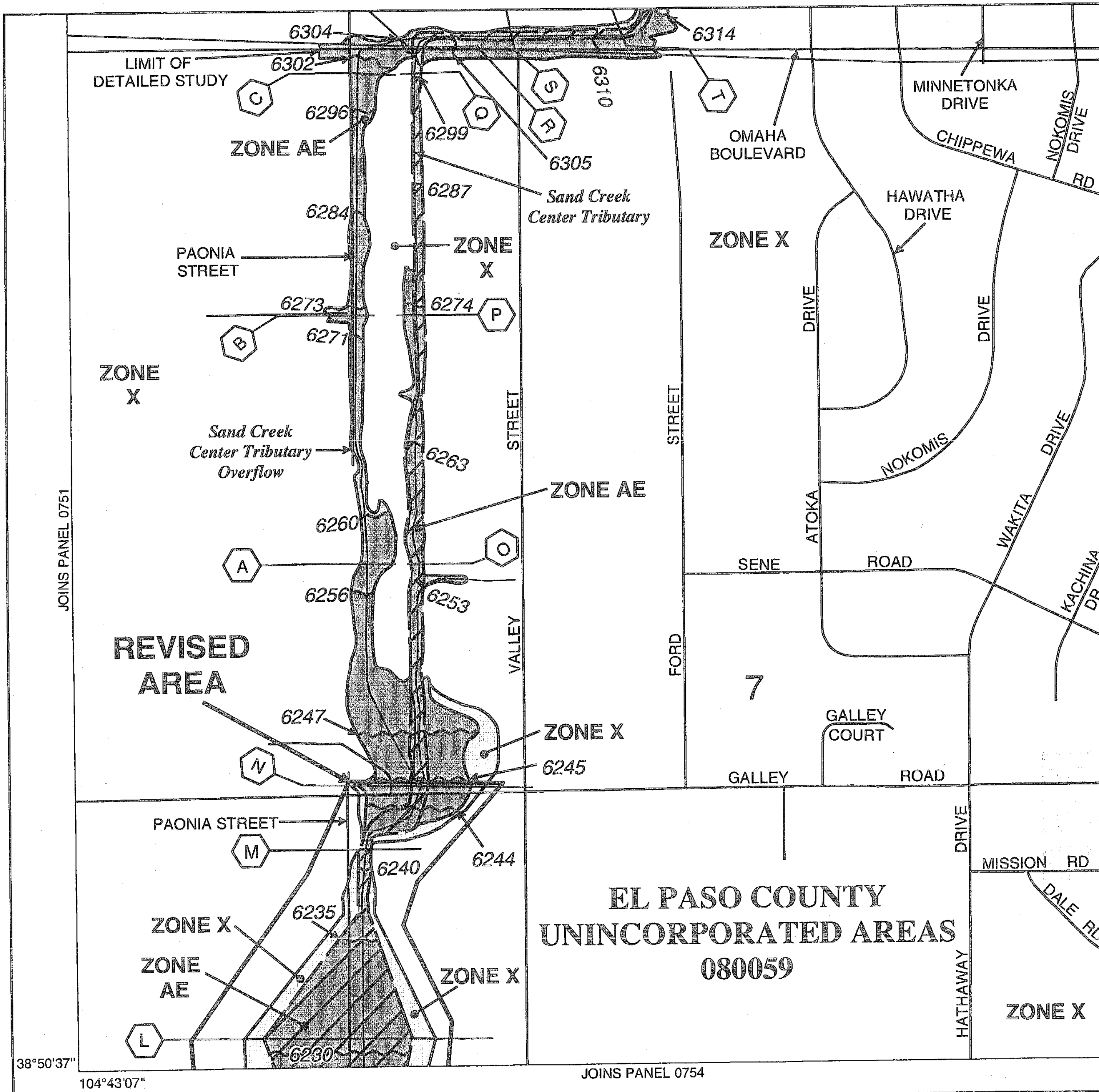
FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO
AND INCORPORATED AREAS

FLOOD PROFILES

SAND CREEK CENTER TRIBUTARY

MAY 23 2007



EL PASO COUNTY UNINCORPORATED AREAS 080059

Legend

- 1% annual chance (100-Year) Floodplain
- 1% annual chance (100-Year) Floodway
- 0.2% annual chance (500-Year) Floodplain

APPROXIMATE SCALE IN FEET

500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 752 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

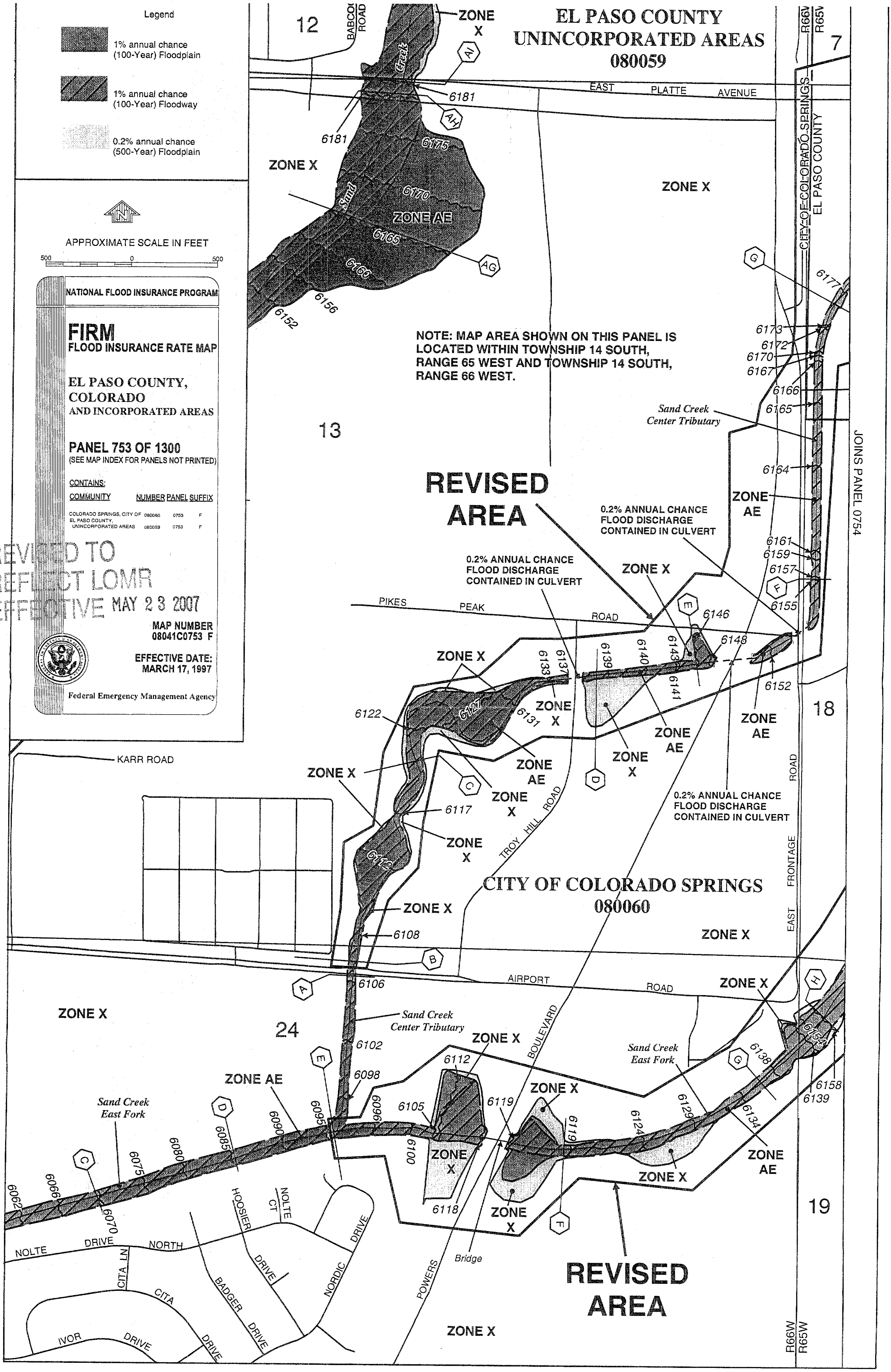
COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0752	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0752	F

MAY 2 8 2007

MAP NUMBER 08041C0752 F

EFFECTIVE DATE: MARCH 17, 1997

Federal Emergency Management Agency


Legend
1% annual chance
(100-Year) Floodplain
1% annual chance
(100-Year) Floodway
0.2% annual chance
(500-Year) Floodplain
APPROXIMATE SCALE IN FEET
500 0 500
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY,
COLORADO
AND INCORPORATED AREAS
PANEL 753 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
COLORADO SPRINGS, CITY OF 080060 0753 F
EL PASO COUNTY, UNINCORPORATED AREAS 080059 0753 F
REVISED TO
REFLECT LOMR
EFFECTIVE MAY 23 2007
MAP NUMBER
08041C0753 F
EFFECTIVE DATE:
MARCH 17, 1997
Federal Emergency Management Agency
EL PASO COUNTY
UNINCORPORATED AREAS
080059
CITY OF COLORADO SPRINGS
080060
NOTE: MAP AREA SHOWN ON THIS PANEL IS
LOCATED WITHIN TOWNSHIP 14 SOUTH,
RANGE 65 WEST AND TOWNSHIP 14 SOUTH,
RANGE 66 WEST.
REVISED
AREA
0.2% ANNUAL CHANCE
FLOOD DISCHARGE
CONTAINED IN CULVERT
ZONE X
ZONE AE
Sand Creek
Sand Creek
Center Tributary
Sand Creek
East Fork
EAST PLATTE AVENUE
PIKES PEAK ROAD
AIRPORT ROAD
KARR ROAD
TROY HILL ROAD
BABCOCK ROAD
EAST FRONTAGE ROAD
POWERS BOULEVARD
NOLTE DRIVE NORTH
NOLTE CT
HOOSIER DRIVE
BADGER DRIVE
NORDIC DRIVE
CITA LN
CITA DRIVE
IVOR DRIVE
Bridge
CITY OF COLORADO SPRINGS
EL PASO COUNTY
JOINS PANEL 0754
R66W
R65W
12
7
13
18
24
19
6181
6175
6170
6165
6160
6156
6152
6177
6173
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6105
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6158
AI
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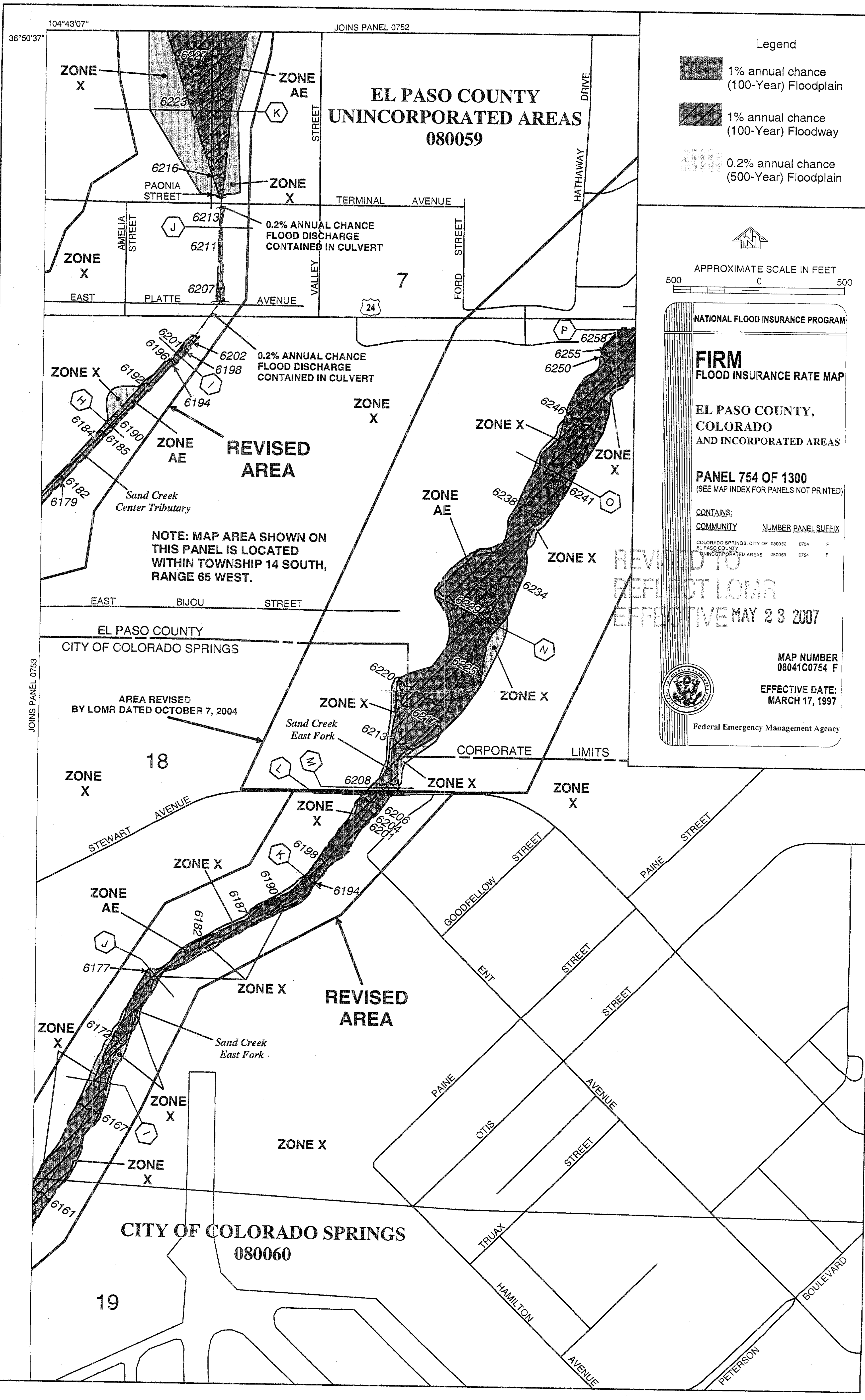
E
D
C
B
A
H

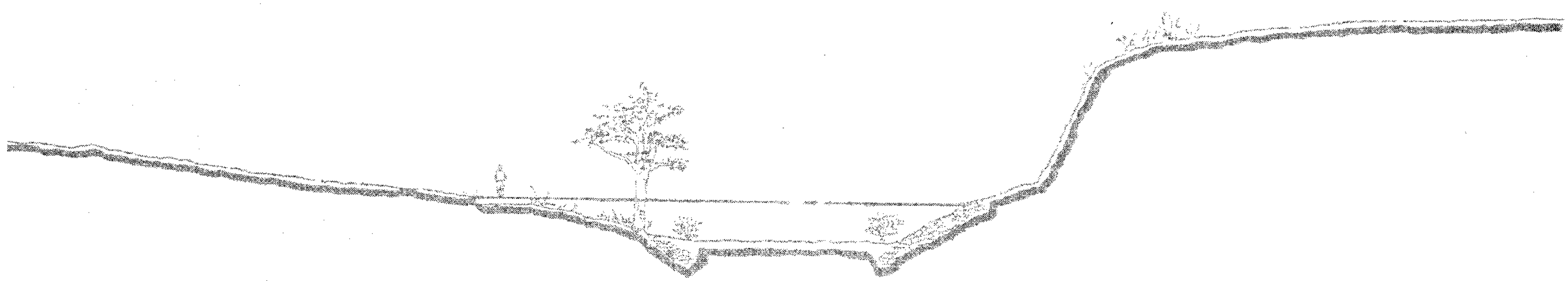


104°43'07"
38°50'37"
JOINS PANEL 0752
JOINS PANEL 0753
EL PASO COUNTY
UNINCORPORATED AREAS
080059
CITY OF COLORADO SPRINGS
080060
ZONE X
ZONE AE
PAONIA STREET
TERMINAL AVENUE
HATHAWAY DRIVE
AMELIA STREET
VALLEY STREET
FORD STREET
EAST PLATTE AVENUE
0.2% ANNUAL CHANCE FLOOD DISCHARGE CONTAINED IN CULVERT
REVISED AREA
Sand Creek Center Tributary
NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 14 SOUTH, RANGE 65 WEST.
EAST BIJOU STREET
EL PASO COUNTY
CITY OF COLORADO SPRINGS
AREA REVISED BY LOMR DATED OCTOBER 7, 2004
Sand Creek East Fork
CORPORATE LIMITS
STEWART AVENUE
GOODFELLOW STREET
PAINE STREET
ENT STREET
OTIS STREET
TRUAX
HAMILTON AVENUE
PETERSON BOULEVARD
7
18
19
Legend
1% annual chance (100-Year) Floodplain
1% annual chance (100-Year) Floodway
0.2% annual chance (500-Year) Floodplain
APPROXIMATE SCALE IN FEET
500 0 500
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO AND INCORPORATED AREAS
PANEL 754 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
REVISED TO REFLECT LOMR EFFECTIVE MAY 23 2007
MAP NUMBER 08041C0754 F
EFFECTIVE DATE: MARCH 17, 1997
Federal Emergency Management Agency

SAND CREEK DRAINAGE BASIN PLANNING STUDY

PRELIMINARY DESIGN REPORT

CITY OF COLORADO SPRINGS, EL PASO COUNTY, COLORADO



PREPARED FOR:

City of Colorado Springs
Department of Comprehensive Planning, Development and Finance
Engineering Division
30 S. Nevada
Colorado Springs, Colorado 80903

PREPARED BY:

Kiowa Engineering Corporation
1011 North Weber
Colorado Springs, CO 80903

SAND CREEK
DRAINAGE BASIN PLANNING STUDY

PRELIMINARY DESIGN REPORT

Prepared for:

City of Colorado Springs
Department of Comprehensive Planning, Development And Finance
Engineering Division - MAIL CODE 435
P.O. Box 1575
Colorado Springs, CO 80901-1575

Prepared by:

Kiowa Engineering Corporation
1001 North Weber #200
Colorado Springs, CO 80903

KIOWA Project No. 90.04.09
R185

JANUARY 1993
Revised APRIL 1993
Revised FEBRUARY 1995
Revised APRIL 1995
Revised OCTOBER 1995
Revised March 1996

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LIST OF FIGURES

Resolution No. 189-95

A RESOLUTION ADOPTING THE SAND CREEK DRAINAGE BASIN PLANNING STUDY AND ESTABLISHING A DRAINAGE FEE, A DETENTION POND CAPITAL FEE, A DETENTION POND LAND FEE, AND AN ARTERIAL BRIDGE FEE FOR THE BASIN.

WHEREAS, the City Engineering Division of the City of Colorado Springs Department of Planning and Development has reviewed the Sand Creek Drainage Basin Planning Study as prepared by Kiowa Engineering Corporation, Colorado Springs, Colorado dated November 2, 1995, and

WHEREAS, the City/County Drainage Board has recommended approval of the above study at their November 2, 1995, meeting;

WHEREAS, the Sand Creek Drainage Basin includes unplatted land within the City limits;

NOW THEREFORE, BE IT RESOLVED by the City Council of the City of Colorado Springs:

Section 1. That the Sand Creek Drainage Basin Planning Study, dated November 1995, by Kiowa Engineering Corporation is adopted for use. City Engineering will utilize that study to assist in evaluating subdivision drainage reports.

Section 2. That a Sand Creek Drainage Basin Fee be established as $4,895/acre, that a Sand Creek Detention Pond Capital Fee be established as $1,213/acre, that a Sand Creek Detention Pond Land Fee be established as $167/acre, and that a Sand Creek Arterial Bridge Fee be established as $323/acre, as part of.

Dated at Colorado Springs, Colorado, this 28th day of November, 1995.

Mayor

ATTEST:

City Clerk

ENGINEER'S STATEMENT:

The attached SAND CREEK DRAINAGE BASIN PLANNING STUDY report was prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the City for drainage reports. I accept responsibility for any liability caused by any negligent acts, errors and omissions on my part in preparing this report.

Kiowa Engineering Corporation, 1011 North Weber St., Suite 200, Colorado Springs, CO 80903

Registered Engineer #19310 Date 7/22/96

I. INTRODUCTION

Authorization

The preliminary design of the drainageway and roadway crossing facilities within the Sand Creek Drainage Basin was authorized under the terms of Agreement Number 90-85 between the City of Colorado Springs (City) and Kiowa Engineering Corporation. The agreement was approved by the Colorado Springs City Council, April 10, 1990. Subsequent to this agreement, a change order to the contract to allow for the inclusion of technical information contained in the draft East Fork Sand Creek Drainage Basin Planning Study was approved July, 1993.

Purpose and Scope

The purpose of the study is to identify feasible stormwater management plans to satisfy the existing and future needs within the Sand Creek Drainage Basin. The Sand Creek basin is to be referred to throughout this study and is inclusive of the Sand Creek mainstem and East Fork Sand Creek watersheds. The specific scope of work for this study included the following tasks:

1. Meet with the City to: insure compliance with the services required by this agreement, obtain existing data and general information from participating entities, solicit desires of participating entities and other interested agencies or groups in order to develop alternate plans, procure current information relative to development plans in the basin, procure information relative to right-of-way limitations, proposed stormwater projects, potential hazards due to flooding, and avoid duplication of effort whenever possible by utilizing existing information available from other agencies.
2. Contact the City, County, individuals, and other agencies who have knowledge and/or interest in the study area.
3. Utilize City policies and criteria and applicable information wherever possible.
4. Perform hydraulic and hydrologic analyses within the study area.
5. Identify environmental setting of basin.
6. Identify existing and potential drainage and/or flooding problems.
7. Develop improvement alternatives to reduce existing and potential flooding problems, and to mitigate the impact of stormwater runoff upon environmentally significant areas along the drainageway(s).
8. Examine the operation and maintenance aspects of feasible alternatives.
9. Conduct an economic analysis of each alternative.
10. Recommend and prepare a preliminary design for a selected alternative plan.
11. Develop drainage and bridge fees for the basin.
12. Prepare a written report discussing all items examined in the study.
13. Conduct presentations to public and private entities in order to define project goals, and to involve agencies with specific interest to help define feasible alternatives.

Summary of Data Obtained

Listed below are the technical reports collected for the review as part of preparing this study:

1. Soil Survey for El Paso County, Colorado, dated June 1981.
2. "City of Colorado Springs/El Paso County Drainage Criteria Manual", prepared by City of Colorado Springs, El Paso County, and HDR Infrastructure, Inc., dated May 1987.
3. "Flood Insurance Studies for Colorado Springs, and El Paso County, Colorado", prepared by the Federal Emergency Management Agency (FEMA), revised 1989.
4. Flood Insurance Restudy, Hydrology Report and Hydrologic Analyses, prepared by RCI, Inc., 1989.
5. Sand Creek Drainage Basin Planning Study prepared by Simons, Li & Associates, Inc., dated July, 1985.
6. Flood Hazard Analysis, Sand Creek, City of Colorado Springs and El Paso County, Colorado, prepared by the Soil Conservation Service, dated December, 1973.
7. Banning-Lewis Ranch Master Drainage Plan, prepared by MSM Consultants, Inc., dated June 1981.
8. Sand Creek Drainage Basin Study, prepared by United Planning and Engineering Company, October, 1977.
9. Draft East Fork Sand Creek Drainage Basin Planning Study, prepared by Kiowa Engineering Corporation, January, 1989.
10. Drainage Basin Inventory, Sand Creek Drainage Basin, prepared by Oliver E. Watts, P.E., June 1990.

In addition to the above listed reports there were a number of drainage study reports, sketch plans, preliminary and final design drawings, land use and zoning maps, development plans, and existing drainage facility maps that were collected from the City, County, and other local agencies.

Reports which were prepared previous to the preliminary design report include the "Sand Creek Drainage Basin Planning Study Hydrology Report," and the "Sand Creek Drainage Basin Planning Study Development of Alternatives Report." These reports were prepared as part of the overall planning effort and have been referred to throughout this report. The Hydrology Report summarized peak flow data for existing and future basin development conditions without improvements in the basin, and established the base line hydrologic conditions from which the alternative planning then proceeded. The Development of Alternatives report evaluated the various combinations of drainageway improvements for the basin, taking into account environmental, cost, construction, right-of-way, maintenance and implementation factors for each feasible alternate plan. These reports are on file with the City Engineering Division, as well as technical addenda for each report. Both of these reports covered only the mainstem of the Sand Creek Basin. The similar information prepared for the draft East Fork Sand Creek Drainage Basin Planning Study has been summarized in this preliminary design report.

Mapping and Surveying

Mapping used in the planning effort for the mainstem of Sand Creek consisted of USGS 7-1/2 minute quadrangles, and 2-foot contour interval, 1-inch to 200-foot scale planimetric topographic maps. For the area of the basin north of Woodmen Road, aerial topographic mapping was compiled in May 1990. For the balance of the basin, the City of Colorado Springs Department of Public Utilities provided topographic mapping compiled from aerial photographs dated 1989. This mapping has been prepared as part of the Facility Inventory Management System (FIMS). The aerial topographic mapping was used in the drainage inventory, hydrologic/hydraulic analyses, and in the alternative planning phases of this project. All topographic mapping was based upon USGS vertical datum.

For the East Fork Sand Creek basin, mapping from the FIMS office and two-foot contour interval topography prepared in 1987 for the Banning-Lewis Ranch property were used in the preparation of the preliminary design. Where topographic mapping was not available, USGS quadrangle maps were used.

Stream cross-section data was obtained from the aerial mapping described above. These sections were verified against the cross-sections compiled in the 1986 City of Colorado Springs Flood Insurance Study (FIS), wherever possible.

Drainageway site inspections were conducted throughout the study area, and photographs were taken documenting the key drainage features.

The following general conditions have been placed upon the use of the FIMS topographic mapping:

-- Use of these products is restricted to the project for which the FIMS products are provided.

-- Only the body content found within the neatline of the borrowed maps may appear in any report/publication developed for your study. Also, the labeling that appears on any photographs provided shall not appear in any such report/publication.

-- All FIMS' products provided to contractors involved in the subject study shall be retrieved by your department upon conclusion of the study and either returned to FIMS or destroyed.

-- The report(s) developed in which the FIMS' products are used shall include the following disclaimer statement:

"The maps and photographs included in this report were developed for purposes of the Colorado Springs Department of Utilities and are for internal use only. The Colorado Springs Department of Utilities makes no warranty, expressed or implied, as to the completeness, accuracy, or content of such products or any reproductions thereof. Any other use is not recommended and occurs at the risk of the user; such user is solely responsible and/or liable for the use of such products.

Original maps and photographs are the property of the Colorado Springs Department of Utilities. All rights are reserved. These maps and photographs or any associated record may not, wholly or in part, be reproduced, stored, or transmitted in any form or by any means, electronic, mechanical, photocopying, or otherwise, without the express prior written permission of the Colorado Springs Department of Utilities.

Regardless of the existence of purported copies of these official maps and photographs which may from time to time be made or published, there is only one set of official maps and photographs, which are those kept and maintained by the Colorado Springs Department of Utilities."

Project Coordination

Throughout the course of the study, meetings were held with representatives of City, County, State, and Federal agencies with an interest in drainageway planning in general. The primary reason for the coordination effort was to obtain technical information and to identify concerns with regard to the development of drainageway facilities within the basin. During the course of preparing the Development of Alternatives report, the planning constraints and concepts were discussed with the agencies and interested individuals and their input used to refine the feasible alternatives and to eventually identify a recommended drainageway plan for further design evaluation. The complete mailing list and project correspondence is contained in Appendix A of this report.

Coordination with a similar list of agencies and individuals was conducted during the preparation of the draft East Fork Sand Creek Drainage Basin Planning study. This study was authorized and conducted for Aries Properties, Inc. Meetings with state and federal agencies, the City and the County were involved in a series of meetings during the development of the alternative planning concepts and the preliminary design for the East Fork Sand Creek basin.

Acknowledgements

During the preparation of the study, several government agencies and interested individuals were routinely involved in the coordination activities. Representatives from the Colorado Division of Wildlife, U.S. Army Corps of Engineers (COE), and various City Departments provided valuable commentary during the development of the alternative plans. A listing of the individuals and agencies routinely coordinated with during the study has been presented below:

Name	Agency
Alan Morrice	El Paso County Department of Public Works
John Fisher	El Paso County Land Use Department
Sue Johnson	El Paso County Parks Department
Rick O'Connor	El Paso County Planning Department
Hugh King	City of Colorado Springs Street Division
Gary Haynes	City Engineering Division
Bruce Thorson	City Engineering Division
Ken Sampley	City Engineering Division
Steve Jacobsen	City Engineering Division
Christine Lytle	City Engineering Division
Bruce Goforth	Colorado Division of Wildlife
Dan Bunting	Regional Building Department
Sarah Fowler	Environmental Protection Agency
John Liou	Federal Emergency Management Agency
Dave Frick	RCI, Inc., Fort Collins, Colorado
Bill Noonan	U.S. Fish and Wildlife
Anita Culp	U.S. Army Corps of Engineers
John Maynard	Aiken/Audobon Society
John Covert	Palmer Foundation
Peter Kernkamp	City Planning Department
Jim Rees	Department of Planning and Development
Fred Mais	City Parks and Recreation
Diana Medina	City of Colorado Springs Department of Public Utilities Gas Division
Dan Tippie	City of Colorado Springs Department of Public Utilities Wastewater Division
Russ Nicklin	City of Colorado Springs Department of Public Utilities Water Division
Wes Tyson	City Attorney's Office

II. STUDY AREA DESCRIPTION

The Sand Creek drainage basin is a left-bank tributary to the Fountain Creek lying in the west-central portions of El Paso County. Sand Creek's drainage area at Fountain Creek is approximately 54 square miles of which approximately 18.8 square miles are inside the City of Colorado Springs corporate limits. The basin is divided into five major sub-basins, the Sand Creek mainstem, the East Fork Sand Creek, the Central Tributary to East Fork, the West Fork, and the East Fork Subtributary. Figure II-1 shows the location of the Sand Creek basin.

Basin Description

The Sand Creek basin covers a total of 54 square miles in unincorporated El Paso County and Colorado Springs, Colorado. Of this total, approximately 28 square miles is encompassed by the Sand Creek basin, and 26 square miles for the East Fork Sand Creek basin. The basin trends in generally a south to southwesterly direction, entering the Fountain Creek approximately two miles upstream of the Academy Boulevard bridge over Fountain Creek. Two main tributaries drain the basin, those being the mainstem of Sand Creek and East Fork Sand Creek. Development presence in most evident along the mainstream. At this time, approximately 25 percent of the basin is developed. This alternative evaluation focuses upon the Sand Creek basin only.

The maximum basin elevation is approximately 7,620 feet above mean sea level, and falls to approximately 5,790 feet at the confluence with Fountain Creek. The headwaters of the basin originate in the conifer covered areas of The Black Forest. The middle eastern portions of the basin are typified by rolling range land with fair to good vegetative cover associated with semi-arid climates.

Climate

This area of El Paso County can be described, in general as high plains, with total precipitation amounts typical of a semi-arid region. Winters are generally cold and dry. Precipitation ranges from 14 to 16 inches per year, with the majority of this precipitation occurring in spring and summer in the form of rainfall. Thunderstorms are common during the summer months, and are typified by quick-moving low pressure cells which draw moisture from the Gulf of Mexico into the region. Average temperatures range from about 30°F in the winter to 75° in the summer. The relative humidity ranges from about 25 percent in the summer to 45 percent in the winter.

Soils and Geology

Soils within the Sand Creek basin vary between soil types A through D, as identified by the U. S. Department of Agriculture, Soil Conservation Service. The predominant soil groupings are in the Truckton and Bresser soil associations. The soils consist of deep, well drained soils that formed in alluvium and residium, derived from sedimentary rock. The soils have high to moderate infiltration rates, and are extremely susceptible to wind and water erosion where poor vegetation cover exists. In undeveloped areas, the predominance of Type A and B soils give this basin a lower runoff per unit area as compared to basins with soils dominated by Types C and D. Presented on Figure II-2 is the Hydrologic Soil distribution map for the Sand Creek basin.

Property Ownership and Impervious Land Densities

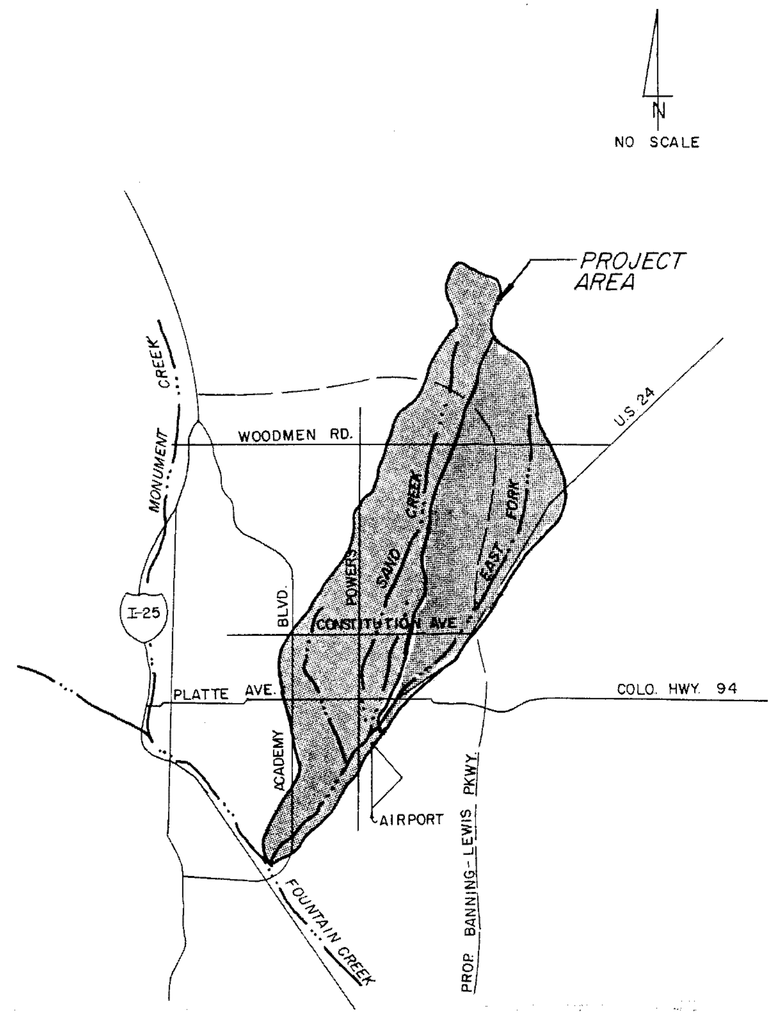
Property ownership along the major drainageway within the Sand Creek basin vary from public to private. Along the developed reaches, drainage right-of-ways and greenbelts have been dedicated during the development of the adjacent residential and commercial land. Where development has not occurred, the drainageways remain under private ownership with no delineated drainage right-of-way or easements. There are several public parks which abut the mainstem of Sand Creek. Roadway and utility easements abutting or crossing the major drainageways occur most frequently in the developed portions of the basin.

Land use information for the existing and future conditions were reviewed as part of the planning effort. This information is used in the hydrologic analysis to predict runoff rates and volumes for the purposes of facility evaluation. The identification of land uses abutting the drainageways is also useful in the identification of feasible plans for stabilization and aesthetic treatment of the creek. Presented on Figure II-3 is the proposed land use map used in the evaluation of impervious land densities discussed in the hydrologic section of this report. Figure II-3 is not intended to reflect the future zoning or land use policies of the City or the County.

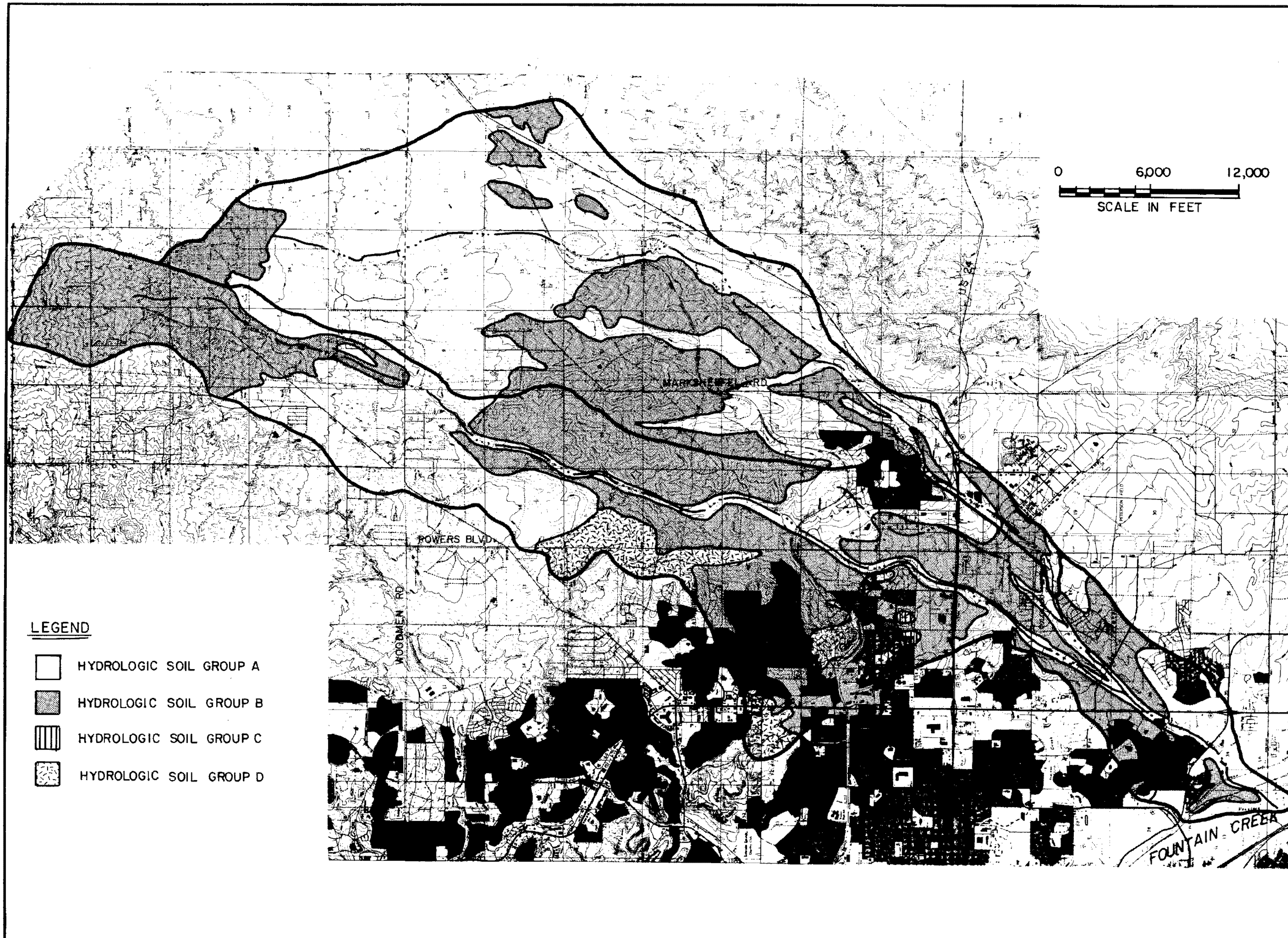
The land use information within the Banning-Lewis Ranch property was obtained from Aries Properties during the time the draft East Fork Sand Creek Drainage Basin Planning Study was being prepared. The land use information was again reviewed with the City of Colorado Springs Department of Planning and was found to be appropriate for use in the estimation of hydrology for the East Fork Basin. The location of future arterial streets and roadways within the Banning Lewis property were obtained from the Banning-Lewis Ranch master plan. The location of roadways offsite from the Banning Lewis-Ranch were obtained from the El Paso County Major Transportation Plan dated 1988.

Park Land and Open Space

An inventory of park land and public open space was prepared. Many times, the combination of the drainageway and adjacent park lands can be used to visually extend the limits of a park or open space. The drainageway can also act to link parks and other land uses within the basin if multiple use trails are incorporated into the channel section(s). The Sand Creek drainageway has been identified as a major trail corridor within the City of Colorado Springs Trails Plan. Park land designated within the Banning-Lewis Ranch master plan were taken into account during the siting of stormwater facilities within the Banning-Lewis property.



VICINITY MAP
FIGURE II-1



Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

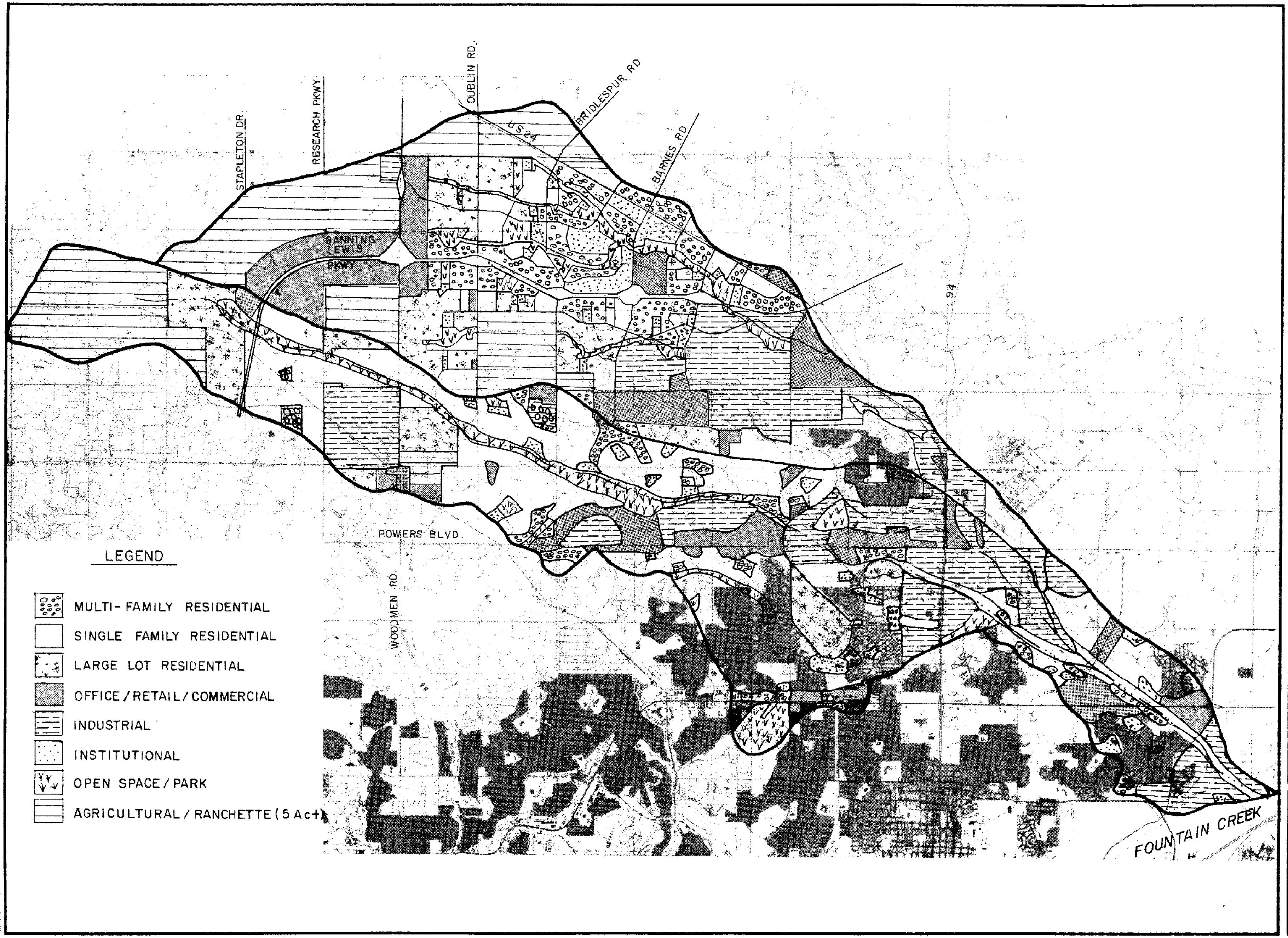
SAND CREEK DRAINAGE
BASIN PLANNING STUDY

HYDROLOGIC SOILS MAP

Project No.	90-04-09
Date:	10/90
Design:	
Drawn:	EAK
Check:	
Revisions:	

6

FIG. II-2



Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

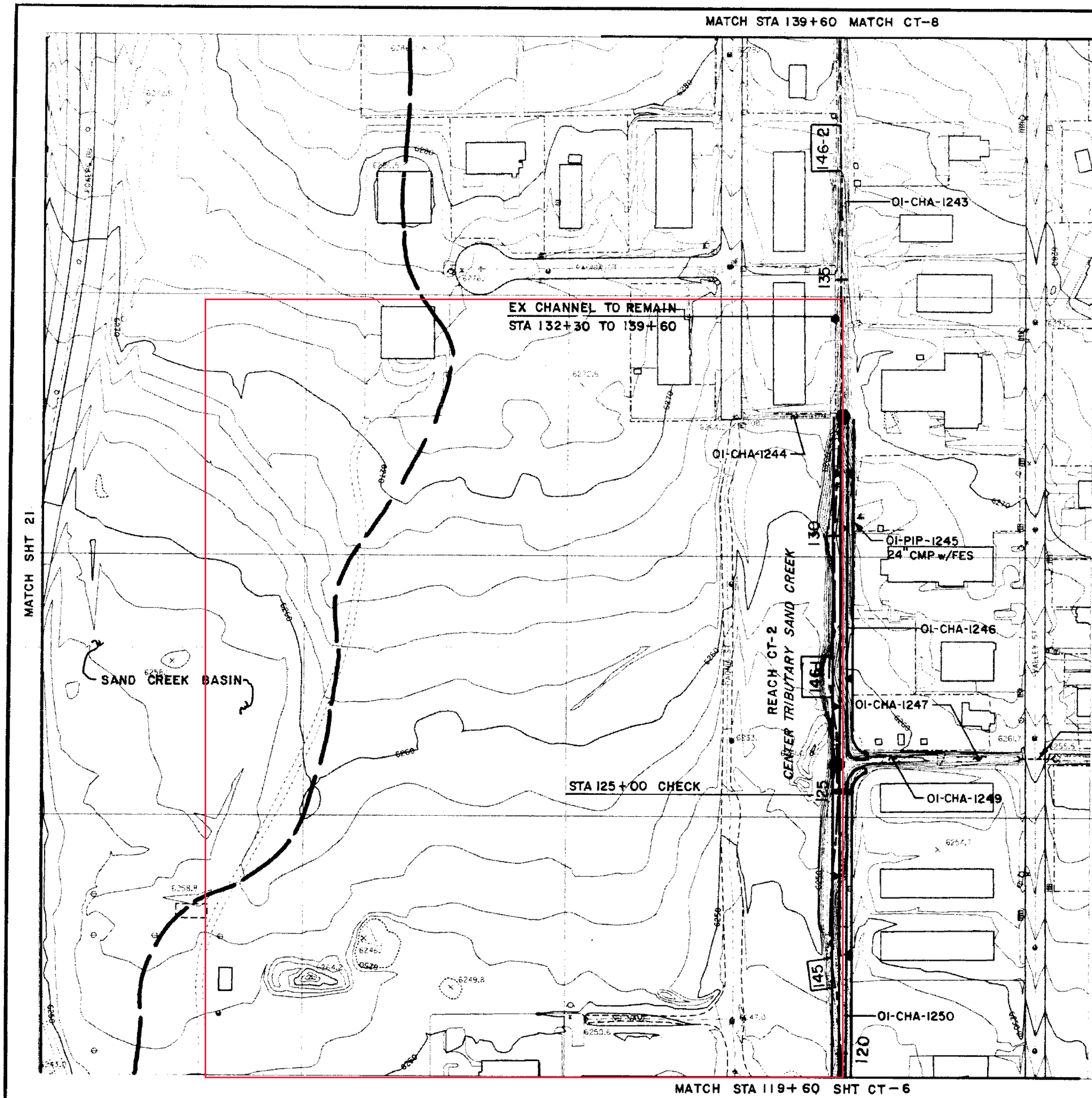
SAND CREEK DRAINAGE BASIN PLANNING STUDY

PROPOSED LAND USE

Project No. 90-04-09
Date: 9/90
Design:
Drawn: EAK
Check:
Revisions:

7

FIG. II-3



THIS DRAWING IS A MASTER PLANNING SHEET REPRESENTING PRELIMINARY AND CONCEPTUAL ENGINEERING. IT SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.

CHANNEL IMPROVEMENTS

SEGMENT NO.	BOTTOM WIDTH (FT)	CHANNEL TYPE
145	16	100-YEAR Conc. CHANNEL, 4' DEPTH
146-1	10	"
146-2	N/A	EXISTING CHANNEL TO REMAIN

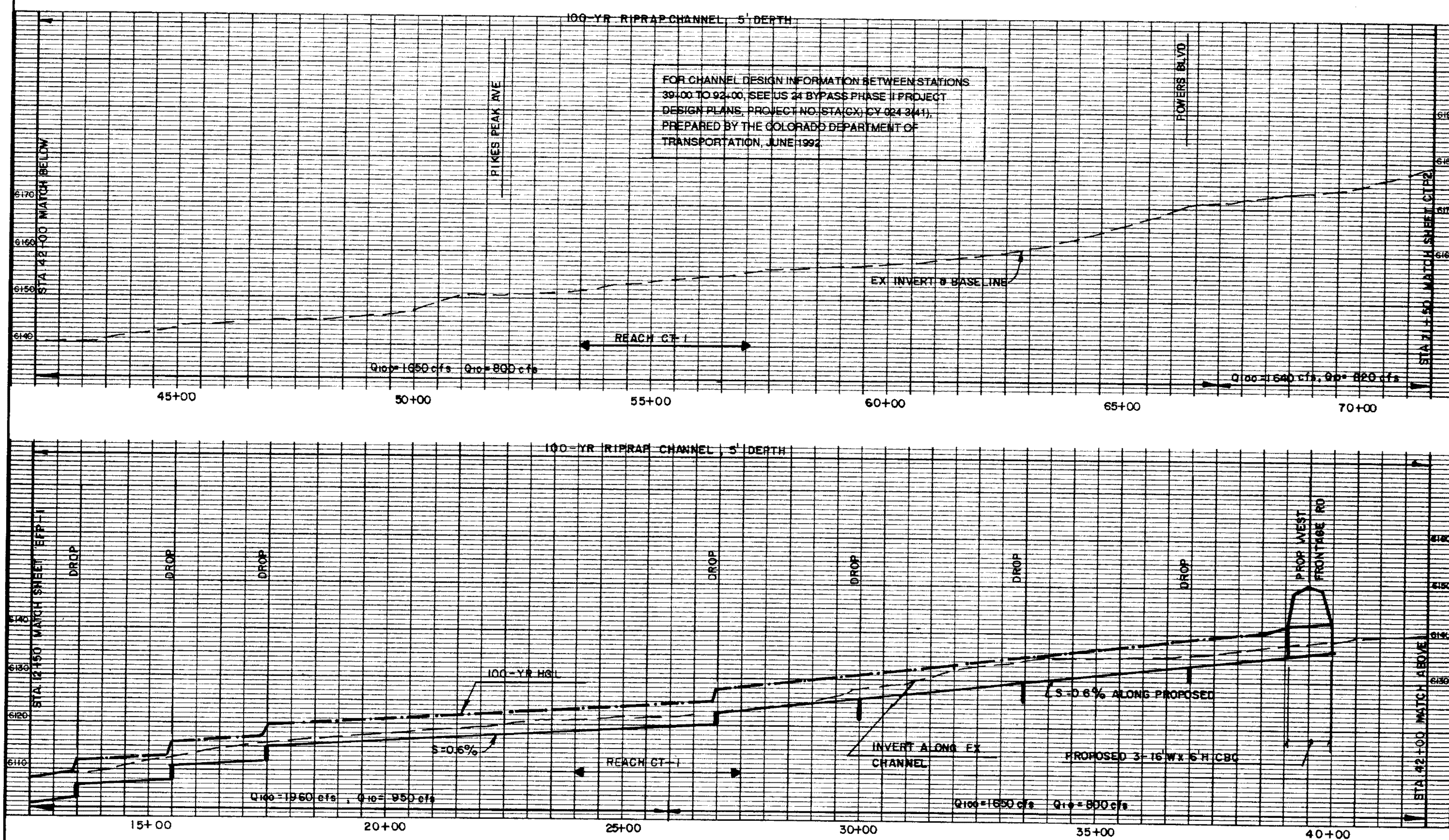
FOR PROFILE SEE SHEETS CTP-2 AND CTP-3

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

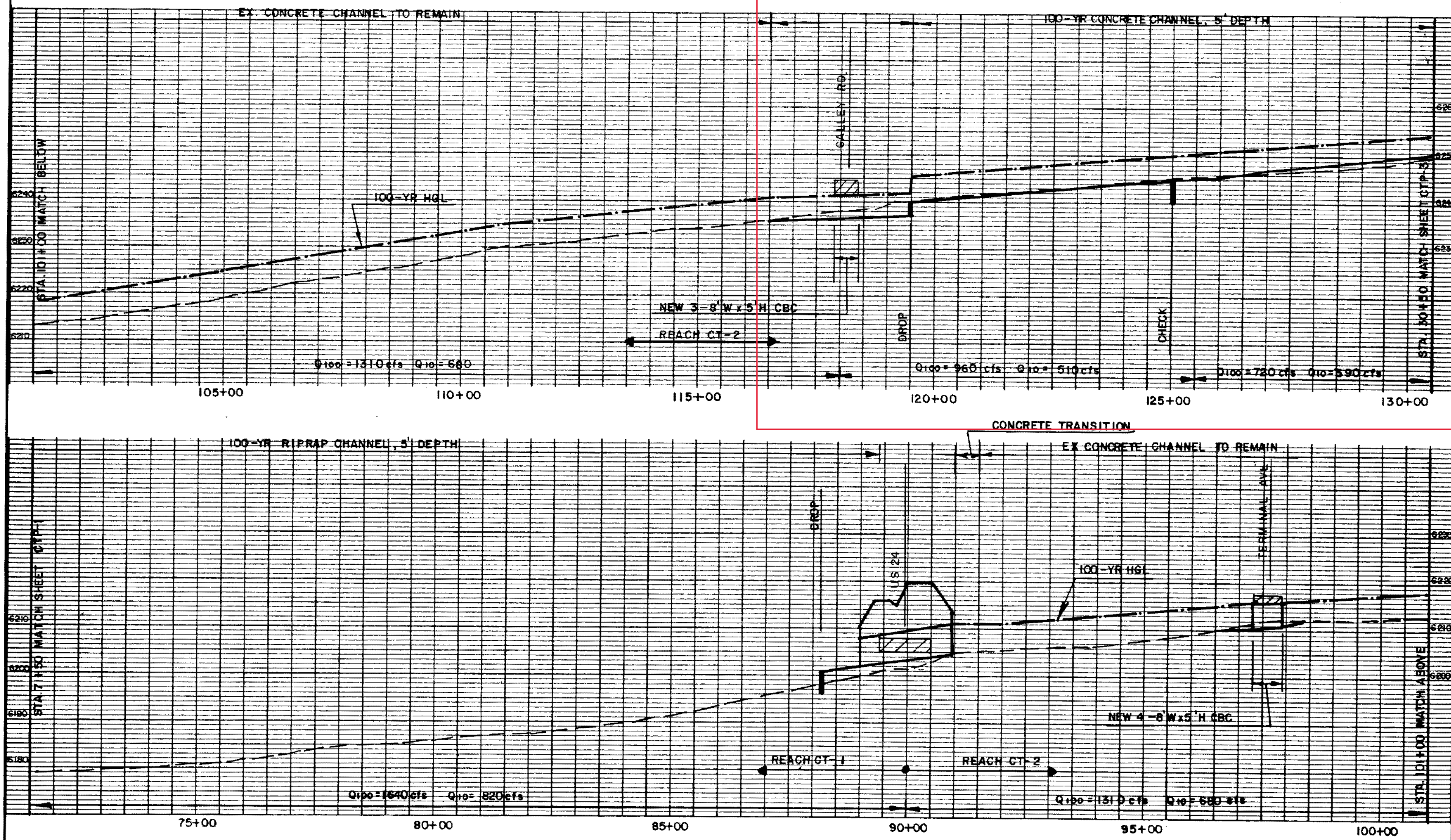
SAND CREEK DRAINAGE BASIN PLANNING STUDY
PRELIMINARY DESIGN PLANS

Project No 90-04-09
Date: 9/92
Design: RNW
Drawn: EAK
Check: RNW
Revisions:

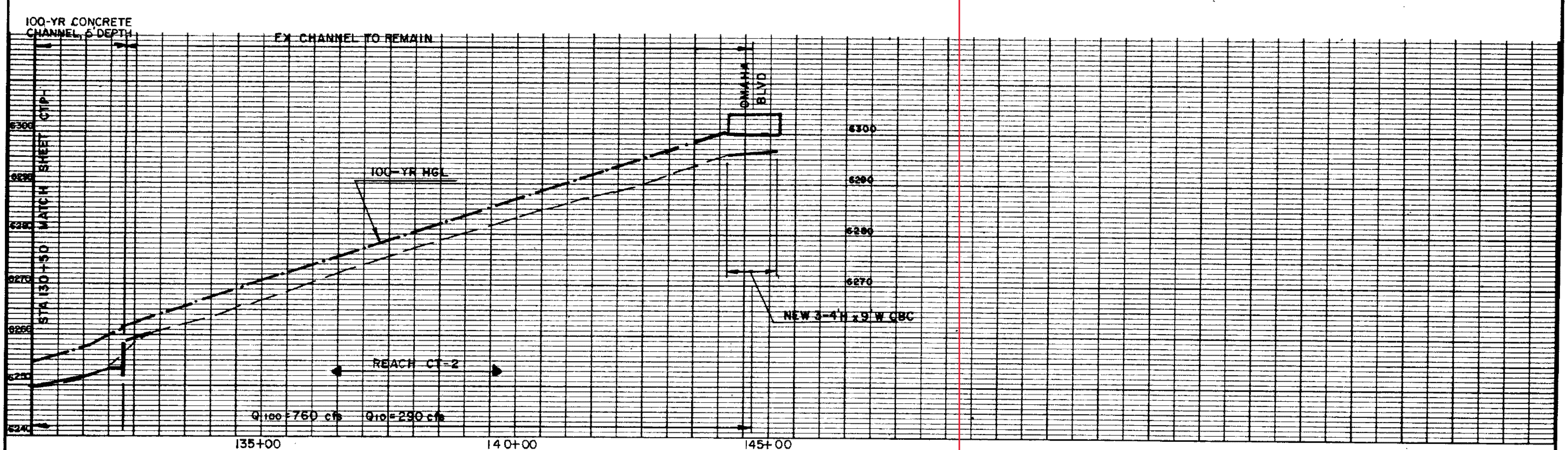
CT-7



Kiowa Engineering Corporation	DESIGNED RNW DATE CHECKED JYC DATE DRAWN EAK DATE 7/92 REVISED DATE	SAND CREEK DRAINAGE BASIN PLANNING STUDY PRELIMINARY DESIGN PROFILES	CITY OF COLORADO SPRINGS EL PASO COUNTY, COLORADO	CENTER TRIBUTARY SAND CREEK Station 12+50 to 71+50	CTP-1



Kiowa Engineering Corporation	DESIGNED RNW DATE CHECKED JYC DATE DRAWN EAK DATE 7/92 REVISED DATE	SAND CREEK DRAINAGE BASIN PLANNING STUDY PRELIMINARY DESIGN PROFILES	CITY OF COLORADO SPRINGS EL PASO COUNTY, COLORADO	CENTER TRIBUTARY SAND CREEK Station 71+50 to 130+50	CTP-2



Kiowa Engineering Corporation

DESIGNED RNW DATE /92
CHECKED JYC DATE /92
DRAWN EAK DATE 7/92
REVISED DATE

SAND CREEK DRAINAGE BASIN PLANNING STUDY
PRELIMINARY DESIGN PROFILES

CITY OF COLORADO SPRINGS
EL PASO COUNTY, COLORADO

CENTER TRIBUTARY SAND CREEK
Station 130+50 to 144+50

CTP-3

TABLE VIII-4: SAND CREEK DRAINAGE BASIN PLANNING STUDY
ROADWAY CULVERT CROSSING COST ESTIMATE
SAND CREEK BASINS

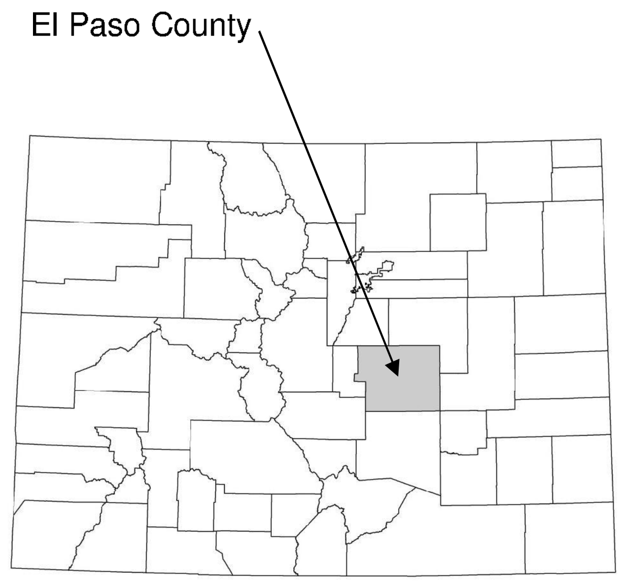
ROADWAY	REACH NUMBER	DRAINAGEWAY SEGMENT	CROSSING TYPE	LENGTH	UNIT	UNIT COST	TOTAL COST	TOTAL REIMBURSABLE COST
BANNING-LEWIS PRKW	SC-8	186	6'Hx10'W CBC	120	LF	$390	$46,800	$46,800
ARROYO LANE	SC-9	171	6'Hx12'W CBC	80	LF	$510	$40,800	$0
VOLLMER ROAD	SC-8	169	60-INCH CMP	80	LF	$120	$9,600	$0
"	SC-9	173	"	80	LF	$120	$9,600	$0
BURGESS ROAD	SC-9	176	42-INCH CMP	80	LF	$75	$6,000	$0
"	SC-9	178	2-42-INCH CMP	80	LF	$150	$12,000	$0
		CENTER TRIBUTARY						
TERMINAL AVENUE	CT-2	144	4-5'Hx8'W CBC	60	LF	$1,200	$72,000	$0
OMAHA BOULEVARD	CT-2	146-2	3-4'Hx9'W CBC	80	LF	$900	$72,000	$0
		WEST FORK SAND CREEK						
WOOTEN ROAD	WF-1	153	2-4'Hx6'W CBC	100	LF	$480	$48,000	$0
EDISON AVENUE	WF-1	153	2-4'Hx6'W CBC	60	LF	$240	$14,400	$0
PALMER PARK BLVD.	WF-1	154-2	2-4'Hx10'W CBC	80	LF	$540	$43,200	$0
CHICAGO RI RR	WF-1	165-1	4'Hx8'W CBC	220	LF	$270	$59,400	$0
HALF MOON DRIVE	WF-1	165-2	4'Hx6'W CBC	60	LF	$240	$14,400	$0
TOTAL CULVERT CONSTRUCTION COSTS, SAND CREEK							$1,902,600	$1,111,000

Table VIII-7: SAND CREEK DRAINAGE BASIN PLANNING STUDY
BRIDGE CROSSING COST ESTIMATE
SAND CREEK DRAINAGE BASINS

ROADWAY	REACH NUMBER	DRAINAGEWAY SEGMENT	CROSSING TYPE	JURISDICTION CITY	JURISDICTION COUNTY	SIZE	UNIT	UNIT COST	TOTAL COST COUNTY	TOTAL COST CITY
		SAND CREEK								
CHELTON ROAD	SC-1	115	210' TWO-SPAN BRIDGE	X		16800	SF	$80	$0	$1,344,000
STETSON HILLS BLVD.	SC-6	130	3- 8'Hx10'W CBC	X		200	LF	$1,110	$0	$222,000
JEDEDIAH SMITH RD.	SC-6	137	3- 8'Hx10'W CBC	X		60	LF	$1,110	$0	$66,600
PETERSON ROAD	SC-6	141	80' CLEAR SPAN BRIDGE	X		6400	SF	$80	$0	$512,000
DUBLIN BOULEVARD	SC-7	141	80' CLEAR SPAN BRIDGE	X		6400	SF	$80	$0	$512,000
MARKSHEFFEL ROAD	SC-8	151	3- 10'Hx10'W CBC		X	80	LF	$1,260	$100,800	$0
RESEARCH PARKWAY	SC-8	163	4- 8'Hx10'W CBC		X	80	LF	$1,560	$124,800	$0
BANNING-LEWIS PRKWY	SC-8	187	4- 8'Hx10'W CBC		X	80	LF	$1,560	$124,800	$0
		CENTER TRIBUTARY								
W. FRONTAGE ROAD	CT-1	142	3- 6'Hx16'W CBC		X	60	LF	$1,770	$106,200	$0
US 24 BYPASS	CT-1	142	3- 6'Hx14'W CBC		X	150	LF	$1,410	$211,500	$0
E. FRONTAGE RD, US 24	CT-1	142	3- 6'Hx14'W CBC		X	60	LF	$1,410	$84,600	$0
BIJOU STREET, US 24	CT-1	142	3- 6'Hx14'W CBC		X	60	LF	$1,410	$84,600	$0
PLATTE AVENUE, US 24	CT-2	142	3- 6'Hx14'W CBC		X	120	LF	$1,410	$169,200	$0
GALLEY ROAD	CT-4	144	3- 5'Hx8'W CBC		X	100	LF	$900	$90,000	$0
		WEST FORK SAND CREEK								
GALLEY ROAD	WF-2	155	54' CLEAR SPAN BRIDGE	X		5130	SF	$80	$0	$410,400
PALMER PARK BLVD.	WF-2	156	54' CLEAR SPAN BRIDGE	X		5130	SF	$80	$0	$410,400
CONSTITUTION AVE.	WF-3	159	40' CLEAR SPAN BRIDGE	X		3200	SF	$80	$0	$256,000
MAIZELAND ROAD	WF-3	170	30' CLEAR SPAN BRIDGE	X		2400	SF	$80	$0	$192,000
SO. CAREFREE	WF-3	170	2- 6'Hx15'W CBC	X		80	LF	$1,200	$0	$96,000
TOTAL BRIDGE CONSTRUCTION COSTS, SAND CREEK									$1,096,500	$4,021,400

FLOOD INSURANCE STUDY

EL PASO COUNTY, COLORADO, AND INCORPORATED AREAS



COMMUNITY NAME	COMMUNNITY NUMBER
CALHAN, TOWN OF	080192
COLORADO SPRINGS, CITY OF	080060
EL PASO COUNTY (UNINCORPORATED AREAS)	080059
FOUNTAIN, CITY OF	080061
GREEN MOUNTAIN FALLS, TOWN OF	080062
MANITOU SPRINGS, CITY OF	080063
MONUMENT, TOWN OF	080064
PALMER LAKE, TOWN OF	080065
RAMAH, TOWN OF	080066

Revised: December 7, 2018

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER 08041CV007A

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) report may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

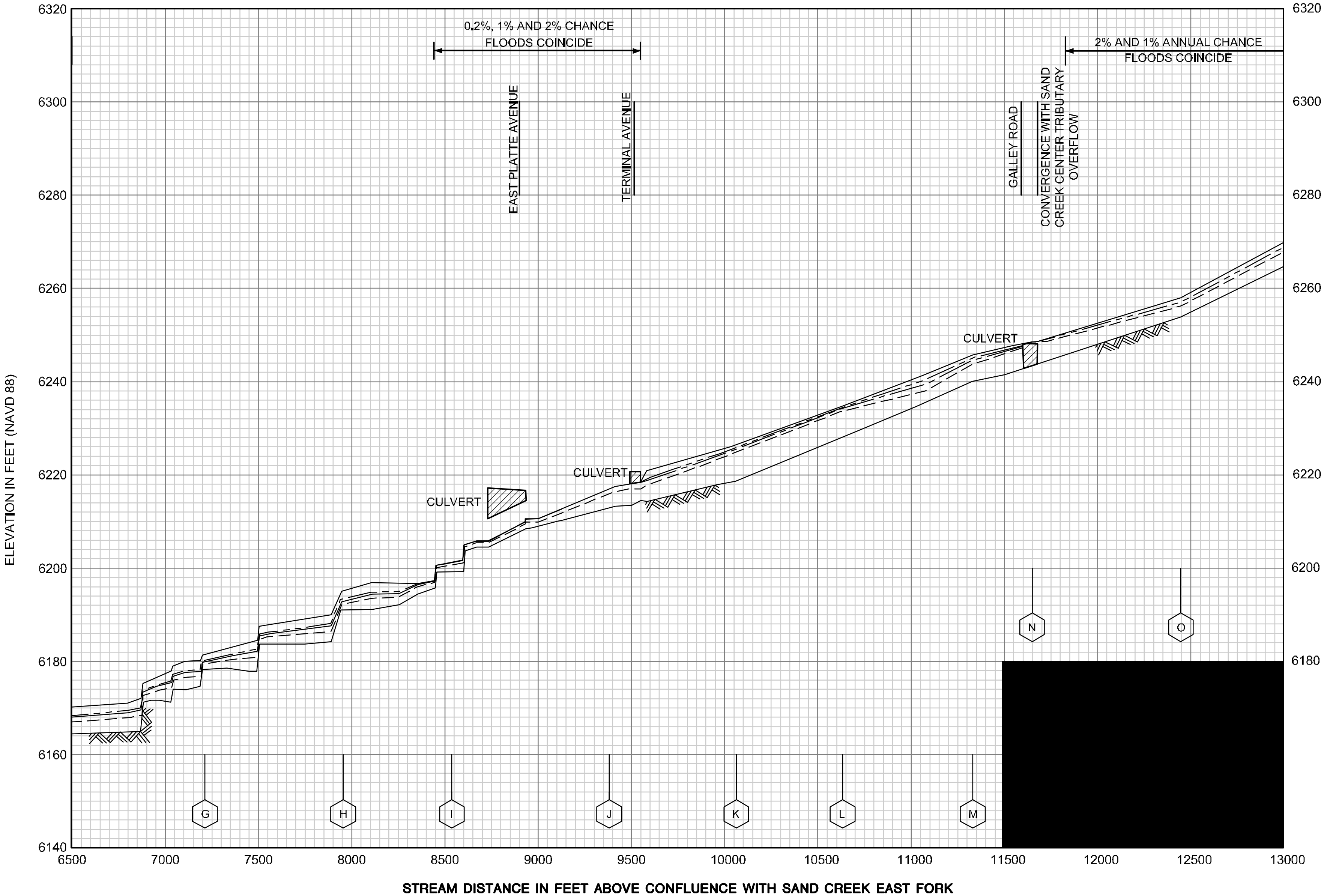
Part or all of this FIS report may be revised and republished at any time. In addition, part of this FIS report may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS report. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS report components.

This FIS report was revised on December 7, 2018. Users should refer to Section 10.0, Revisions Description, for further information. Section 10.0 is intended to present the most up-to-date information for specific portions of this FIS report. Therefore, users of this report should be aware that the information presented in Section 10.0 superseded information in Sections 1.0 through 9.0 of this FIS report.

Initial Countywide FIS Report Effective Date: March 17, 1997

First Revised Countywide FIS Report Effective Date: August 23, 1999 - to add base flood elevations, to add special flood hazard areas, and to change special flood hazard areas.

Second Revised Countywide FIS Report Effective Date: December 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.



FLOOD PROFILES

SAND CREEK CENTER TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO

(AND INCORPORATED AREAS)

335P

SAND CREEK - CENTER TRIBUTARY
CHANNEL ANALYSIS REPORT
FOR
SOLACE APARTMENTS

Prepared For:
Jackson Dearborn Partners
404 S. Wells Street, Suite 400
Chicago, IL 60607
(734) 216-2577

June 30, 2020
Project No. 25174.00

Prepared By:
JR Engineering, LLC
5475 Tech Center Drive
Colorado Springs, CO 80919
719-593-2593

PCD File NO. SP201

CONTENTS

Overview

This report was prepared to provide design information for the existing Sand Creek -Center Tributary Drainageway as part of the Solace Apartment development. This document is the Channel Analysis report for the Solace Apartments. The Sand Creek-Center Tributary Drainageway has been studied as part of a Flood Insurance Study (FIS) for El Paso County Colorado, Volume 7 of 8, revised December 7, 2018 and Sand Creek Drainage Basin Planning Study, dated January 1993. Existing flow rates from the Sand Creek Planning Study were used as the basis for the design of the existing channel condition.

General Location and Description

Location

The proposed Solace Apartments, known as "Solace" from herein, is a parcel of land located in Section 7, Township 14 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. Solace is a 28.99 acre, urban, multifamily-development and is comprised of 16 apartment buildings and associated infrastructure. Solace is bound by existing industrial developments to the North and vacant land to the West. Galley Road bounds the property to the south and existing light industrial businesses to the east. A vicinity map of the area is presented in Appendix A.

Description of Property

Solace is currently unoccupied and undeveloped. The existing ground cover is sparse vegetation and open space, typical of a Colorado rolling range land condition. In general, Solace slopes from northwest to southeast. The existing conditions of the Sand Creek -Center Tributary Drainageway on the site are heavily wooded for the length of the channel throughout the Solace site.

Per an NRCS web soil survey of the area, Solace is made up of Type B soils with a very small percentage of Type A in the northwest corner of the property. This Type B soil is a blendon sandy loam. This soil type has a moderate infiltration rate when thoroughly wet. It also consists of moderately deep or deep, moderately well drained or well drained soil. A soil survey map has been presented in Appendix A.

Floodplain Statement

Based on the FEMA FIRM Map numbers 08041C0751G & 08041C0752G, dated December 7, 2018, a portion of the existing drainageway lies within Zone AE and Zone X. Zone AE is defined as area subject to inundation by the 1-percent-annual-chance flood event and is a flood hazard area. Zone X is defined as area outside the Special Flood Hazard Area (SFHA) and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. The FIRM Map has been presented in Appendix A. Currently a portion of the Solace site lies within Zone AE at the extension of Paonia Street to Galley Road, as seen in FEMA FIRM Map number 08041C0752G.

PREVIOUS SAND CREEK STUDIES

Solace lies within Sand Creek Drainage Basin based on the "*Sand Creek Drainage Basin Planning Study*" prepared by Kiowa Engineering in January 1993.

The Sand Creek Drainage Basin covers approximately 54 square miles in unincorporated El Paso County, CO. The Sand Creek Drainage Basin is tributary to Fountain Creek. In its existing condition, the basin is comprised of developed land with the exception of the Solace Parcel which is comprised of rolling rangeland with fair to good vegetative cover associated with Colorado's semi-arid climate. The natural Drainageway within the site limits is typically deep and narrow with a well-defined flow path in most areas. Anticipated land use for the Solace parcel includes multifamily residential and open space.

As part of its drainage research, JR Engineering reviewed the following drainage studies, reports and LOMRs:

- Sand Creek Drainage Basin Planning Study prepared by Kiowa Engineering Corporation in January 1993.
- Flood Insurance Study– El Paso County, Colorado & Incorporated Areas Vol 7 of 8, December 2018.
- LOMR- Case No. 05-08-0368P Federal Emergency Management Agency, May 23, 2007.

The *Sand Creek Drainage Basin Planning Study* was used to establish a stormwater management plan for the existing and future stormwater infrastructure needs within the Sand Creek Drainage Basin. The *Sand Creek Drainage Basin Planning Study* conducted a hydrologic analysis using a runoff model named the Soil Conservation Service (SCS) Computer Program for the Project Formulation Hydrology (TR20). Based on provided drainage maps and analysis, in its existing condition, the Sand Creek-Center Tributary Drainageway contains a 100-year flow of 720 cfs at upstream station 1053 then jumps to 960 cfs at station 1030 in Sand Creek along Solace's east property line. The flow then changes again at station 1014, to a value of 956 cfs, where the flow from the secondary drainageway on Paonia Street converges with the Sand Creek Drainageway, this flow was based on JR Engineering analysis. These flows were used in the model as they were depicted as being the flows present in the project section of the Sand Creek Tributary Drainageway as called out in *Sand Creek Drainage Basin Planning Study*. The major Sand Creek-Center Tributary Drainageway conveys the stormwater south along the eastern property line where it ultimately outfalls into the Fountain Creek. JR Engineering also performed a hydrologic analysis to determine the flows in the Sand Creek-Center Tributary Drainageway and arrived at similar results to those shown in the *Sand Creek Drainage Basin Planning Study,* thus verifying the validity of these flows. These basin calculations show that the 720-960 cfs, based on the *Sand Creek Drainage Basin Planning Study,* are still valid for this existing condition, a summary table of the flows in the Sand Creek Drainageway based on various studies can be found below.

SOLACE APARTMENTS		
Sand Creek Center Tributary Flow Summary Table		
Report/Study	Location	Flow (cfs)
Sand Creek DBPS, Kiowa Engineering, Rev. March 1996, Table III-2	DP 45, @ Galley Rd. Crossing	1,340
Sand Creek DBPS, Kiowa Engineering, Rev. March 1996, CTP-2	@ STA 125+00	960
Sand Creek DBPS, Kiowa Engineering, Rev. March 1996, CTP-2	@ STA 132+30	720
Flood Insurance Study, El Paso County, Rev. December 7, 2018	Section N, @ Galley Road	723
JR Engineering October 2019	@ Galley Road	956

FEMA prepared a revised FIS for El Paso County Colorado, Volume 7 of 8, dated December 7, 2018. The effective floodplain for the site is shown on the FIRM 08041C0752G, revised to reflect LOMR, dated May 23, 2007. The study area of the FIS where the Sand Creek Drainageway crosses Galley Road, was found to overtop the culverts and flow onto the road. According to the FIS, this crossing has a 10% annual chance of flooding and is located in Zone AE of the FIRM. This location is a Special Flood Hazard Area (SFHA) inundated by the 100-year flood, Zone AE (base flood elevations determined). The *Sand Creek Drainage Basin LOMR* was executed on May 23, 2007. The LOMR revised the flood zone or the area south of Galley Road. See FIRM Map Panel 08041C0752G for limits of LOMR study and revised flood zones, presented in Appendix C.

To the west of the Sand Creek-Center Tributary Drainageway is a secondary Drainageway that captures the flow coming from the west side of Paonia Street. This drainage way is located at the proposed extension of Paonia Street to meet Galley Road. The flows created by the secondary drainageway and the development north of the site will be captured on the Solace site, and transported to the Sand Creek-Center Tributary Drainageway. According to *Sand Creek Drainage Basin LOMR*, the flow present in this secondary drainageway in a 1-percent-annual-chance flood event is 213 cfs. This was calculated by use of the LOMR maps, and evaluating the difference in flow as the Sand Creek Center Tributary Drainageway splits as it crosses Omaha Boulevard. Section R of the FEMA Map Panel 08041C0752G, shows the split as the flow present in the channel drops to 421 cfs from 634 cfs at section S just upstream. The difference in these flows is 213 cfs this flow is assumed to overtop the road at Omaha Boulevard crossing structure, and travel west to Paonia Street and is routed south in the Sand Creek Center Tributary onto the Solace site. A calculation of the flows present in Paonia was also conducted by Galloway Engineering in the *Preliminary Drainage Report and Floodplain Certification for Powers Center Point*, dated October 1st, 2007. This report used a similar methodology in calculating the flows; however this analysis was made using LOMR data from 1997 with higher flows thus resulting in a calculated flow of 500 cfs. To be conservative, JR Engineering's design will be based on the 500 cfs specified, rather than the 213 cfs calculated. Additional information has been requested via FEMA FIS data request. When this additional data can be obtained, a proposed channel improvements report including both main channel and overflow improvements will be updated to reflect the latest available information. At the current point in time, all available published data has been exhausted to prove a reduced flow rate in the overflow channel (Paonia Street).

Just north of the Solace site on Paonia Street a concrete channel exists that diverts a portion of the flows present in Paonia Street back into the Sand Creek-Center Tributary Drainageway. However the size of this channel will not convey all flows present in Paonia, therefore improvements are necessary to mitigate the offsite flows. Potential options to mitigate these flows are discussed below. Each possible alternative has been preliminarily evaluated to ensure feasibility in mitigating the secondary drainageway currently existing in Paonia Street.

The first conceptual option would be to have future Paonia Street continue to maintain an existing super elevation that will direct all flows present on Paonia towards the east side of the road. GIS contours indicate this super elevation exists, as well as confirmation stated by the Galloway Engineering Preliminary Drainage Report. The curb and gutter along the east side of Paonia will be omitted to create a 110 ft weir that will route flows back to the existing Sand Creek-Center Tributary Drainageway. The 110 ft weir would reduce into a 40 ft wide channel as it approaches the existing channel at a 45 degree angle. Flow calculations for this overflow design can be found in Appendix B, along with flow capacity calculations for existing Paonia Street & existing concrete channel north of the site.

A second conceptual option would be to create a low point in Paonia shortly after crossing south onto the subject property, thus creating a sump condition. The sump inlets would capture minor runoff and pipe it to the main channel, while a larger event would behave in a similar manner to the above scenario, routing via the same overflow weir and channel back to the main Sand Creek-Center Tributary Channel. The alternative profile for this scenario can be found in Appendix B, as well as on the preliminary Paonia Street Improvement plans.

Finally, a third option would be to widen the existing concrete channel at the property line to increase capacity enough to accept all flows from the overflow channel.

The first option has been presented in the drainage maps and preliminary plans associated with this report; however no alternative has been definitively selected at this time. One alternative or a combination of these alternatives may be utilized at time of final design to safely and efficiently route the Paonia Street overflow channel back to the main channel near the northern site boundary.

Channel Deficiencies

The *Sand Creek Drainage Basin Planning Study* performed a hydraulic analysis of the Sand Creek-Center Tributary Drainageway between Galley Road and Paonia Street, and an analysis of the crossing structure for Sand Creek at Galley Road. For the crossing structure at Galley Road they determined that the existing crossing structures were inadequate for the demands of the Drainageway and would require improvements to expand the capacity of these structures. These results can be seen in Table IV-1 Summary of Hydraulic Structures – Crossings: Sand Creek Drainage Basin Planning Study shown below. The Study proposed improvements to the existing crossing structures by replacing them with 3-8'Wx 5'H Concrete Box Culverts.

TABLE IV-1: SUMMARY OF HYDRAULIC STRUCTURES - CROSSINGS
SAND CREEK DRAINAGE BASIN PLANNING STUDY

LOCATION	REACH #	SIZE	TYPE	CAPACITY EXISTING	CAPACITY FUTURE (1)	COMMENTS
Airport Road	CT-1	5-6'x8'	BOX CULVERT	ADEQUATE	ADEQUATE	
Pikes Peak Ave.	CT-1	NONE		INADEQUATE	INADEQUATE	POWERS BLVD. OVERTOPPED FREQUENTLY BETWEEN BIJOU ST. AND PIKES PEAK AVE.
Powers Blvd.	CT-1	VARIOUS	METAL PIPE	INADEQUATE	INADEQUATE	
Platte Ave (US 24)	CT-1	8'x4'	BOX CULVERT	INADEQUATE	INADEQUATE	APPROACH CHANNEL IN NEED OF REALIGNMENT
Terminal Avenue	CT-2	2-4'x8'	BOX CULVERT	INADEQUATE	INADEQUATE	
Galley Road	CT-2	3-42"x72"	METAL ARCH PIPE	INADEQUATE	INADEQUATE	
Omaha Boulevard	CT-2	2-36"x57"	METAL ARCH PIPE	INADEQUATE	INADEQUATE	

The study also found the existing channel for the Sand Creek-Center Tributary Drainageway between Galley Road and Paonia Street to be inadequate for the given flow rate. The report says that the existing channel has limited maintenance access, leading to the channel degrading and being filled with obstructions. Those findings can be seen in Table IV-2 Summary of Hydraulic Structures – Channels: Sand Creek Drainage Basin Planning Study. The *Sand Creek Drainage Basin Planning Study* recommended improvements to the existing channel by lining the channel with concrete.

TABLE IV-2: SUMMARY OF HYDRAULIC STRUCTURES - CHANNELS
SAND CREEK DRAINAGE BASIN PLANNING STUDY

LOCATION FROM / TO	REACH #	DIMENSIONS TW (ft)	SS	DEPTH (ft)	TYPE	CAPACITY (1) ADQ	INADQ	COMMENTS
CENTER TRIBUTARY								
East Fork Sand Creek to Airport Road	CT-1	45	2:1	6	Riprap lined trapezoidal channel	X	X	Riprap has failed or is non-existent along some portions of this segment of the Center Tributary
Pikes Peak to Bijou St.	CT-1			N/A	Rubble lined ditches along Powers Blvd.			Flow passes over and along Powers Blvd. street section on a frequent basis. Road closures common.
Bijou St. to Platte Ave.	CT-1			N/A	Unlined, natural.			Overbanks vegetated, channel dry with sand invert, no. vegetation. Channel eroded at outlet of US24 culvert.
Platte Ave. to Terminal Ave.	CT-2	15-25	1:1	4-6	Trapezoidal concrete lined.	X		Channel has adequate capacity.
Terminal Avenue to Galley Road	CT-2	21	1:1	5	Trapezoidal concrete lined.	X		Channel has adequate capacity.
Galley Road to Paonia Ct. (ext)	CT-2	30-40	varies	4-5	Unimproved segment.		X	Channel is degraded and filled with debris. Poor maintainance access.
Paonia Ct. to Omaha Blvd.	CT-2	21	1:1	5	Trapezoidal concrete lined channel.	X		Maintainence access poor. Debris and trash in channel.

The GeoHecRas model results completed with this report contain similar findings to those in the drainage basin planning study. This model was based on the existing channel conditions; a model will be created for the sites proposed conditions in the final drainage report. Average velocities of 10-12 fps for a majority of the channel reach exceed allowable limits for an unprotected channel. The current Galley road crossing structures lack of capacity also leads to overtopping of the road during these events. This report confirms that both this Sand Creek channel reach and Galley Road crossing structures are inadequate for the 100-yr storm event.

Channel Improvement Recommendations

The *Sand Creek Drainage Basin Planning Study (DBPS)* concluded that the Sand Creek-Center Tributary Drainageway channel, in its current state, is inadequate to handle the historical flows tributary to the channel. This report falls in line, indicating that improvements shall be made to the channel in order to provide adequate capacity and prevent erosion. In the DBPS improvements are also designated for the crossing structures at Galley Road to provide adequate capacity and prevent overtopping of the road. Upon further investigation, this report found that overtopping of Galley Road appears to be addressed via the overflow structure and associate downstream bank protections shown in Figure 1. This weir was analyzed to determine the effectiveness to safely pass overtopping flows. From the HEC-RAS model, it was determined that approximately 581 cfs overtops the roadway during a 100-year event. The weir in its current configuration could only adequately pass approximately 40 cfs of this flow. On the north side of the Galley road crossing, there is a section of roadway without curb & gutter; this allows the water transported along the north half of galley road to directly flow into the Sand Creek Center Tributary Drainageway. A picture of this curb opening is shown below in figure 2.

Figure 1: Existing Drainage Structures at Galley Road (Viewed from South)

Figure 2: Curb Opening on North Half of the Galley Road Crossing (Looking to the North)

This analysis notes existing overtopping, further discussion with the county engineer to discuss potential solutions is recommended. One possible solution is that the existing culverts be replaced to prevent overtopping at Galley Road by upsizing to a larger culvert(s). Ultimately, culvert improvements will be necessary when the County deems the historic overtopping of Galley Road above acceptable tolerance. Currently, no adjacent structures are impacted by this overtopping. Weir calculations can be found in the appendix.

Based upon the findings to the *Sand Creek Drainage Basin Planning Study* and the conforming GeoHecRas modeling contained in this report, potential recommended channel improvements include:

- Widening of the channel west bank to reduce flow depth, thus corresponding velocities
- Lining portions of the channel with riprap or other protective surfaces
- Adding check structures and potentially drop structures to reduce channel grade, a conceptual profile can be seen in Appendix A.
- Replacing existing culverts at Galley Road to prevent roadway overtopping

Stable slopes of 1% were chosen for the channel based on stable slope specified by The *Sand Creek Drainage Basin Planning Study (DBPS.)*

CONCEPT COST ESTIMATE

Below is Conceptual Cost Estimate for the proposed channel improvements to the Sand Creek-Center Tributary Drainageway.

Table 3: Cost Opinion-Public Reimbursable

PUBLIC DRAINAGE FACILITIES				
Item	**Quantity**	**Unit**	**Unit Price**	**Extended Cost**
Clearing & Grubbing	2	AC	$5,000.00	$10,000.00
Channel Widening Earthwork (Cut)	7000	CY	$3.00	$21,000.00
Riprap Lining (Type M)	5100	CY	$85.00	$433,500.00
Drop Structures	2	EA	$20,000.00	$40,000.00
			Sub-Total	$504,500.00
	10% Eng. And Contingency			$50,450.00
			Grand Total	$554,950.00

DRAINAGE DESIGN CRITERIA

Development Criteria Reference

Storm drainage analysis techniques were taken from the "*City of Colorado Spring/El Paso County Drainage Criteria Manual*" Volumes 1 and 2 (EPCDCM), dated October 12, 1994, the "*Urban Storm Drainage Criteria Manual*" Volumes 1 - 3 (USDCM) and Chapter 6 and Section 3.2.1 of Chapter 13 of the "Colorado Springs Drainage Criteria Manual (CCSDCM), dated May 2014, as adopted by El Paso County.

Hydrologic Criteria

The hydrologic analysis for this project is based on the *Sand Creek Drainage Basin Planning Study*. The flow rates for the 100-yr storm event were taken from sheets CTP-2 & CTP-3 of this study. The Baseline Flows from the *Sand Creek Drainage Basin Planning Study* are included in Appendix C.

Hydraulic Criteria

GeoHecRas was used as the primary analysis method for the site. GeoHecRas was used to model existing flows within the Sand Creek-Center Tributary Drainageway. This model was used to verify flood plains and analyze any overtopping that may occur within the project site. The 100-year water surface profiles for the model were analyzed form the north property line of the site to the area 100 feet south of the Galley Road Crossing. Hydraulic computations for the models are contained in Appendix B. In the model the value for the roughness coefficient (n) were based upon those shown in Table 12-2 of the City of Colorado Springs Drainage Criteria Manual, Volume 1. The manning's roughness coefficient for the sides of the channel was evaluated as n = 0.05, as the channel sides are most closely categorized as sluggish reaches with weeds, the minimum value of n was taken. For the bottom of the channel a manning's roughness coefficient value of n = 0.025, as the existing channel bottom being very clear and free of plants or other debris, the minimum value of n was taken. Table 12-2 highlights the manning values used for the model. The channel was analyzed as a winding channel in the GeoHecRas model.

Table 12-2. Roughness Coefficients

Channel Description	Roughness Coefficient (n)		
	Minimum	Typical	Maximum
Natural Streams (top width at flood stage <100 feet			
1. Streams on Plain			
a. Clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
b. Same as above, but more stones and weeds	0.030	0.035	0.040
c. Clean, winding, some pools and shoals	0.033	0.040	0.045
d. Same as above, but some weeds and stones	0.035	0.045	0.050
e. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
f. Same as c, but more stones	0.045	0.050	0.060
g. Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
h. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.100	0.150
2. Mountain Streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages			
a. Bottom: gravels, cobbles, and few boulders	See Jarrett's equation*		
b. Bottom: cobbles with large boulders			

The flows in the channel, upstream and downstream of the Solace site, were determined using the sheet CTP-2 of the *Sand Creek Drainage Basin Planning Study*, with the flow 720 cfs being used at the upstream end of the channel till river station 1031 where the flow changes to 960 cfs, and once again at the Galley Road crossing to 1340 cfs. These can be seen in the GeoHecRas output table. Geometry of the channel and the crossing structure at Galley Road was determined from survey conducted by JR Engineering's internal survey department. The Galley road crossing structure was modeled in the GeoHecRas model; its geometric parameters were determined using survey obtained data to the crossing. The sizes of the 48" CMP culverts in the crossing were also determined from survey data.

SUMMARY

This analysis of the Sand Creek-Center Tributary Drainageway remains consistent with previous studies. Velocities in the drainageway are of concern and require channel improvements, such as widening and riprap lining to ensure the Sand Creek Drainageway remains stable during a 100-yr event. This report meets the latest El Paso County Drainage Criteria requirements for this site. The results of JR Engineering's GeoHecRas model for the channel appear accurate as the water surface elevations of the channel matchup very closely to the elevations called out in the FEMA FIS along the channel. The overtopping elevation at Galley Road shown in the model matches the elevation shown in the FEMA floodplain map of 6249, showing that the GeoHecRas model results are valid.

REFERENCES:

1. El Paso County Drainage Criteria Manual Volume 1, El Paso County, CO, 1994.

2. Urban Storm Drainage Criteria Manual, Urban Drainage and Flood Control District, Latest Revision.

3. Flood Insurance Study- El Paso County, Colorado & Incorporated Areas Vol 7 of 8, Federal Emergency Management Agency, December 7, 2018.

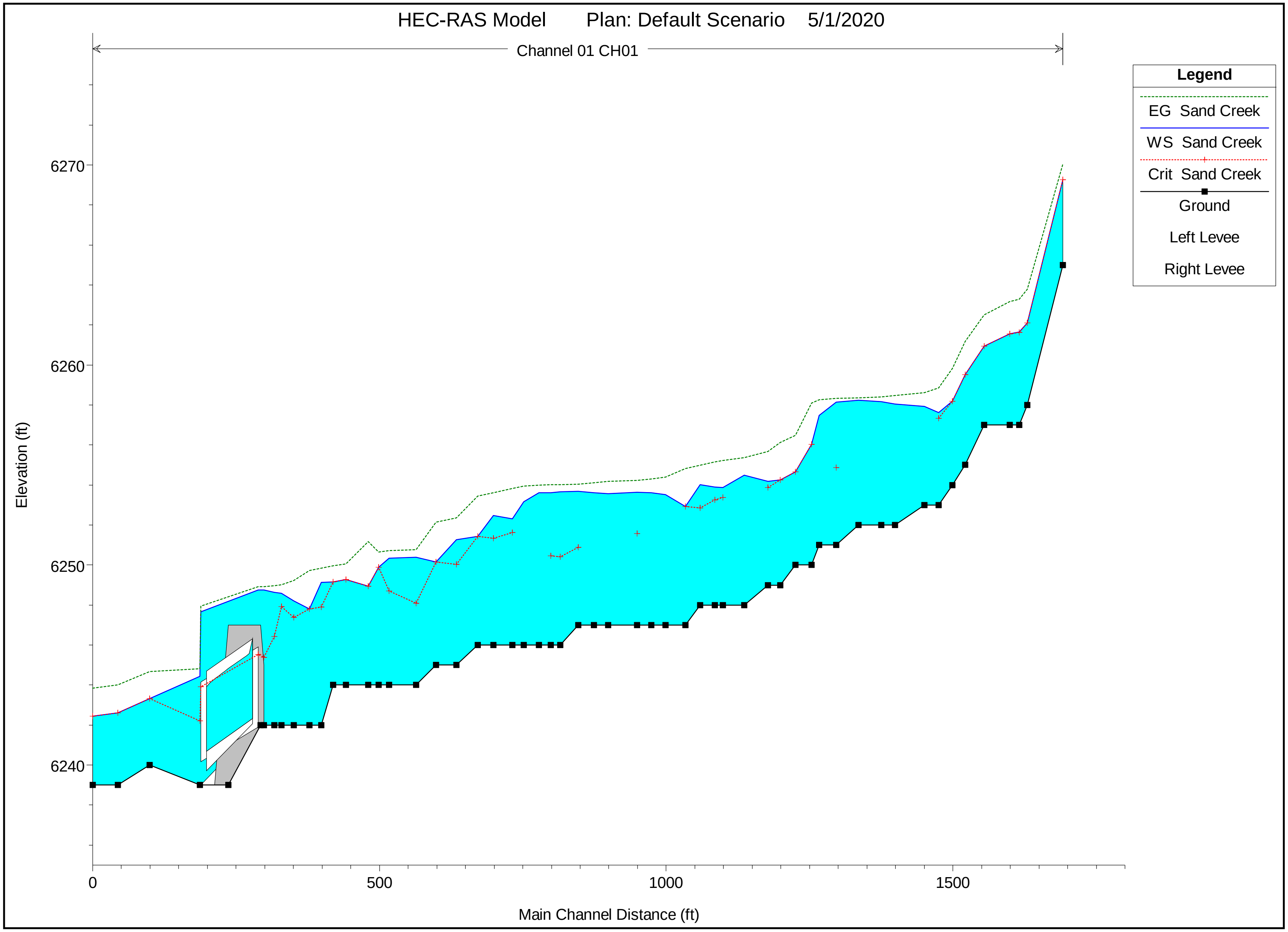
4. Sand Creek Drainage Basin Planning Study, Kiowa Engineering, January 1993.

5. Sand Creek Drainage Basin LOMR, Federal Emergency Management Agency, May 23, 2007.

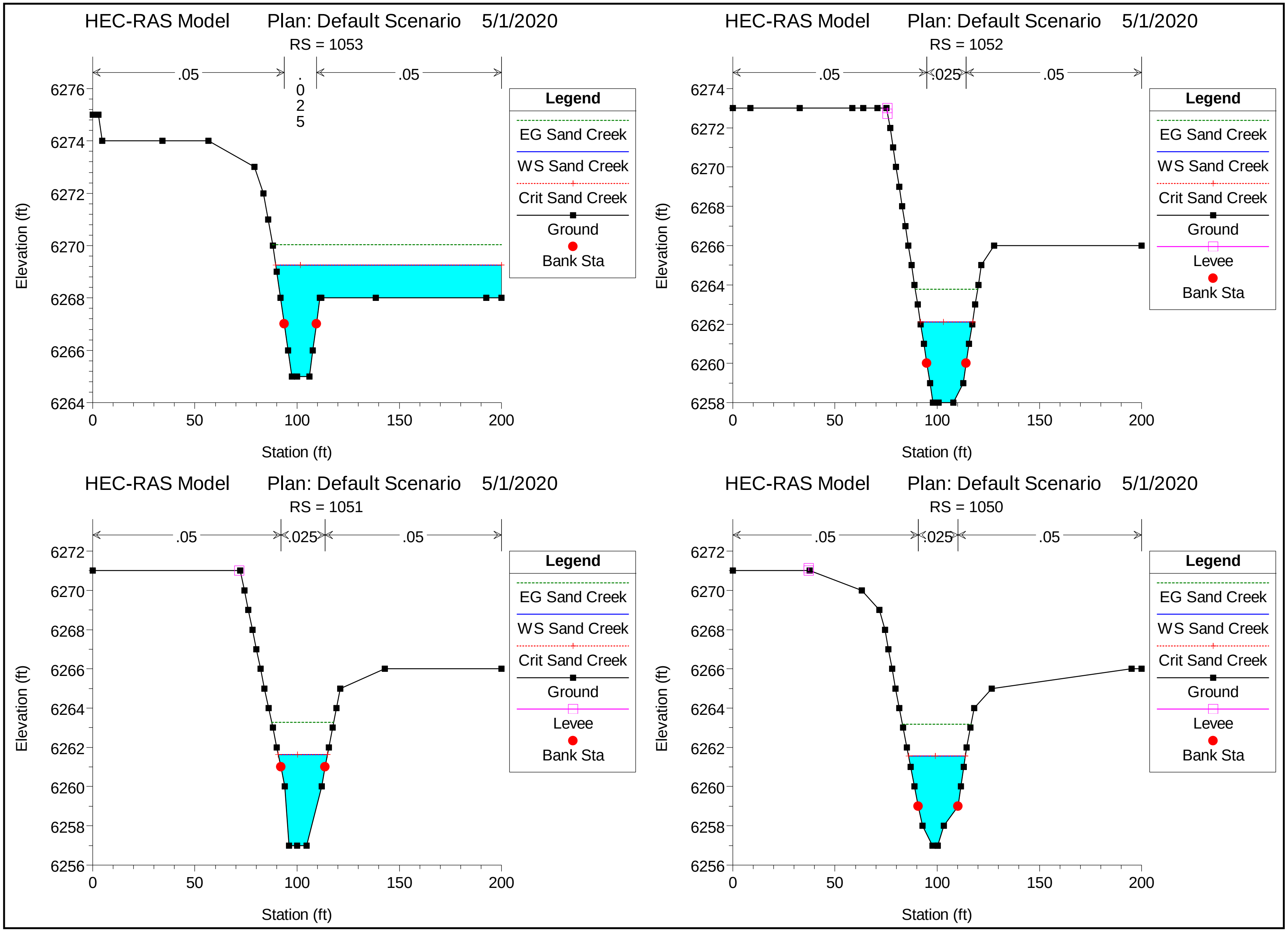
6. Preliminary Drainage Report and Floodplain Certification for Powers Center Point, Galloway Engineering, October 2007.

HEC-RAS Plan: Default Scenario River: Channel 01 Reach: CH01 Profile: Sand Creek

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
CH01	1053	Sand Creek	760.00	6265.00	6269.26	6269.26	6270.04	0.003762	8.51	179.27	110.42	0.77
CH01	1052	Sand Creek	760.00	6258.00	6262.11	6262.11	6263.78	0.005804	10.49	77.83	25.50	0.96
CH01	1051	Sand Creek	760.00	6257.00	6261.64	6261.64	6263.29	0.006883	10.30	74.47	24.12	0.98
CH01	1050	Sand Creek	760.00	6257.00	6261.55	6261.55	6263.17	0.005614	10.36	81.50	27.77	0.96
CH01	1049	Sand Creek	760.00	6257.00	6260.93	6260.93	6262.50	0.005917	10.15	80.51	28.71	0.97
CH01	1048	Sand Creek	760.00	6255.00	6259.52	6259.52	6261.19	0.005730	10.51	80.21	27.19	0.97
CH01	1047	Sand Creek	760.00	6254.00	6258.20	6258.20	6259.83	0.006013	10.34	79.30	27.50	0.98
CH01	1046	Sand Creek	760.00	6253.00	6257.62	6257.33	6258.86	0.004369	9.10	93.85	32.59	0.85
CH01	1045	Sand Creek	760.00	6253.00	6257.94		6258.62	0.002044	6.71	123.65	36.54	0.59
CH01	1044	Sand Creek	760.00	6252.00	6258.04		6258.47	0.000942	5.39	158.77	38.15	0.42
CH01	1043	Sand Creek	760.00	6252.00	6258.17		6258.40	0.000450	3.84	219.34	49.10	0.29
CH01	1042	Sand Creek	760.00	6252.00	6258.25		6258.35	0.000192	2.60	333.13	72.33	0.19
CH01	1041	Sand Creek	760.00	6251.00	6258.15	6254.86	6258.33	0.000342	3.46	250.00	54.53	0.26
CH01	1040	Sand Creek	760.00	6251.00	6257.48		6258.25	0.001509	7.34	129.48	31.17	0.53
CH01	1039	Sand Creek	720.00	6250.00	6256.03	6256.03	6258.09	0.005145	12.17	78.63	22.88	0.93
CH01	1038	Sand Creek	720.00	6250.00	6254.65	6254.65	6256.48	0.005632	11.04	74.30	23.99	0.96
CH01	1037	Sand Creek	720.00	6249.00	6254.26	6254.26	6256.12	0.005266	11.39	78.61	25.24	0.94
CH01	1036	Sand Creek	720.00	6249.00	6254.18	6253.87	6255.67	0.004153	10.16	86.85	27.64	0.84
CH01	1035	Sand Creek	720.00	6248.00	6254.49		6255.37	0.001997	8.12	123.42	33.33	0.60
CH01	1034	Sand Creek	720.00	6248.00	6253.87	6253.37	6255.23	0.003530	9.97	96.29	27.50	0.78
CH01	1033	Sand Creek	720.00	6248.00	6253.90	6253.27	6255.15	0.003218	9.54	100.27	28.48	0.75
CH01	1032	Sand Creek	720.00	6248.00	6254.02	6252.85	6254.99	0.002212	8.21	107.83	28.30	0.63
CH01	1031	Sand Creek	720.00	6247.00	6252.93	6252.93	6254.82	0.005902	11.67	81.05	24.65	0.92
CH01	1030	Sand Creek	960.00	6247.00	6253.53		6254.38	0.001956	8.14	169.51	45.64	0.61
CH01	1029	Sand Creek	960.00	6247.00	6253.61		6254.29	0.001452	7.08	180.40	43.93	0.52
CH01	1028	Sand Creek	960.00	6247.00	6253.63	6251.57	6254.24	0.001217	6.58	184.56	43.62	0.48
CH01	1027	Sand Creek	960.00	6247.00	6253.56		6254.17	0.001232	7.01	201.11	46.32	0.50
CH01	1026	Sand Creek	960.00	6247.00	6253.62		6254.11	0.000969	5.82	199.63	47.17	0.43
CH01	1025	Sand Creek	960.00	6247.00	6253.70	6250.88	6254.05	0.000644	4.85	227.01	48.43	0.35
CH01	1024	Sand Creek	960.00	6246.00	6253.67	6250.42	6254.02	0.000576	4.98	235.21	46.35	0.34
CH01	1023	Sand Creek	960.00	6246.00	6253.62	6250.47	6254.01	0.000626	5.21	225.63	43.80	0.35
CH01	1022	Sand Creek	960.00	6246.00	6253.61		6254.00	0.000607	5.19	221.85	41.91	0.35
CH01	1021	Sand Creek	960.00	6246.00	6253.17		6253.94	0.001350	7.37	164.92	36.16	0.51
CH01	1020	Sand Creek	960.00	6246.00	6252.32	6251.61	6253.82	0.003159	10.30	118.91	30.63	0.76
CH01	1019	Sand Creek	960.00	6246.00	6252.49	6251.34	6253.62	0.002313	9.03	140.23	36.35	0.66
CH01	1018	Sand Creek	960.00	6246.00	6251.44	6251.44	6253.45	0.004819	12.21	109.12	31.63	0.94
CH01	1017	Sand Creek	960.00	6245.00	6251.26	6250.03	6252.37	0.002324	8.73	133.16	32.49	0.65
CH01	1016	Sand Creek	960.00	6245.00	6250.14	6250.14	6252.15	0.005299	11.66	96.28	28.21	0.95
CH01	1015	Sand Creek	960.00	6244.00	6250.38	6248.09	6250.77	0.000839	5.11	215.92	53.82	0.39
CH01	1014	Sand Creek	956.00	6244.00	6250.35	6248.71	6250.72	0.000950	5.78	370.06	207.76	0.42
CH01	1013	Sand Creek	956.00	6244.00	6249.89	6249.89	6250.66	0.001931	8.21	274.84	196.01	0.61
CH01	1012	Sand Creek	956.00	6244.00	6248.95	6248.95	6251.16	0.005865	12.67	104.90	38.16	1.02
CH01	1011	Sand Creek	956.00	6244.00	6249.28	6249.28	6250.05	0.002387	8.46	279.17	203.66	0.66
CH01	1010	Sand Creek	956.00	6244.00	6249.16	6249.16	6249.97	0.002504	8.54	254.79	169.44	0.67
CH01	1009	Sand Creek	956.00	6242.00	6249.14	6247.90	6249.85	0.001612	7.93	276.71	166.57	0.55
CH01	1008	Sand Creek	956.00	6242.00	6247.80	6247.80	6249.73	0.004748	11.73	106.54	31.47	0.91
CH01	1007	Sand Creek	956.00	6242.00	6248.22	6247.39	6249.22	0.002263	9.17	222.13	127.82	0.66
CH01	1006	Sand Creek	956.00	6242.00	6248.59	6247.92	6249.01	0.001105	6.67	368.21	181.76	0.46
CH01	1005	Sand Creek	956.00	6242.00	6248.64	6246.43	6248.97	0.000738	5.28	352.19	168.51	0.38
CH01	1004	Sand Creek	956.00	6242.00	6248.76	6245.39	6248.91	0.000242	3.31	399.38	160.30	0.22
CH01	1003.56		Culvert									
CH01	1003	Sand Creek	956.00	6239.00	6244.43	6242.22	6244.82	0.000233	4.99	191.73	160.51	0.40
CH01	1002	Sand Creek	956.00	6240.00	6243.32	6243.32	6244.68	0.001891	9.35	102.20	38.15	1.01
CH01	1001	Sand Creek	956.00	6239.00	6242.61	6242.61	6244.01	0.001806	9.51	100.52	34.95	0.99
CH01	1000	Sand Creek	956.00	6239.00	6242.44	6242.44	6243.85	0.001879	9.55	100.10	35.71	1.01



HEC-RAS Model Plan: Default Scenario 5/1/2020
Channel 01 CH01
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Left Levee
Right Levee
Elevation (ft)
6270
6260
6250
6240
0
500
1000
1500
Main Channel Distance (ft)


HEC-RAS Model Plan: Default Scenario 5/1/2020
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.025
.05
Legend
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WS Sand Creek
Crit Sand Creek
Ground
Bank Sta
Elevation (ft)
Station (ft)
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1052
.05
.025
.05
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1051
.05
.025
.05
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1050
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.05
Legend
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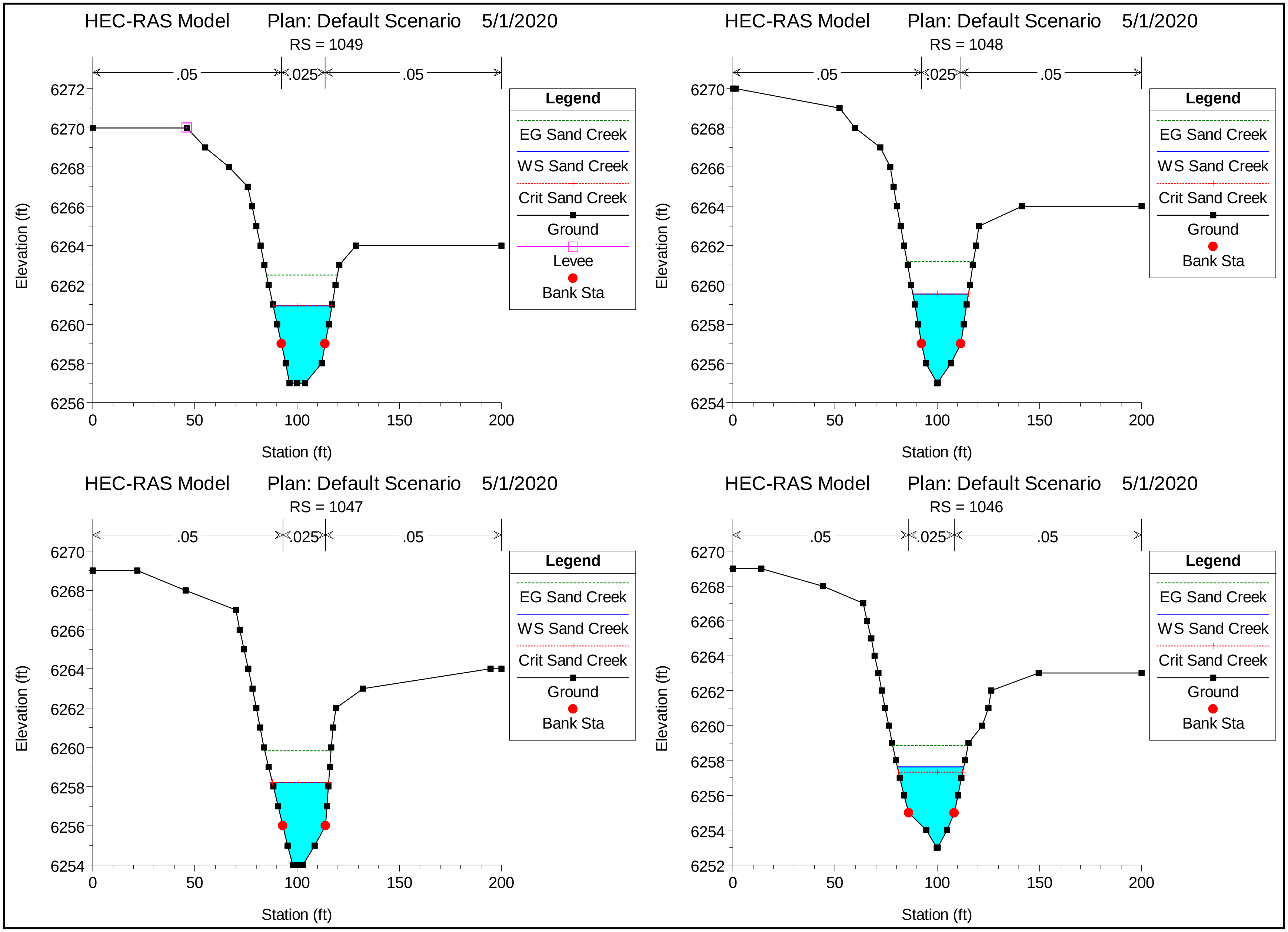
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)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Legend
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WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
6256
6258
6260
6262
6264
6266
6268
6270
6272
0
50
100
150
200
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1048
.05
.025
.05
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Bank Sta
Elevation (ft)
Station (ft)
6254
6256
6258
6260
6262
6264
6266
6268
6270
0
50
100
150
200
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1047
.05
.025
.05
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Bank Sta
Elevation (ft)
Station (ft)
6254
6256
6258
6260
6262
6264
6266
6268
6270
0
50
100
150
200
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1046
.05
.025
.05
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Bank Sta
Elevation (ft)
Station (ft)
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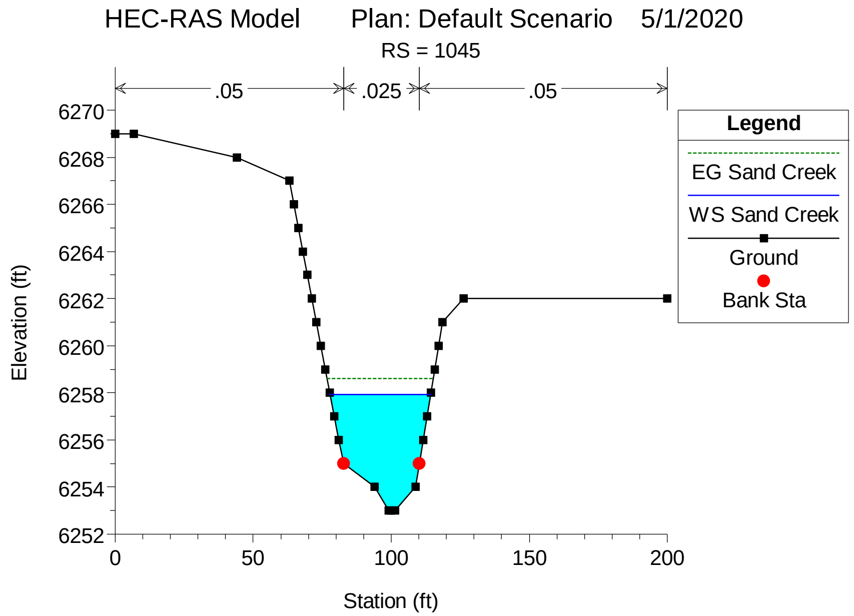
6254
6256
6258
6260
6262
6264
6266
6268
6270
0
50
100
150
200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.025
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EG Sand Creek
WS Sand Creek
Ground
Bank Sta
Elevation (ft)
6252
6254
6256
6258
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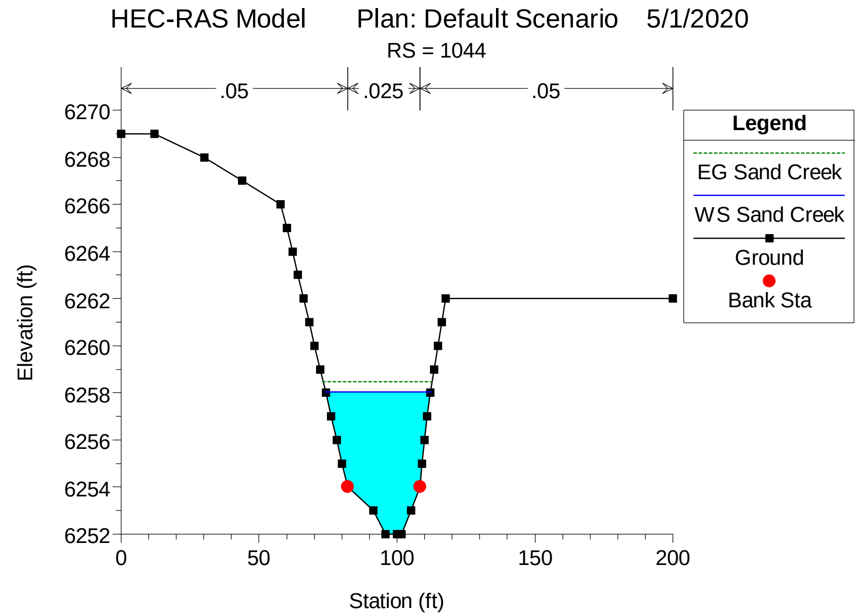
6262
6264
6266
6268
6270
0
50
100
150
200
Station (ft)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.05
Legend
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WS Sand Creek
Ground
Bank Sta
Elevation (ft)
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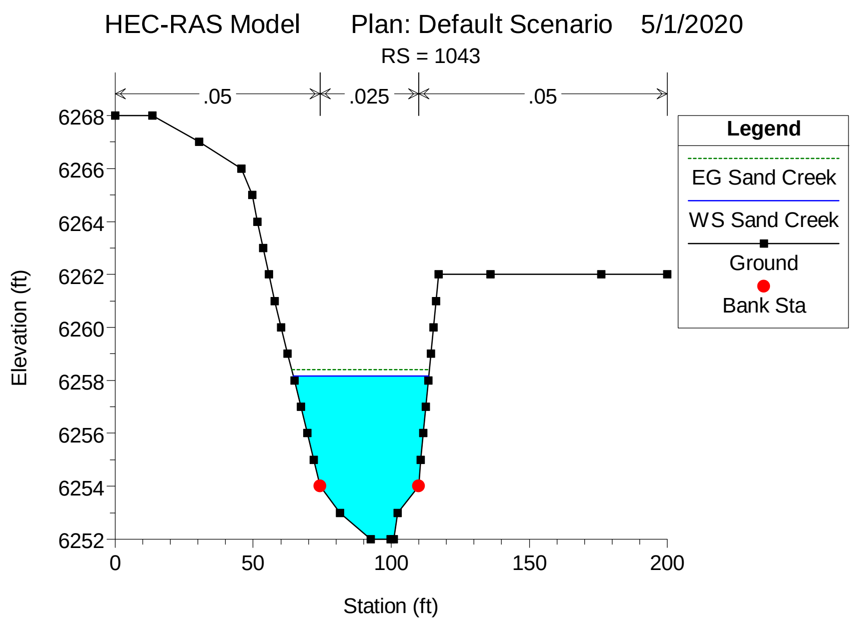
6256
6258
6260
6262
6264
6266
6268
6270
0
50
100
150
200
Station (ft)


HEC-RAS Model Plan: Default Scenario 5/1/2020
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.05
.025
.05
Legend
EG Sand Creek
WS Sand Creek
Ground
Bank Sta
Elevation (ft)
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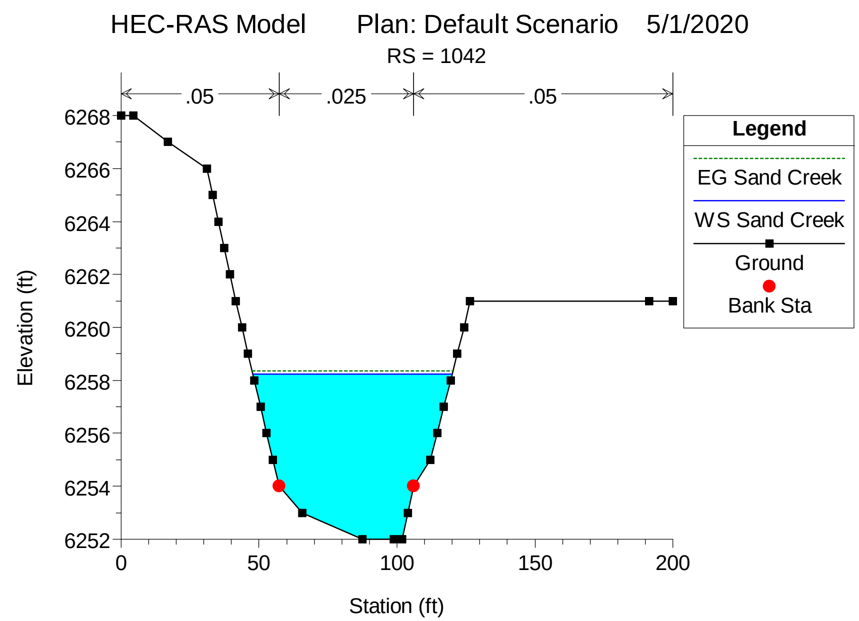
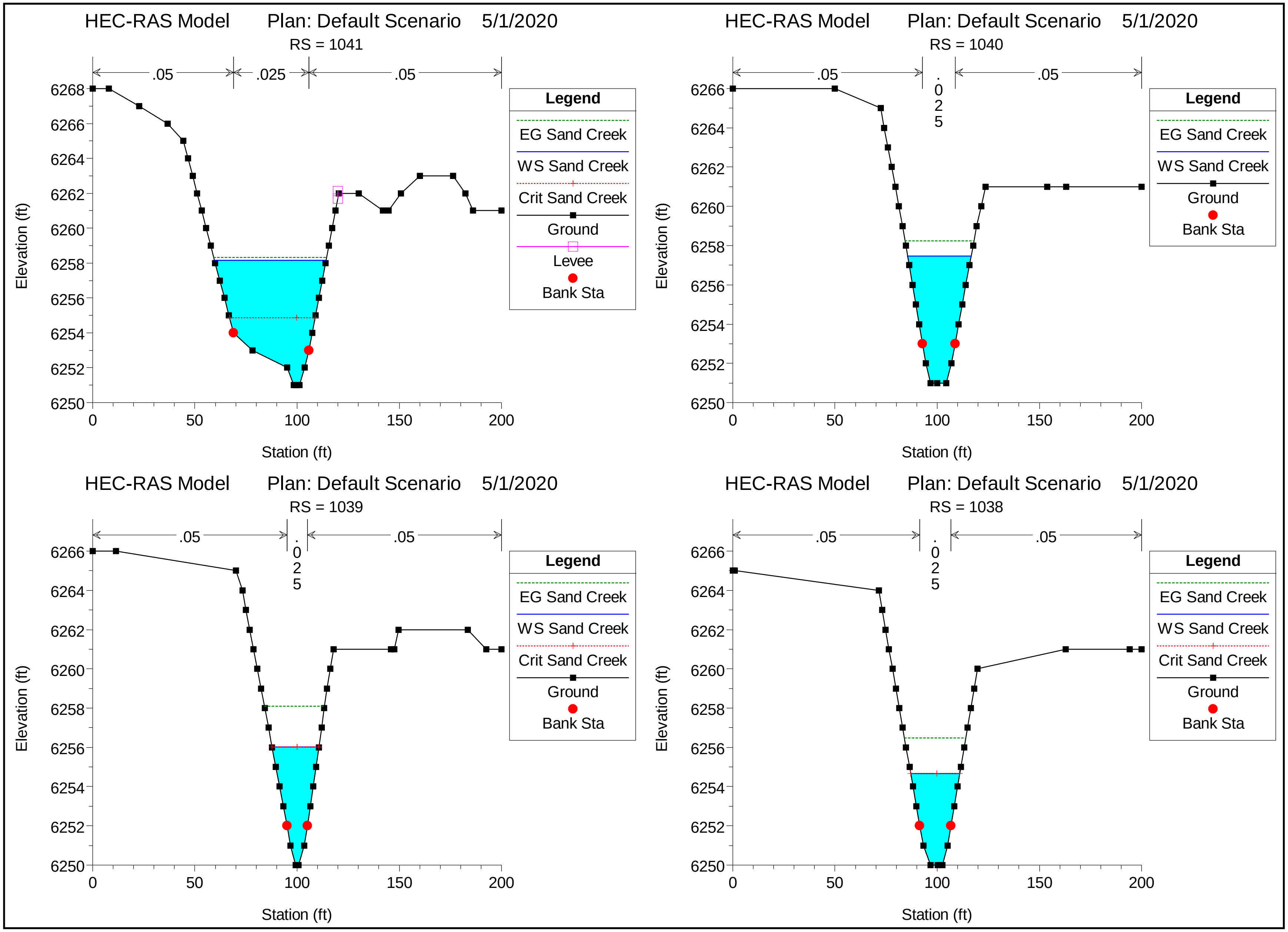
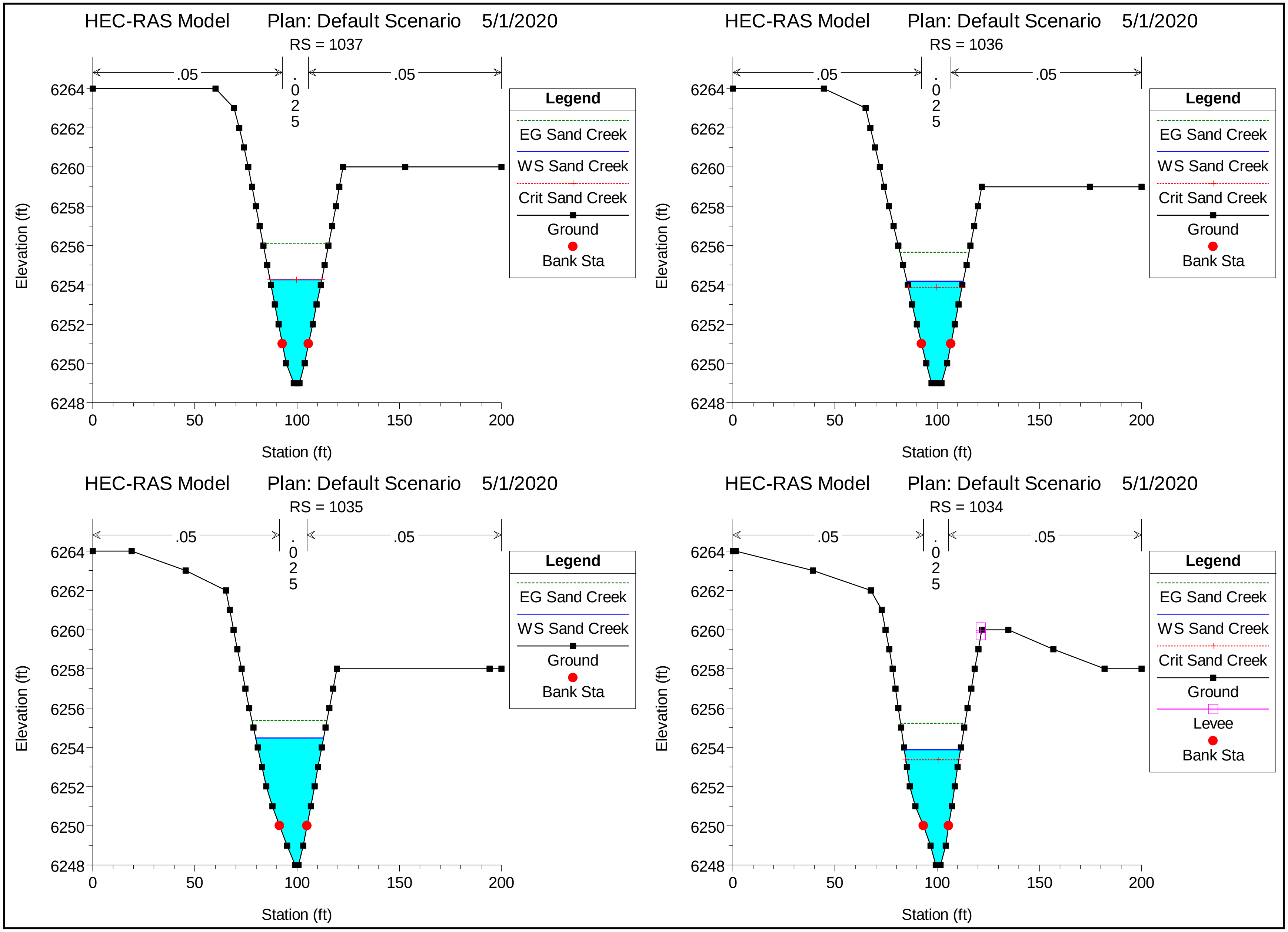
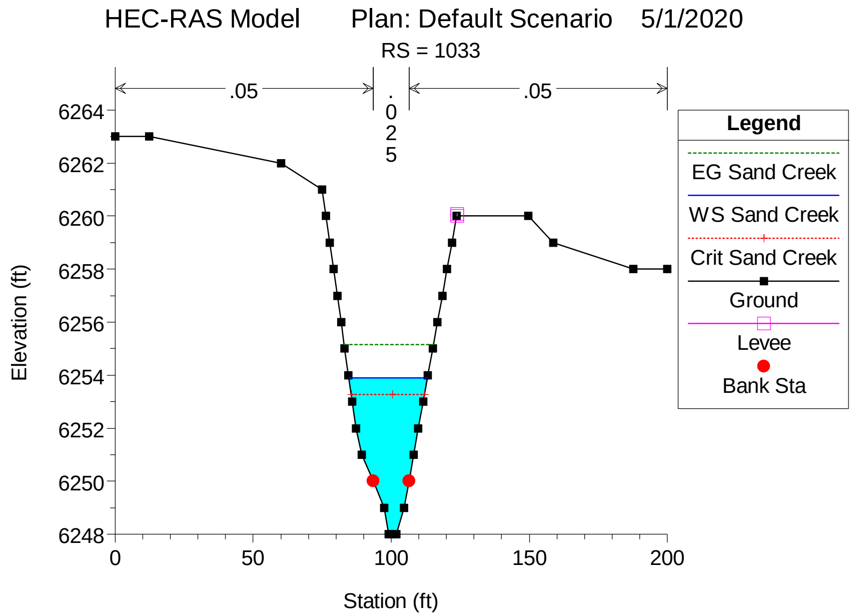
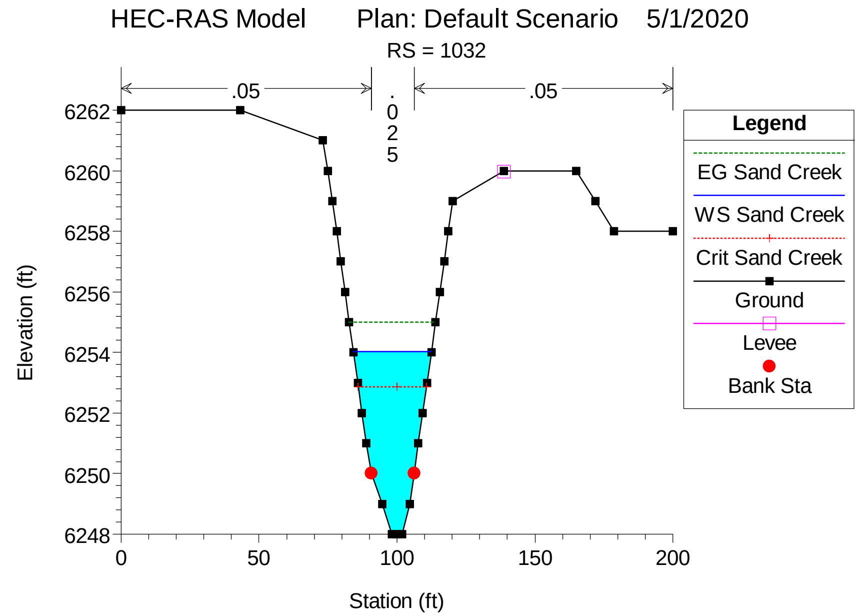
6254
6256
6258
6260
6262
6264
6266
6268
0
50
100
150
200
Station (ft)

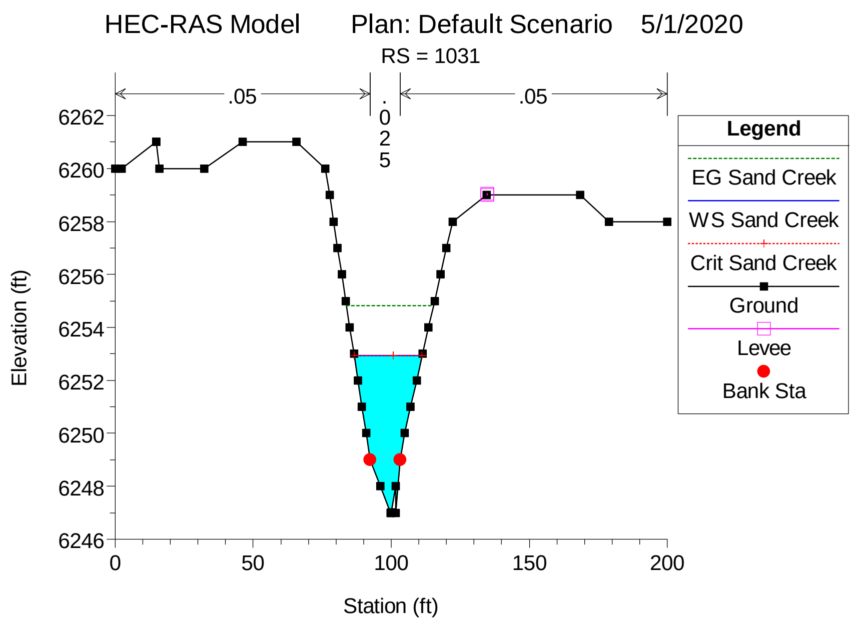

HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1042
.05
.025
.05
Legend
EG Sand Creek
WS Sand Creek
Ground
Bank Sta
Elevation (ft)
6252
6254
6256
6258
6260
6262
6264
6266
6268
0
50
100
150
200
Station (ft)

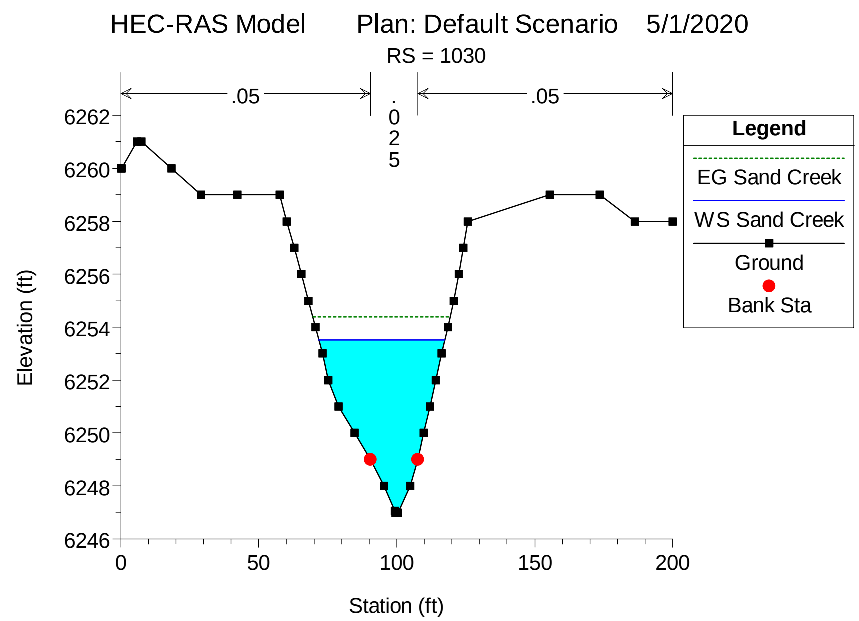

HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1041
.05 .025 .05
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta
Elevation (ft)
6268 6266 6264 6262 6260 6258 6256 6254 6252 6250
0 50 100 150 200
Station (ft)
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1040
.05 .025 .05
Legend
EG Sand Creek
WS Sand Creek
Ground
Bank Sta
Elevation (ft)
6266 6264 6262 6260 6258 6256 6254 6252 6250
0 50 100 150 200
Station (ft)
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1039
.05 .025 .05
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Bank Sta
Elevation (ft)
6266 6264 6262 6260 6258 6256 6254 6252 6250
0 50 100 150 200
Station (ft)
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1038
.05 .025 .05
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Bank Sta
Elevation (ft)
6266 6264 6262 6260 6258 6256 6254 6252 6250
0 50 100 150 200
Station (ft)

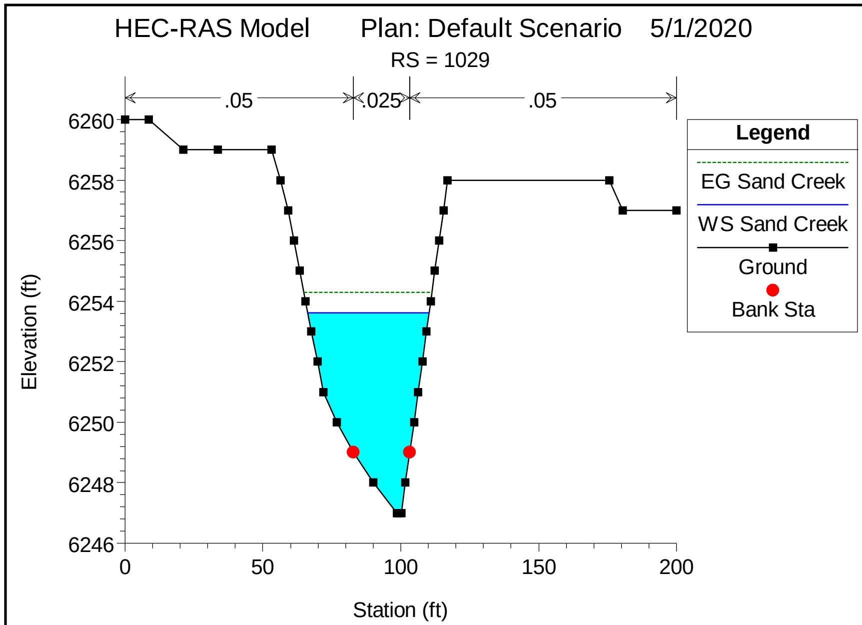
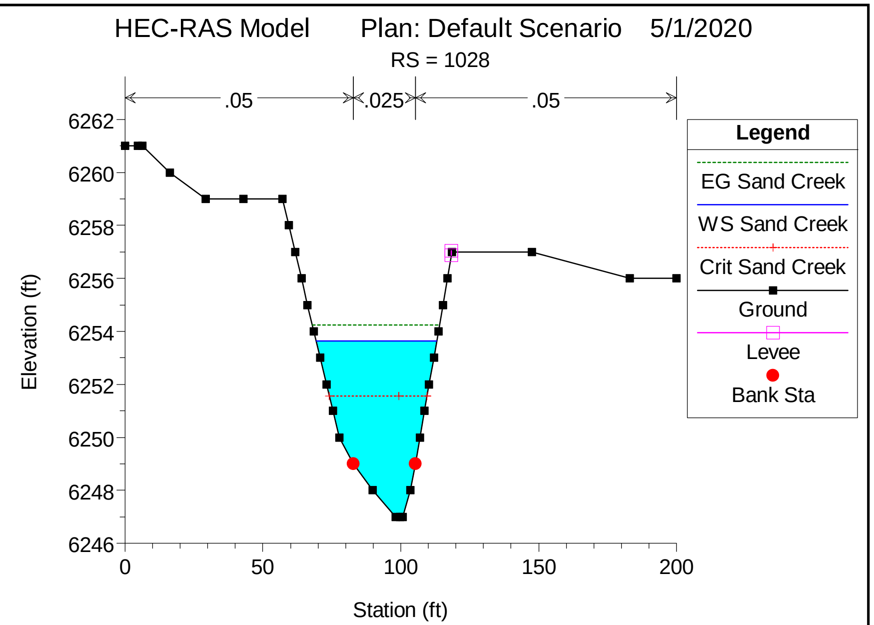
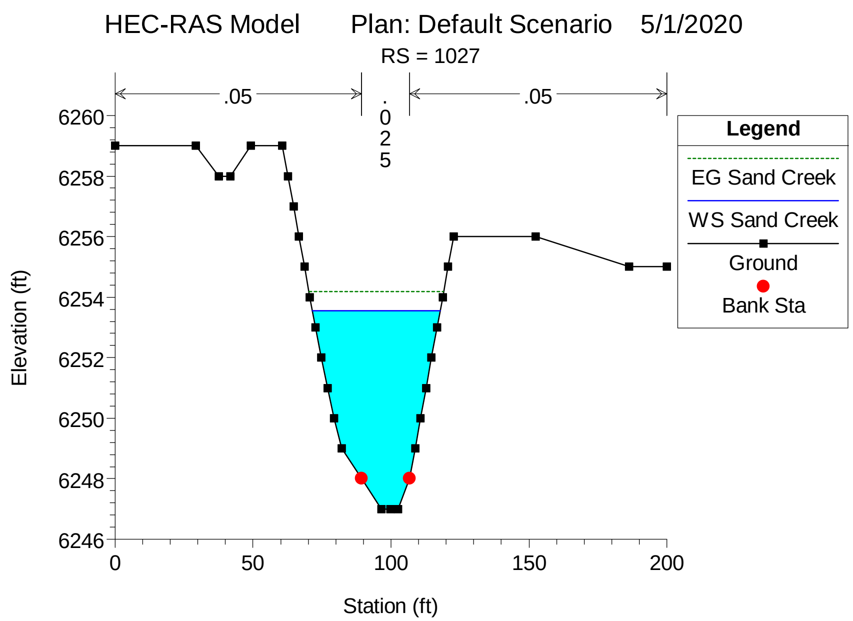
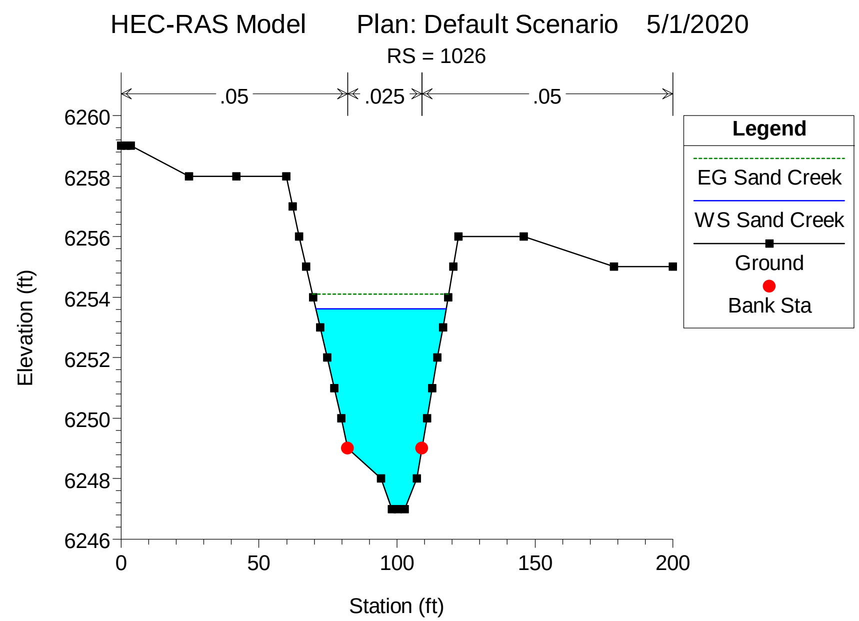

HEC-RAS Model
Plan: Default Scenario
5/1/2020
RS = 1037
.05
.025
.05
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Bank Sta
Elevation (ft)
Station (ft)
HEC-RAS Model
Plan: Default Scenario
5/1/2020
RS = 1036
.05
.025
.05
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Bank Sta
Elevation (ft)
Station (ft)
HEC-RAS Model
Plan: Default Scenario
5/1/2020
RS = 1035
.05
.025
.05
Legend
EG Sand Creek
WS Sand Creek
Ground
Bank Sta
Elevation (ft)
Station (ft)
HEC-RAS Model
Plan: Default Scenario
5/1/2020
RS = 1034
.05
.025
.05
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
6248
6250
6252
6254
6256
6258
6260
6262
6264
0
50
100
150
200

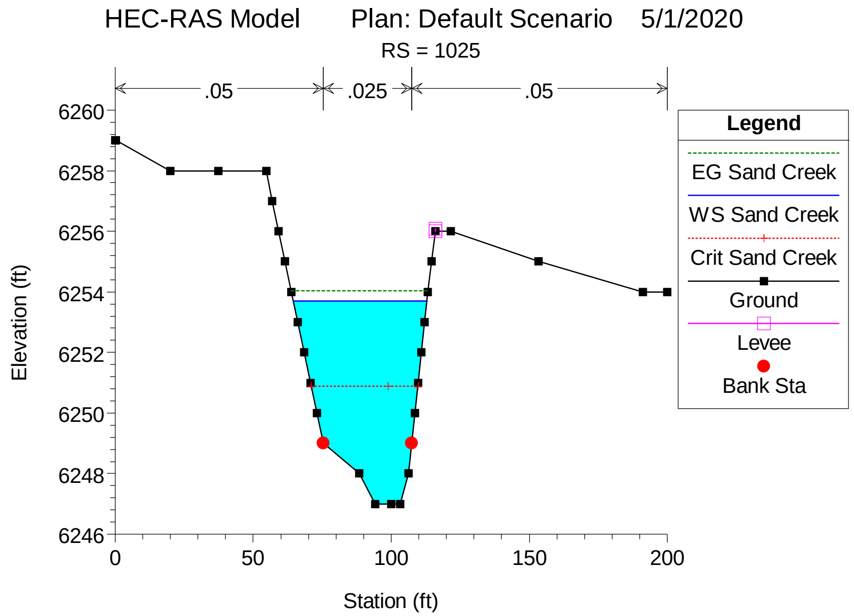

HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1033
.05
.025
.05
Elevation (ft)
Station (ft)
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta

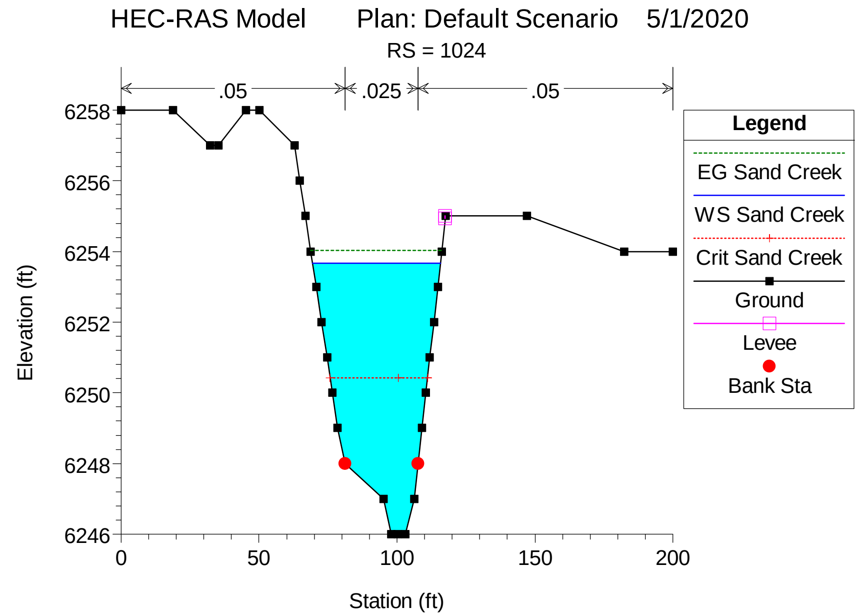

HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1032
.05
.025
.05
Elevation (ft)
Station (ft)
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta

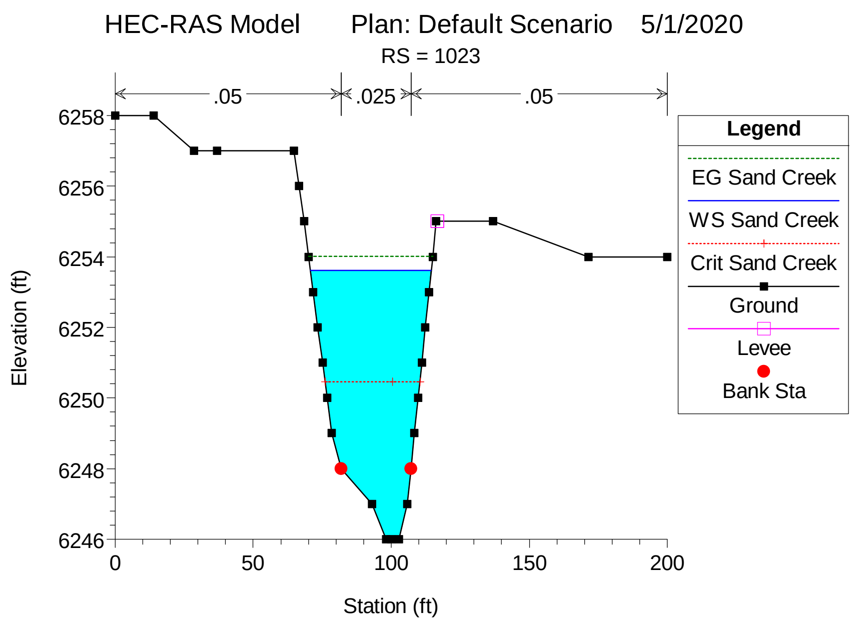

HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1031
.05
.025
.05
Elevation (ft)
Station (ft)
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta

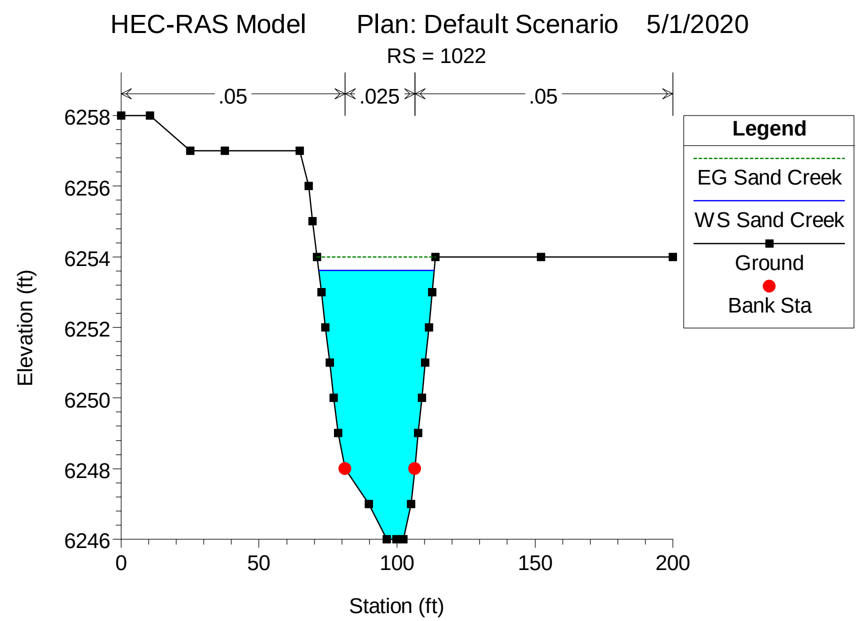

HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1030
.05
.025
.05
Elevation (ft)
Station (ft)
Legend
EG Sand Creek
WS Sand Creek
Ground
Bank Sta

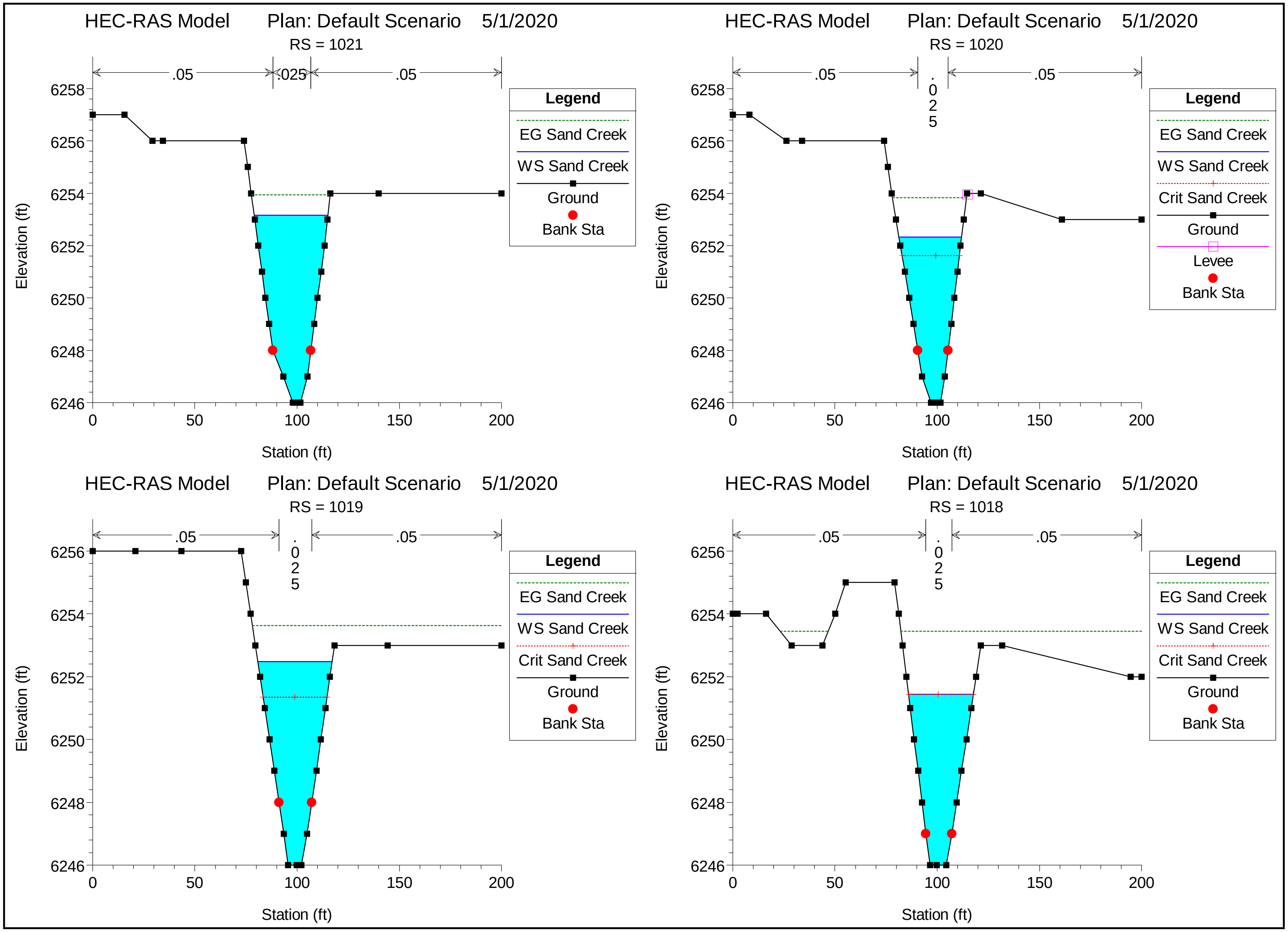

HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1029
.05
.025
.05
Legend
EG Sand Creek
WS Sand Creek
Ground
Bank Sta
Elevation (ft)
6260
6258
6256
6254
6252
6250
6248
6246
0
50
100
150
200
Station (ft)

HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1028
.05
.025
.05
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta
Elevation (ft)
6262
6260
6258
6256
6254
6252
6250
6248
6246
0
50
100
150
200
Station (ft)

HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1027
.05
.025
.05
Legend
EG Sand Creek
WS Sand Creek
Ground
Bank Sta
Elevation (ft)
6260
6258
6256
6254
6252
6250
6248
6246
0
50
100
150
200
Station (ft)

HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1026
.05
.025
.05
Legend
EG Sand Creek
WS Sand Creek
Ground
Bank Sta
Elevation (ft)
6260
6258
6256
6254
6252
6250
6248
6246
0
50
100
150
200
Station (ft)

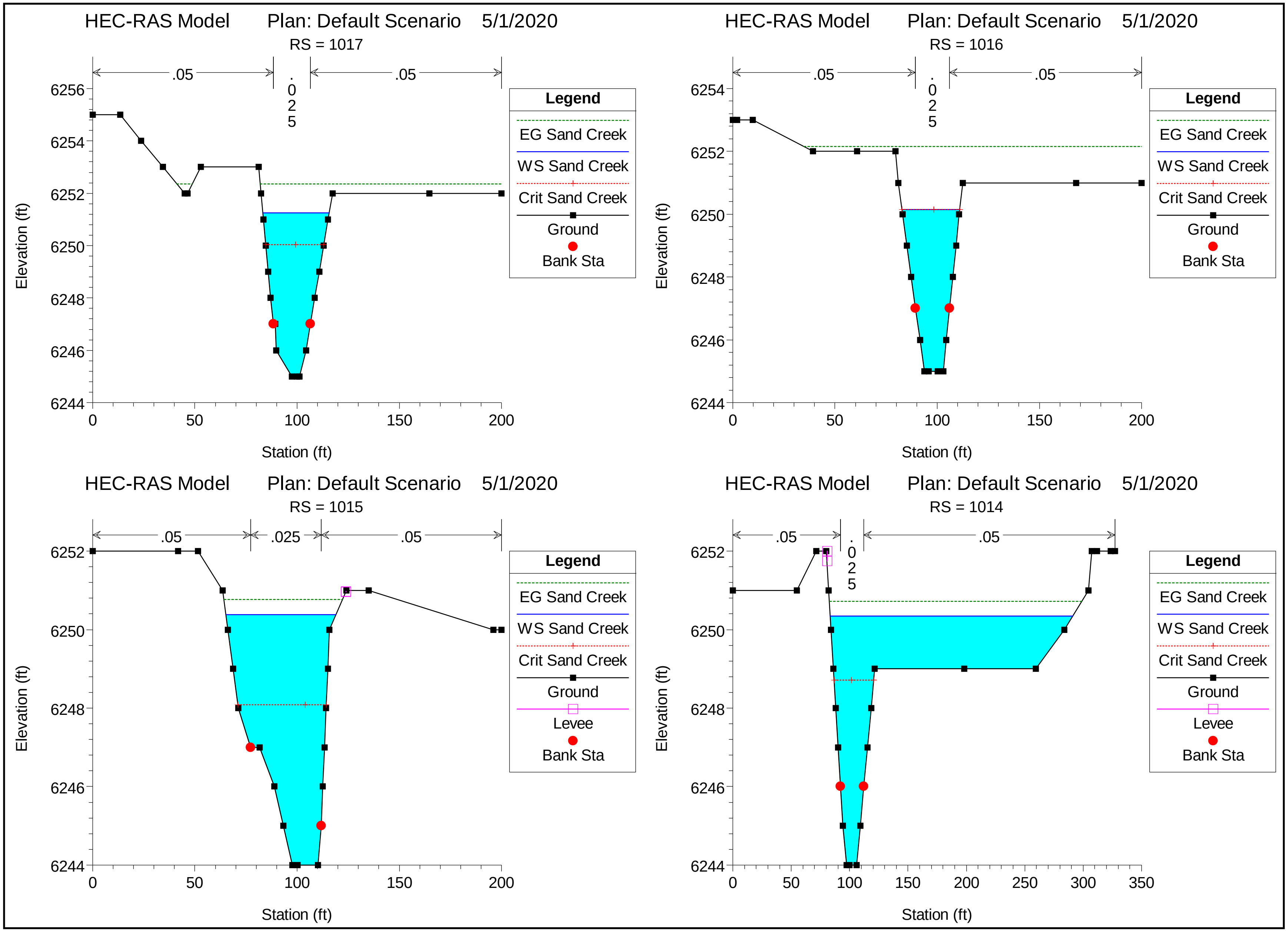

HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1025
.05
.025
.05
Elevation (ft)
6246
6248
6250
6252
6254
6256
6258
6260
Station (ft)
0
50
100
150
200
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta


HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1024
.05
.025
.05
Elevation (ft)
6246
6248
6250
6252
6254
6256
6258
Station (ft)
0
50
100
150
200
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta

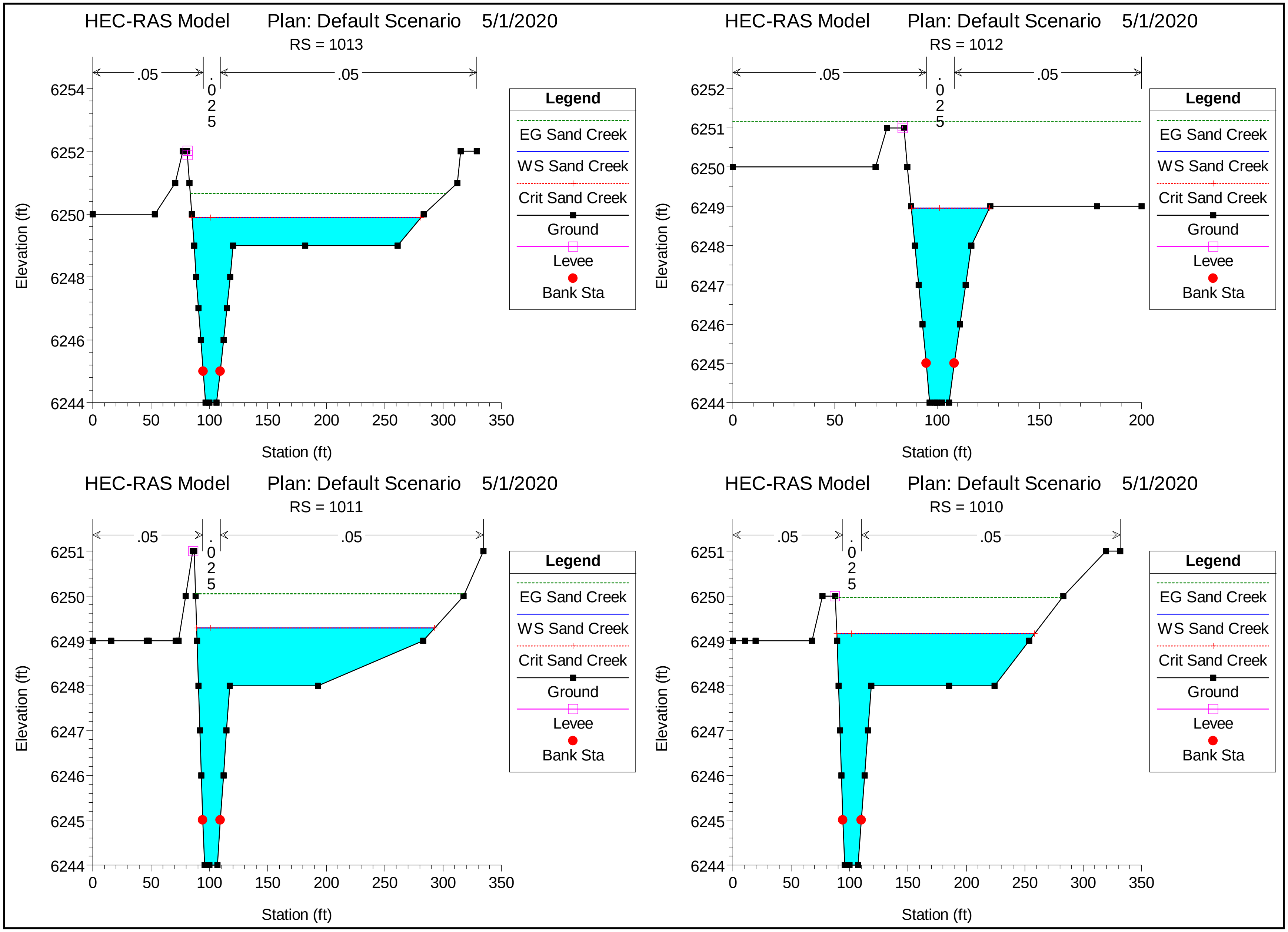

HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1023
.05
.025
.05
Elevation (ft)
6246
6248
6250
6252
6254
6256
6258
Station (ft)
0
50
100
150
200
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta

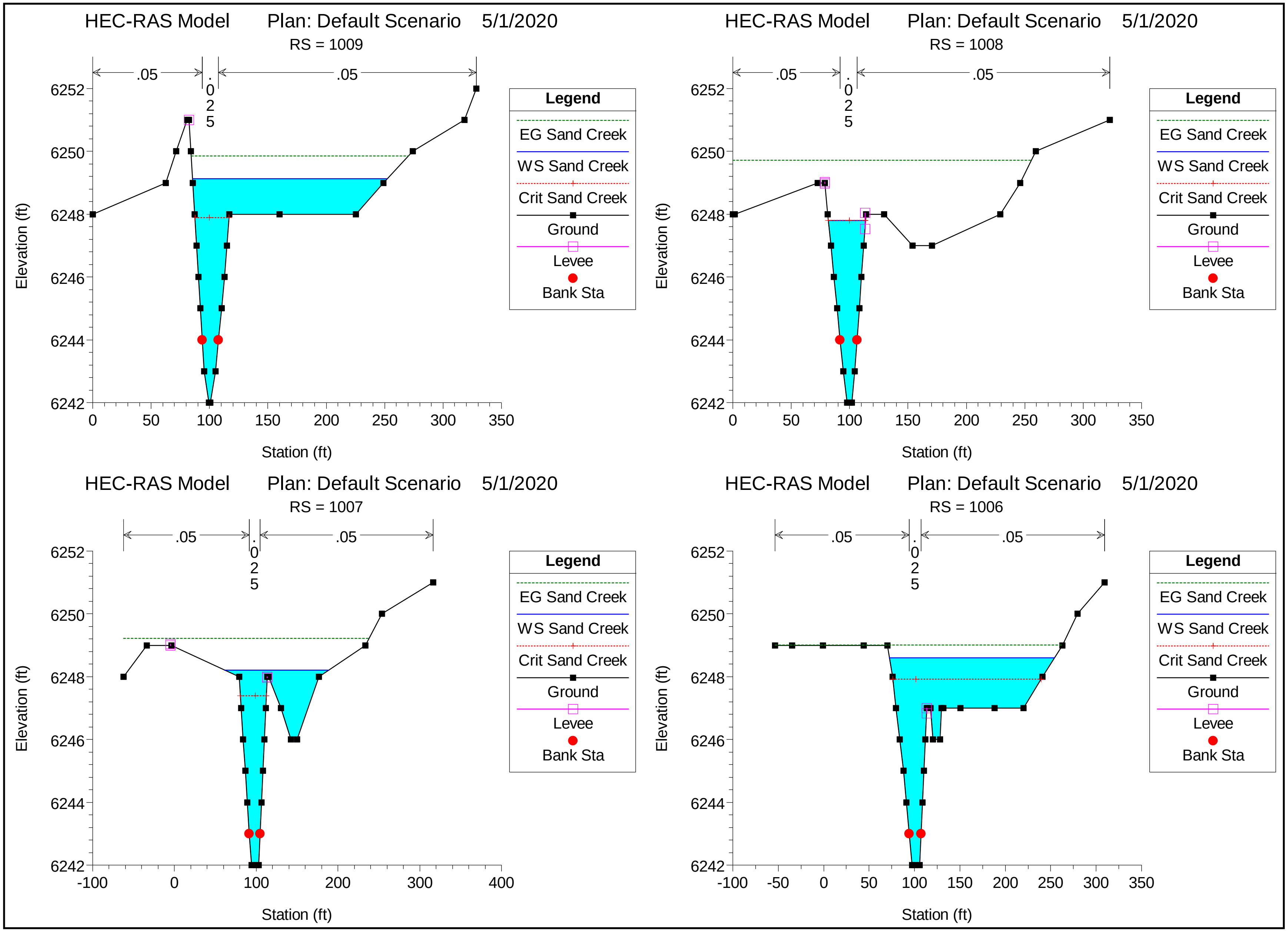

HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1022
.05
.025
.05
Elevation (ft)
6246
6248
6250
6252
6254
6256
6258
Station (ft)
0
50
100
150
200
Legend
EG Sand Creek
WS Sand Creek
Ground
Bank Sta


HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1021
.05
.025
.05
Legend
EG Sand Creek
WS Sand Creek
Ground
Bank Sta
Elevation (ft)
Station (ft)
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1020
.05
.025
.05
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1019
.05
.025
.05
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Bank Sta
Elevation (ft)
Station (ft)
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1018
.05
.025
.05
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Bank Sta
Elevation (ft)
Station (ft)



HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1017
.05
.025
.05
Elevation (ft)
Station (ft)
6244
6246
6248
6250
6252
6254
6256
0
50
100
150
200
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Bank Sta
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1016
.05
.025
.05
Elevation (ft)
Station (ft)
6244
6246
6248
6250
6252
6254
0
50
100
150
200
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Bank Sta
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1015
.05
.025
.05
Elevation (ft)
Station (ft)
6244
6246
6248
6250
6252
0
50
100
150
200
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1014
.05
.025
.05
Elevation (ft)
Station (ft)
6244
6246
6248
6250
6252
0
50
100
150
200
250
300
350
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta


HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1013
.05
.025
.05
Elevation (ft)
Station (ft)
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1012
.05
.025
.05
Elevation (ft)
Station (ft)
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1011
.05
.025
.05
Elevation (ft)
Station (ft)
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1010
.05
.025
.05
Elevation (ft)
Station (ft)
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta


HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1009
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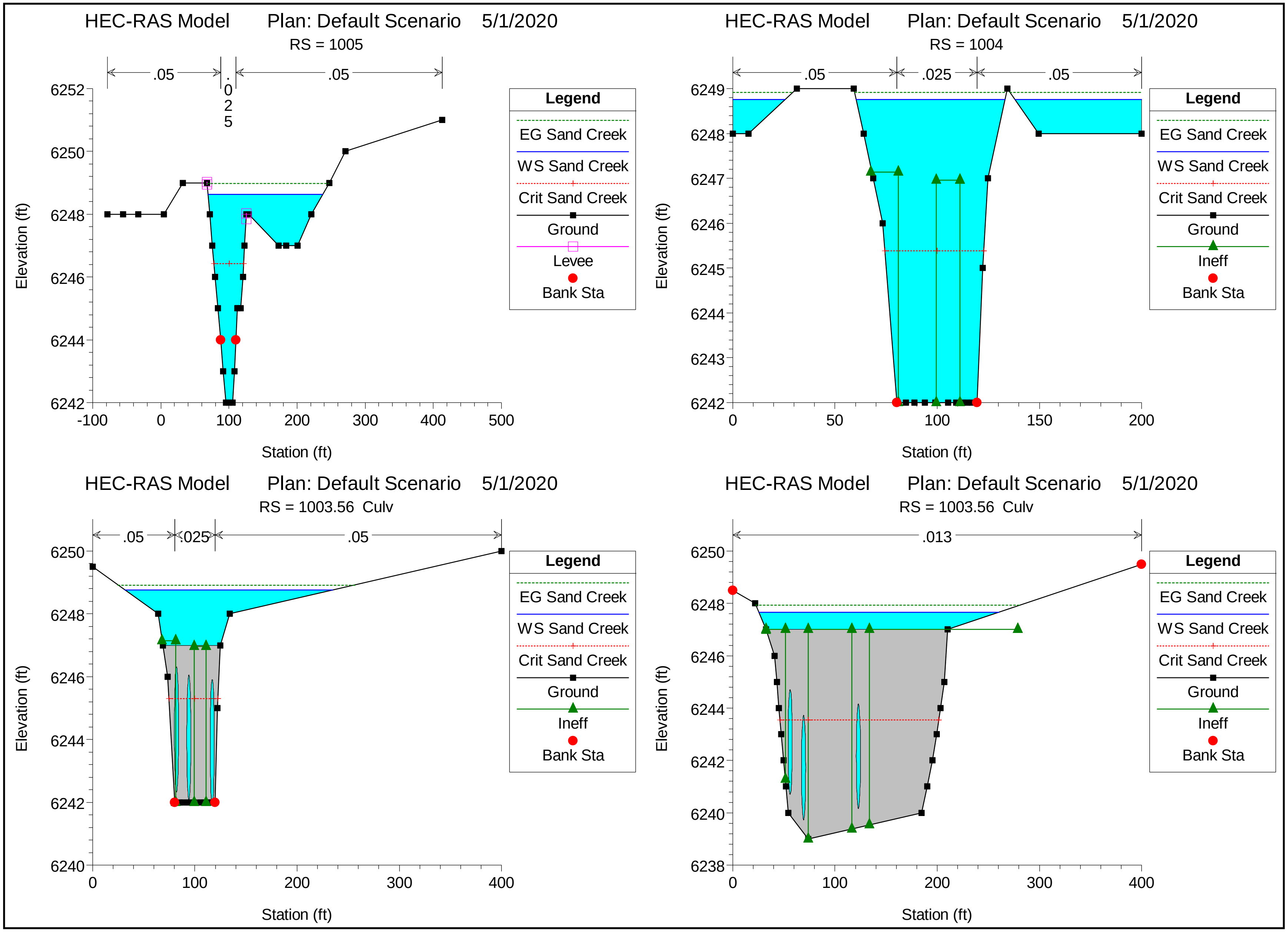
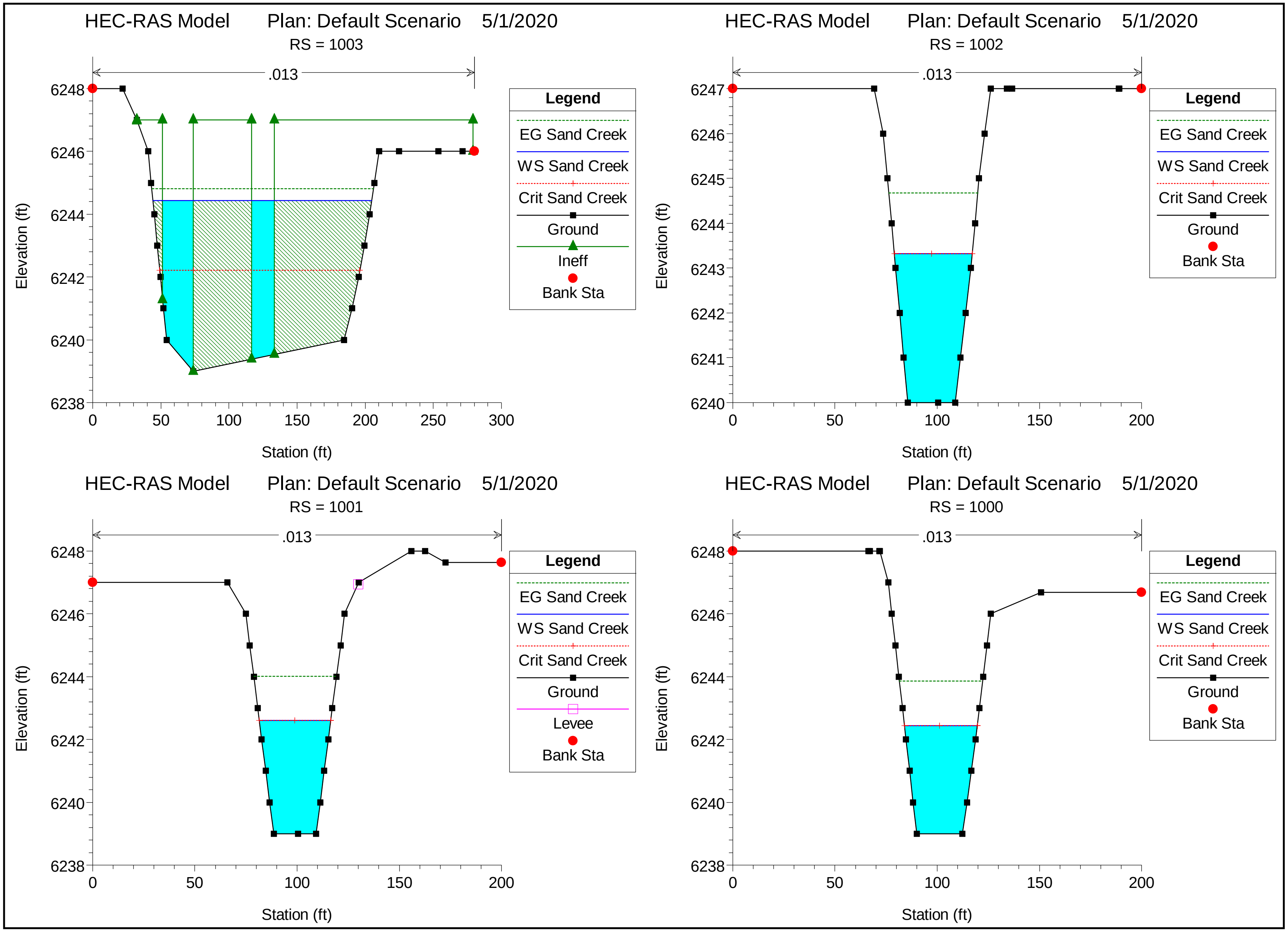
.025
.05
Elevation (ft)
Station (ft)
6242
6244
6246
6248
6250
6252
0
50
100
150
200
250
300
350
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1008
.05
.025
.05
Elevation (ft)
Station (ft)
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1007
.05
.025
.05
Elevation (ft)
Station (ft)
-100
0
100
200
300
400
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1006
.05
.025
.05
Elevation (ft)
Station (ft)
-100
-50
0
50
100
150
200
250
300
350
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta


HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1005
.05
.025
.05
Elevation (ft)
Station (ft)
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1004
.05
.025
.05
Elevation (ft)
Station (ft)
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Ineff
Bank Sta
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1003.56 Culv
.05
.025
.05
Elevation (ft)
Station (ft)
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Ineff
Bank Sta
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1003.56 Culv
.013
Elevation (ft)
Station (ft)
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Ineff
Bank Sta



HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1003
.013
Elevation (ft)
Station (ft)
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Ineff
Bank Sta
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1002
.013
Elevation (ft)
Station (ft)
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Bank Sta
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1001
.013
Elevation (ft)
Station (ft)
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Levee
Bank Sta
HEC-RAS Model Plan: Default Scenario 5/1/2020
RS = 1000
.013
Elevation (ft)
Station (ft)
Legend
EG Sand Creek
WS Sand Creek
Crit Sand Creek
Ground
Bank Sta

Worksheet for Rectangular Weir - 4' Openings (10)

Project Description

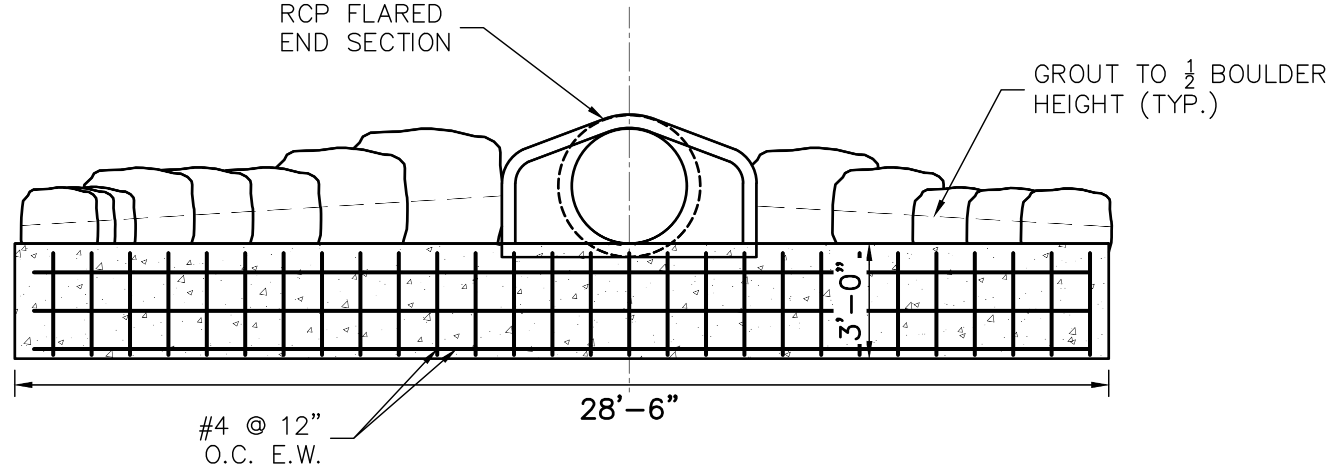
Solve For	Discharge

Input Data

Headwater Elevation	0.50	ft
Crest Elevation	0.00	ft
Tailwater Elevation	0.00	ft
Weir Coefficient	3.10	US
Crest Length	4.00	ft
Number Of Contractions	0	

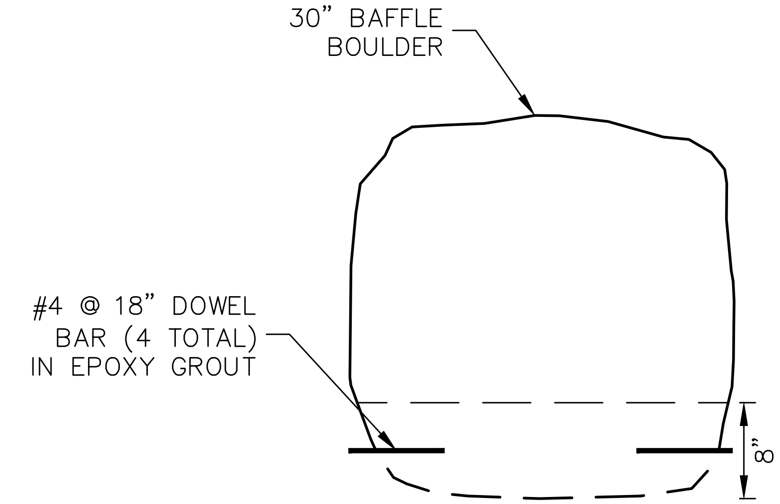
Results

Discharge	4.38	ft^3/s
Headwater Height Above Crest	0.50	ft
Tailwater Height Above Crest	0.00	ft
Flow Area	2.00	ft^2
Velocity	2.19	ft/s
Wetted Perimeter	5.00	ft
Top Width	4.00	ft



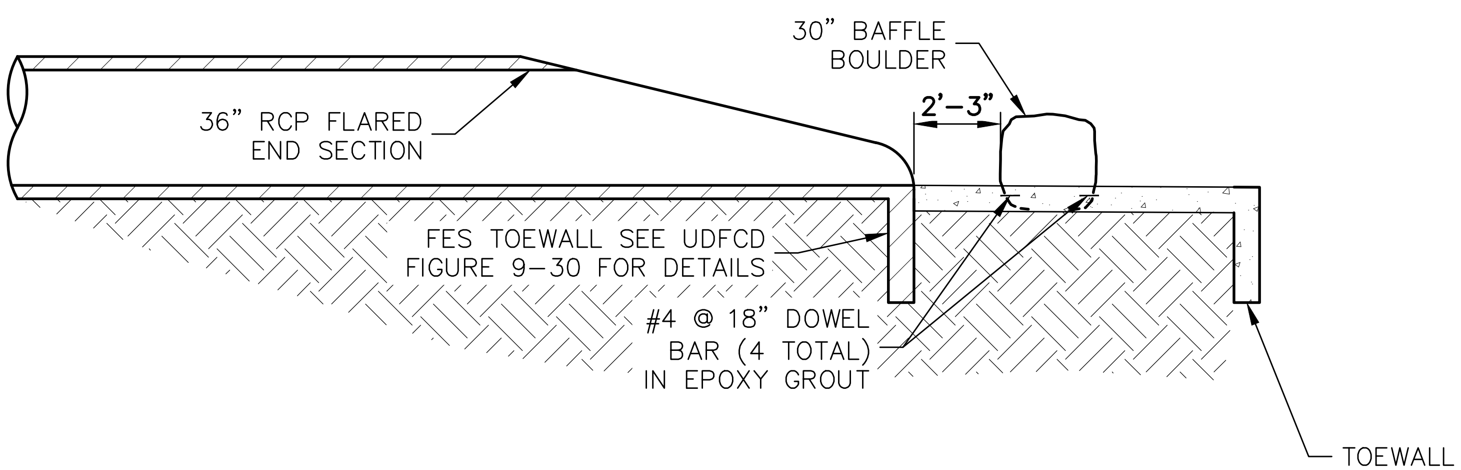
36" RCP TOEWALL FOOTING ELEVATION VIEW

SCALE: 1" = 5'



BAFFLE BOULDER DETAIL

SCALE: NTS



TOEWALL FOOTING PROFILE

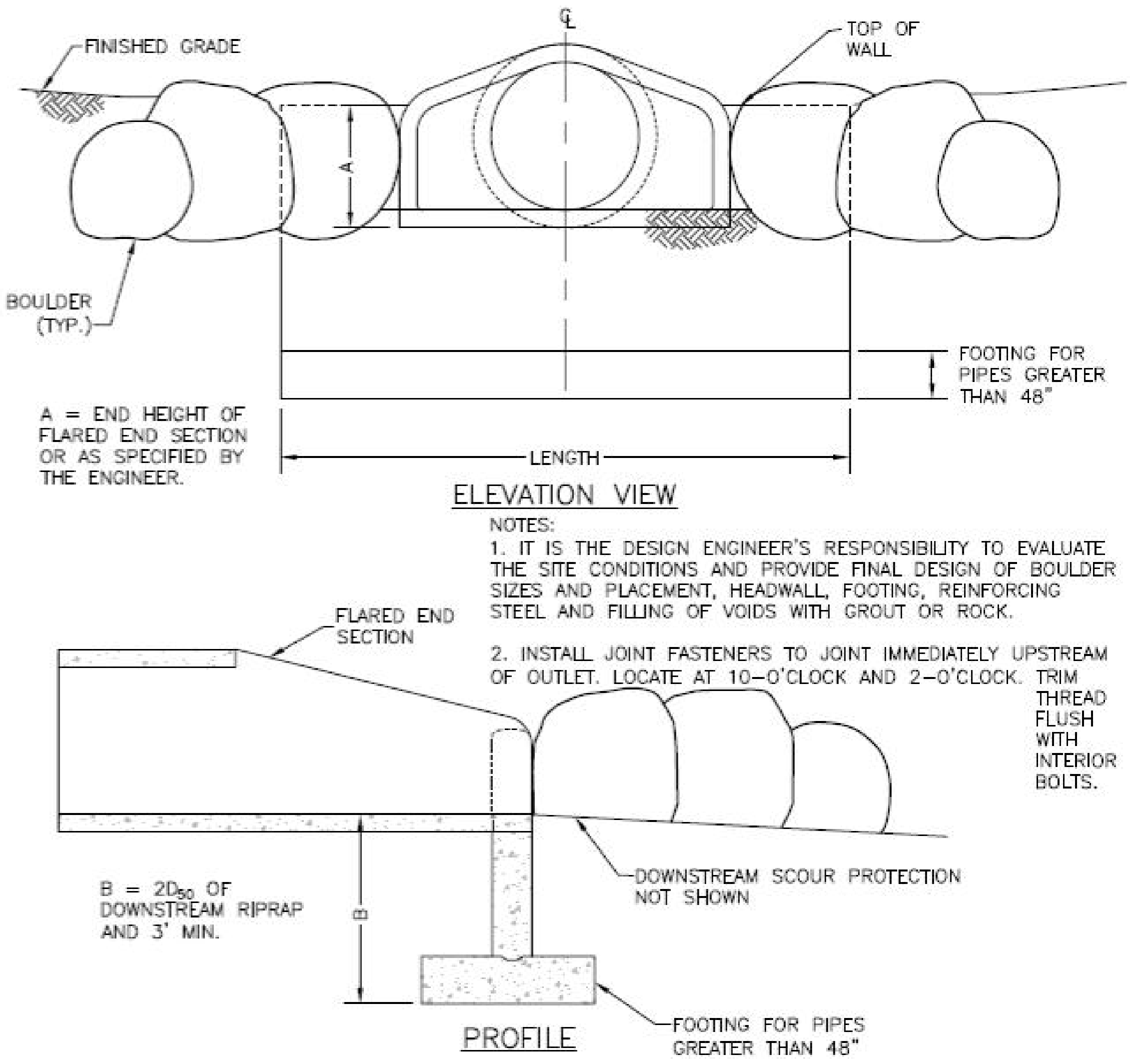
SCALE: 1" = 5'

ENERGY DISSIPATION
STRUCTURE
SOLACE APARTMENTS
JOB NO. 25174.00
5/1/20
SHEET 1 OF 1

J·R ENGINEERING
A Westrian Company

Centennial 303-740-9393 • Colorado Springs 719-593-2593
Fort Collins 970-491-9888 • www.jrengineering.com

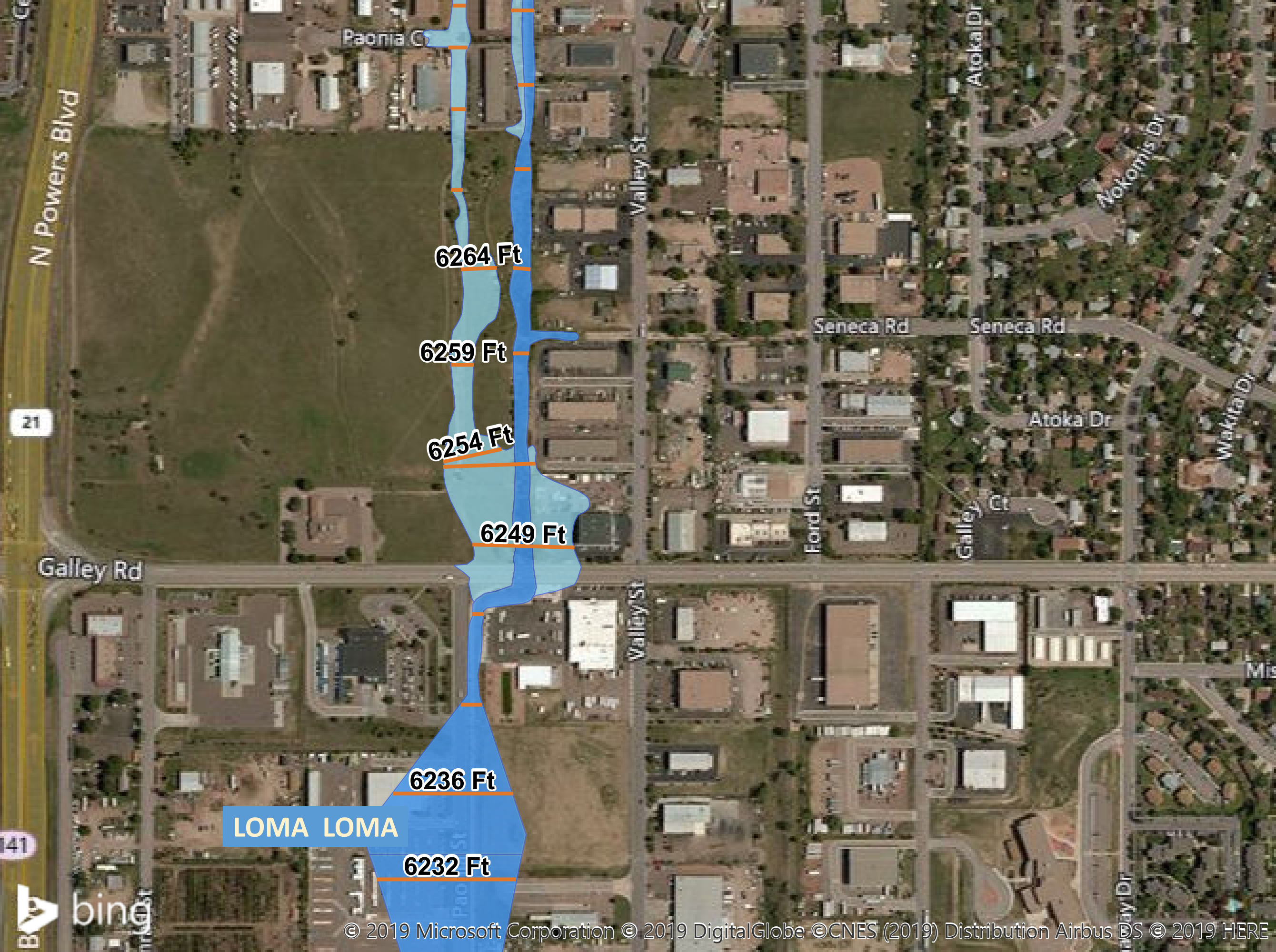
X:\2510000.all\2517400\Drawings\Presentations\Energy Dissipation.dwg, 11x17 Landscape, 4/28/2020 9:10:08 AM, McmullanA



TOEWALL DESIGN TABLE

PIPE SIZE	LENGTH, MIN.
18"	7'-0"
24"	8'-0"
30"	10'-0"
36"	12'-0"
42"	12'-6"
48"	13'-0"
54"	13'-6"
60"	14'-0"
66"	14'-6"
72"	15'-0"

Figure 9-30. Flared end section (FES) headwall concept


Paonia Ct
N Powers Blvd
21
6264 Ft
6259 Ft
6254 Ft
6249 Ft
6236 Ft
6232 Ft
LOMA LOMA
Galley Rd
Valley St
Ford St
Atoka Dr
Nokomis Dr
Seneca Rd
Seneca Rd
Atoka Dr
Wakita Dr
Galley Ct
141
bing
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Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. — Thursday, Jun 25 2020

Ex. Concrete Channel

Trapezoidal

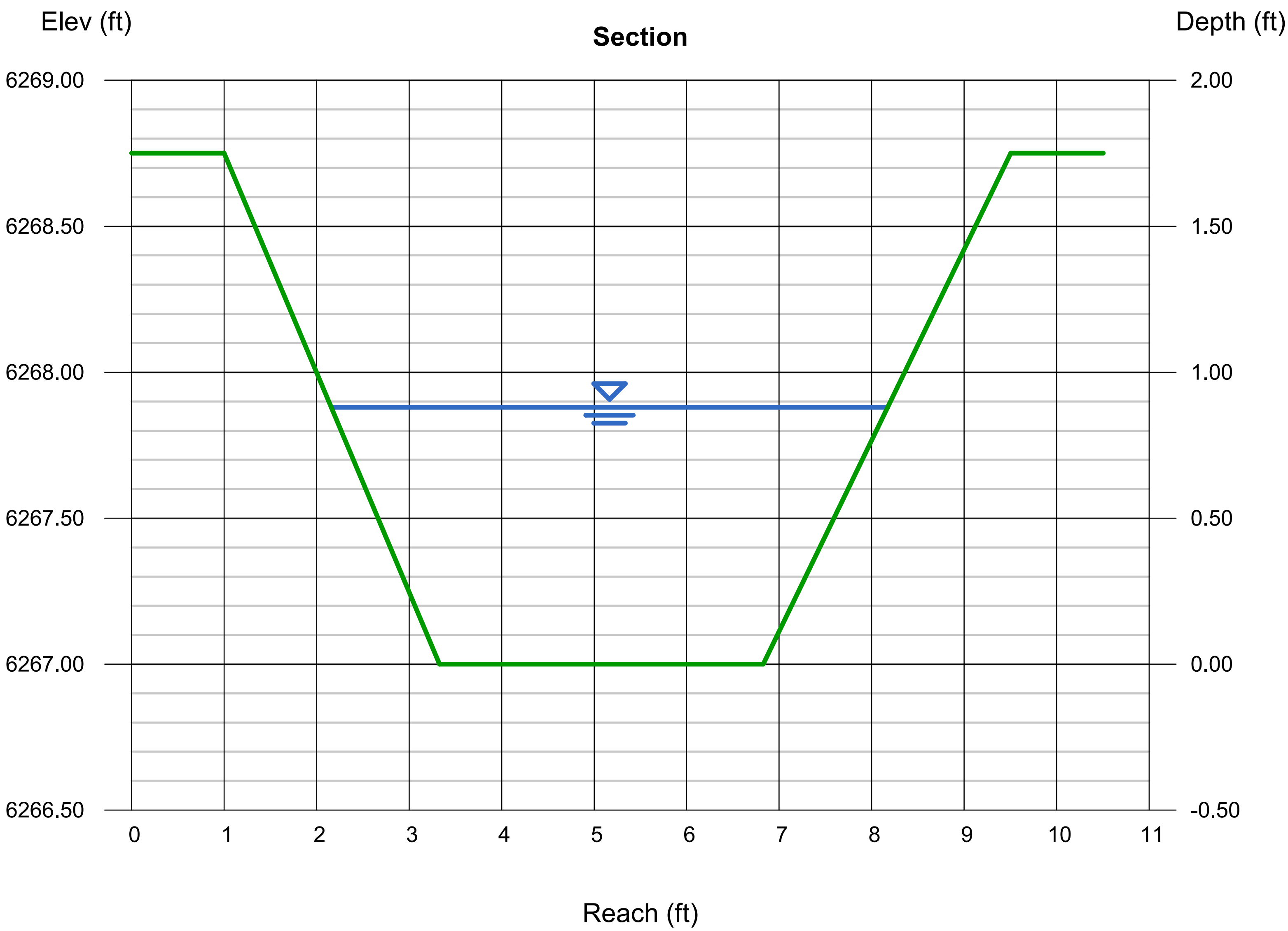
Bottom Width (ft)	= 3.50
Side Slopes (z:1)	= 1.33, 1.53
Total Depth (ft)	= 1.75
Invert Elev (ft)	= 6267.00
Slope (%)	= 1.41
N-Value	= 0.013

Calculations

Compute by:	Known Depth
Known Depth (ft)	= 0.88

Highlighted

Depth (ft)	= 0.88
Q (cfs)	= 42.08
Area (sqft)	= 4.19
Velocity (ft/s)	= 10.05
Wetted Perim (ft)	= 6.57
Crit Depth, Yc (ft)	= 1.37
Top Width (ft)	= 6.02
EGL (ft)	= 2.45



Weir Report

Paonia Street Weir

Compound Weir

Crest	= Sharp
Bottom Length (ft)	= 115.00
Total Depth (ft)	= 1.25
Length, x (ft)	= 80.00
Depth, a (ft)	= 0.50

Highlighted

Depth (ft)	= 1.24
Q (cfs)	= 439.00
Area (sqft)	= 125.10
Velocity (ft/s)	= 3.51
Top Width (ft)	= 115.00

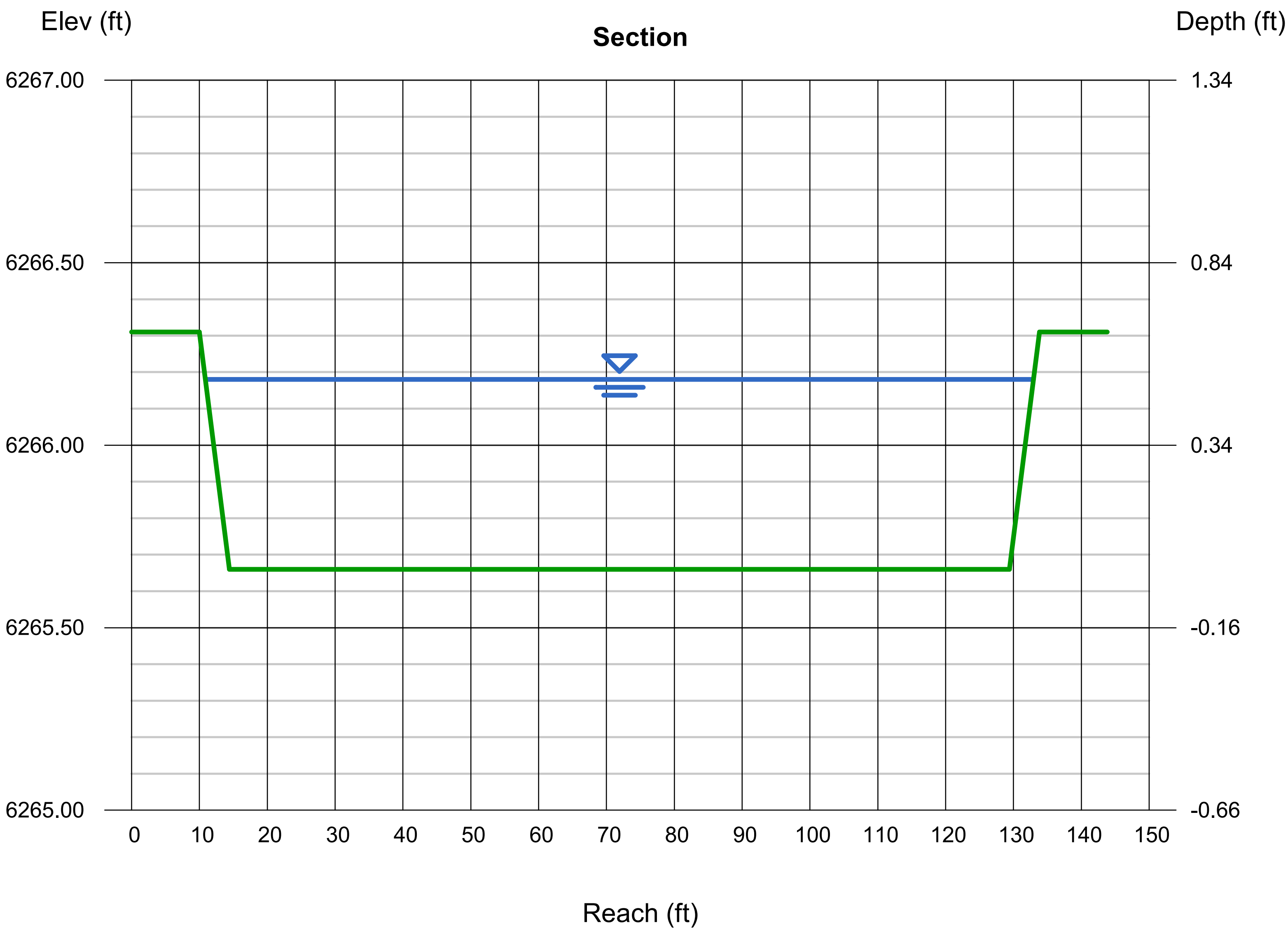
Calculations

Weir Coeff. Cw	= 3.33
Compute by:	Known Q
Known Q (cfs)	= 439.00

Channel Report

Overflow Channel

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 115.00	Depth (ft)	= 0.52
Side Slopes (z:1)	= 6.80, 6.80	Q (cfs)	= 439.00
Total Depth (ft)	= 0.65	Area (sqft)	= 61.64
Invert Elev (ft)	= 6265.66	Velocity (ft/s)	= 7.12
Slope (%)	= 1.68	Wetted Perim (ft)	= 122.15
N-Value	= 0.017	Crit Depth, Yc (ft)	= 0.65
		Top Width (ft)	= 122.07
Calculations		EGL (ft)	= 1.31
Compute by:	Known Q		
Known Q (cfs)	= 439.00		

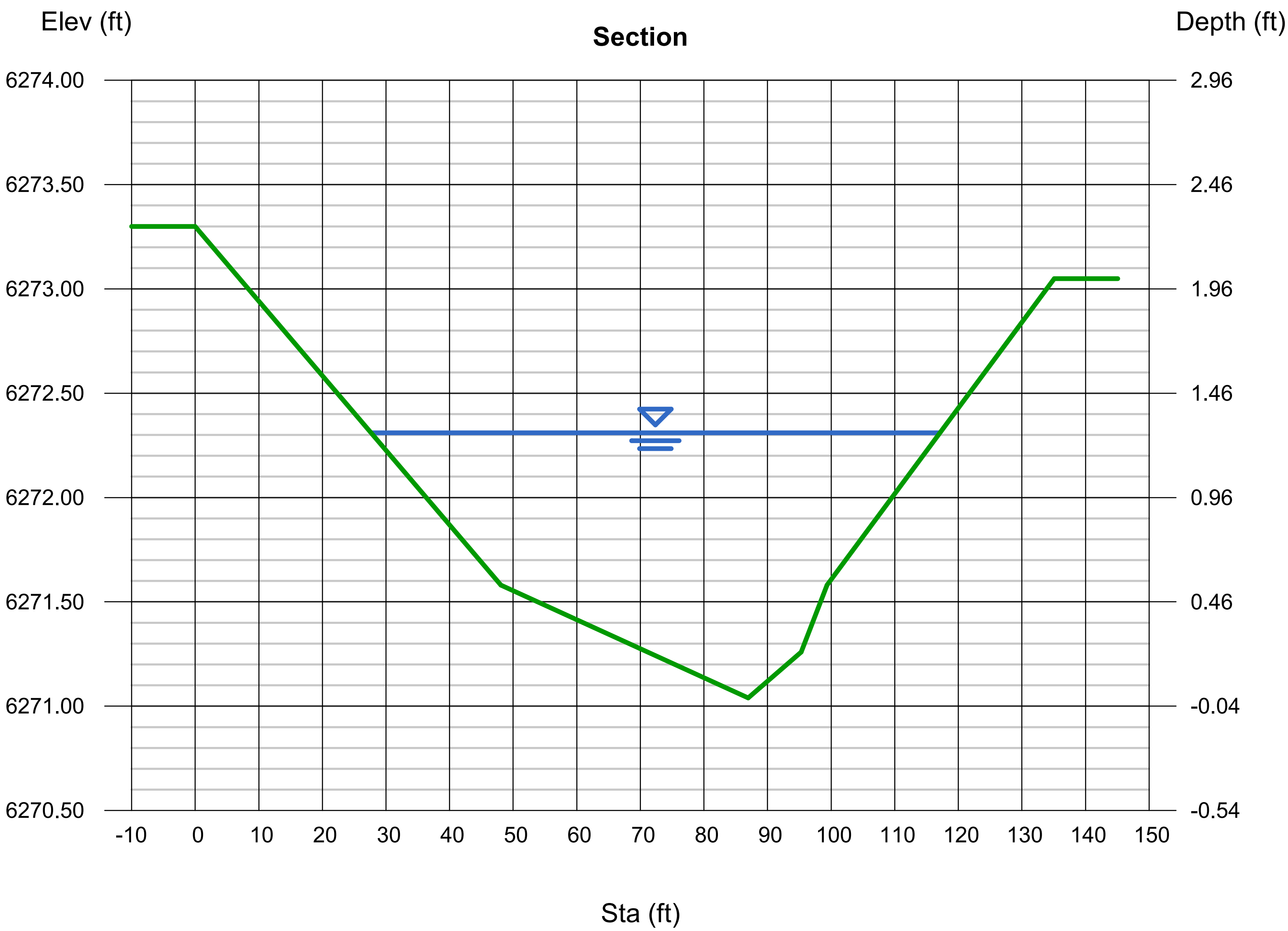


Channel Report

Paonia Street Ex.

User-defined		**Highlighted**	
Invert Elev (ft)	= 6271.04	Depth (ft)	= 1.27
Slope (%)	= 1.00	Q (cfs)	= 500.00
N-Value	= 0.016	Area (sqft)	= 66.09
		Velocity (ft/s)	= 7.57
Calculations		Wetted Perim (ft)	= 89.48
Compute by:	Known Q	Crit Depth, Yc (ft)	= 1.56
Known Q (cfs)	= 500.00	Top Width (ft)	= 89.43
		EGL (ft)	= 2.16

(Sta, El, n)-(Sta, El, n)...
(0.00, 6273.30)-(48.06, 6271.58, 0.016)-(86.95, 6271.04, 0.016)-(95.27, 6271.26, 0.016)-(99.33, 6271.58, 0.016)-(135.09, 6273.05, 0.016)



J·R ENGINEERING

To: El Paso County Engineering Division

From: Mike Bramlett, PE

Date: November 25, 2020

Subject: Sand Creek Center Tributary Channel Improvements

The purpose of this letter is to provide design information for the existing conditions of the Sand Creek Center Tributary Drainageway, located east of the Solace Apartments site. This letter will also discuss the proposed improvements for the channel, design methodology, and the modeling results. For further information on the previous evaluation of the channel in its existing conditions and conceptual design, see the *Sand Creek – Center Tributary Channel Analyses Report for Solace Apartments* by JR Engineering. For further information concerning drainage for the Solace Apartments Site, see the *Final Drainage Report for Solace Apartments*, by JR Engineering.

Project General Discussion

The Sand Creek Center Tributary Channel is located in Section 7, Township 14 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado. The site is part of the Solace Apartments project and is located on the eastern edge of the project. As part of the proposed improvements for the Solace Apartments Project, this reach of the Sand Creek Center Tributary will also be improved. The sections upstream and downstream of the site have already undergone improvements, and the channel in its current state shows extensive flooding in a 100 year event. In addition to improvements to the Sand Creek Center Tributary Channel, the channels secondary drainageway located to the west of the channel in Paonia Street will also be improved with an overflow channel that will direct flow present in the secondary drainageway into the main channel and avoid further flooding of the Paonia Street extension into the Solace Apartments site.

Channel Flows

Evaluation of the flows present in the Sand Creek Center Tributary and its secondary drainageway were discussed in detail in the *Sand Creek – Center Tributary Channel Analysis for Solace Apartmen*ts by JR Engineering. Since the initial analysis of the channel took place, JR Engineering was able to acquire the modeling data used by FEMA for determination of flood plain modeling shown in FEMA FIRM 08041C0752G. JR Engineering assumes FEMA's flows to be accurate, and thus utilized these as the basis for our model. The main channel contains 820 cfs of flow and the secondary channel contains 217 cfs. The flow in the main channel then jumps up to 1,037 cfs at the convergence of the secondary drainageway. Downstream an existing channel coming from nearby Valley Road (east) converges with the main channel, we then utilized FEMA's 1,100 cfs to model the remaining portion of the channel.

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Existing Channel Conditions

In its existing conditions the Sand Creek Center Tributary Channel along the Solace site consists of a natural channel overgrown with trees and bushes along the sides of the channel with the bottom being relatively clean and free of obstacles. The 1,350 LF reach of the Sand Creek Center Tributary Channel located incorporated with the Solace site is undeveloped, as compared to the majority of channels in the basin which have had some improvement. Downstream and upstream sections of the Sand Creek Center Tributary Channel are concrete lined. The secondary Drainageway located in Paonia Street flows south from Omaha Blvd to the Solace Apartments site where flow splits between an existing concrete channel running east to the main Sand Creek Center Tributary Channel, and a swale flowing south where it eventually rejoins the main channel at the Galley Road crossing. It is anticipated that the concrete channel will divert 42 cfs from the 217cfs present in the secondary drainageway, with 175 cfs flowing south down the existing swale. There is also an existing channel coming from Valley Road to the east. This channel intersects the main channel approximate halfway between the north and south limits of the site, adding 63 cfs to the main channel, as discussed in the Channel Flows section above. In its existing conditions, the Sand Creek Center Tributary Channel FEMA firm panel 08041C0752G, depicts 100 year flooding extending into the adjacent properties to the east and onto Paonia Street improvements to the west. The existing channel currently overtops the Galley Road crossing; primarily due to the capacity of the culverts at the crossing rather than the channel's current conditions.

Proposed Channel Improvements

As determined by the Sand Creek Drainage Basin Planning Study (DBPS) & and JR Engineering Sand Creek – Center Tributary Channel Analysis for Solace Apartments, this section of the Sand Creek Center Tributary will require improvements to ensure adequate capacity in the channel and protection against erosive velocities. In order to be consistent with improvements already made in the surrounding area and to align with the recommendations made by the DBPS, JR Engineering is proposing concrete lining of the channel along the Solace site, along with widening of the existing channel and modification to the channel alignment in this area. JR Engineering is also proposing the addition of a USBR Type III Stilling Basin and 10 foot sloped concrete drop in the channel, in order to force a hydraulic jump in the channel and reduce velocities present in the channel while still matching existing grades for the majority of channel alignment. The design methodology of the sloped drop and USBR Type III Stilling Basin are based on the design procedure for Stilling Basins presented in the Federal Highway Administrations Hydraulic Engineering Circular No. 14, Chapter 8. Calculation for stilling basin and accessories sizing can be found in the Appendix of this letter. The proposed channel section shall be a trapezoidal channel section with a 10' bottom width, with a minimum channel depth of 6.5' and side slopes varying from 3:1 to 2:1 along the channel's alignment. The channel shall be lined with concrete for a depth of 4.5' to protect the channel from the erosive velocities present in the channel, with an average depth of flow in a 100 year event for the proposed channel being approximately 3' this will provide a freeboard of 1'-1.5' from the top of the concrete lining to the 100 year water surface. The concrete section shall typically be a 6" thick concrete apron for the channel, with sections of the section of channel located within the sloped drop and stilling basin being a 12" thick concrete apron. In accordance with the DBPS the channel shall be designed with a stable slope of 1% for the majority of the channel. For further details please see the Channel Improvement Plans included in the Appendix of this letter. In order to reduce the velocities present in the channel and avoid excessively steep slopes for extended portions of the channel's alignment, a 100' long sloped drop structure, with a total vertical drop of 10', will be placed at the upstream end of the channel. At the base of the drop will be a USBR Type III Stilling Basin that will include chute blocks, baffle blocks and a sill wall to decrease the velocity of the water coming down the sloped drop and force a hydraulic jump. This basin will also include a low flow channel through the sill wall located at the end of the stilling basin to allow water movement through the structure at lower flows and prevent ponding of water in the structure. Further detail for the sloped drop and stilling basin can be found in the channel improvement plans shown in the Appendix.

Paonia Street Secondary Drainageway Improvements
Part of the Sand Creek Center Tributary Improvements also includes the addition of a diversion channel that will direct flows present in the Paonia Street Secondary Drainageway into the main channel. This diversion will be known as the Overflow Channel for the remainder of this letter. The Overflow Channel shall be a concrete and riprapped lined channel with varying widths and depths that will convey the flows present in Paonia Street into the main channel. The diversion channel shall be concrete from the edge of Paonia to the right-of-way, after which it will become a riprap trapezoidal channel section with a typical bottom width of 20' and a depth of 2'-3'. The channel will run east from Paonia until it intersects with the proposed Sand Creek Center Tributary Channel alignment, where it will outfall just upstream of the proposed sloped drop in the channel. Just south of the diversion channel opening along Paonia Street will be two 15'type R inlets, that will be used to capture nuisance flows in the curb & gutter and also any flow that may bypass the diversion channel. These inlets will directly outfall into the main channel and will not be detained by any of the onsite detention ponds. For further detail on the diversion channel please see the channel improvement plans, and for detail on the type R inlets see the exert of the Solace Construction Drawings, both shown in the Appendix of this letter.

Modeling Results
The proposed conditions of the channel and its second Drainageway were modeled using GeoHecRas to determine the extents of the 100 year floodplain for the site. Flow rates from the model were used based on those discussed in the Channel Flows section and Existing Conditions section of this letter. The model was run with downstream boundary conditions for each reach using critical depths, and the entirety of the model was ran using steady flow conditions. The model was contains four separate reaches, with the main reach modeling the proposed alignment and conditions for the Sand Creek Center Tributary Channel. The other reaches modeling the Paonia Street Overflow Channel, the existing concrete overflow channel at Paonia and an existing channel that runs east to west from Valley Street and intersects the Sand Creek Center Tributary Channel, each reach intersection were modeled using the energy equation. The model used manning's values (n) of 0.013 for the concrete lining, 0.033 for the riprap of the overflow channel, and 0.03 for the any location outside of the concrete or riprap extents as they were determined to be most similar to a grassed area with some weeds. The results of the GeoHecRas model show that the proposed improvements to the channel substantially reduce the extents of the flood plain in the channel and contain the 100 year flood plain within the concrete extents of the channel. The results also show a maximum velocity in the channel of 10.32 ft/s in a 100 year event, showing that the concrete lining of the channel will provide sufficient protection from erosive velocities present in the channel. The GeoHecRas model for the proposed conditions also shows overtopping of the channel crossing at Galley Road, which is consistent with the flood data presented by the FEMA FIRM 08041C0752G. Flooding of

the roadway is due to the insufficient capacity of the culvert crossing in this area, with the current configuration of three 48” CMP culverts only providing 365 cfs of capacity of the 1,100 cfs flow at the crossing. Flooding of the Galley Road Crossing could be alleviated by upsizing of the culvert(s), these improvements will be necessary when the County deems the historic overtopping of Galley Road to be above acceptable tolerance. *The channel improvements did not results in any change to existing overtopping of Galley Road as this is due to insufficient capacity of the culverts at this crossing, which will ultimately be addressed at a later date.* Further details on the model results can be found in the Appendix.

Summary

The analysis of the proposed improvements of the Sand Creek Center Tributary Drainageway and its secondary drainageway located in Paonia Street show significant reduction of the flood plain extents, with it now being contained within the channel extents and no longer extensively flooding properties adjacent the proposed Solace Apartment Site. The proposed diversion channel also redirects flow that would otherwise flood the proposed extension of Paonia Street back into the channel, thus alleviating the risk of the roadway flooding in a 100 year event.

Please contact me should you have any questions or concerns regarding this letter at 303-267-6240.

Sincerely,
JR ENGINEERING, LLC

Mike Bramlett, PE
JR Engineering

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Colorado Springs, CO 80907
303-740-9393 • Fax: 303-721-9019
www.jrengineering.com

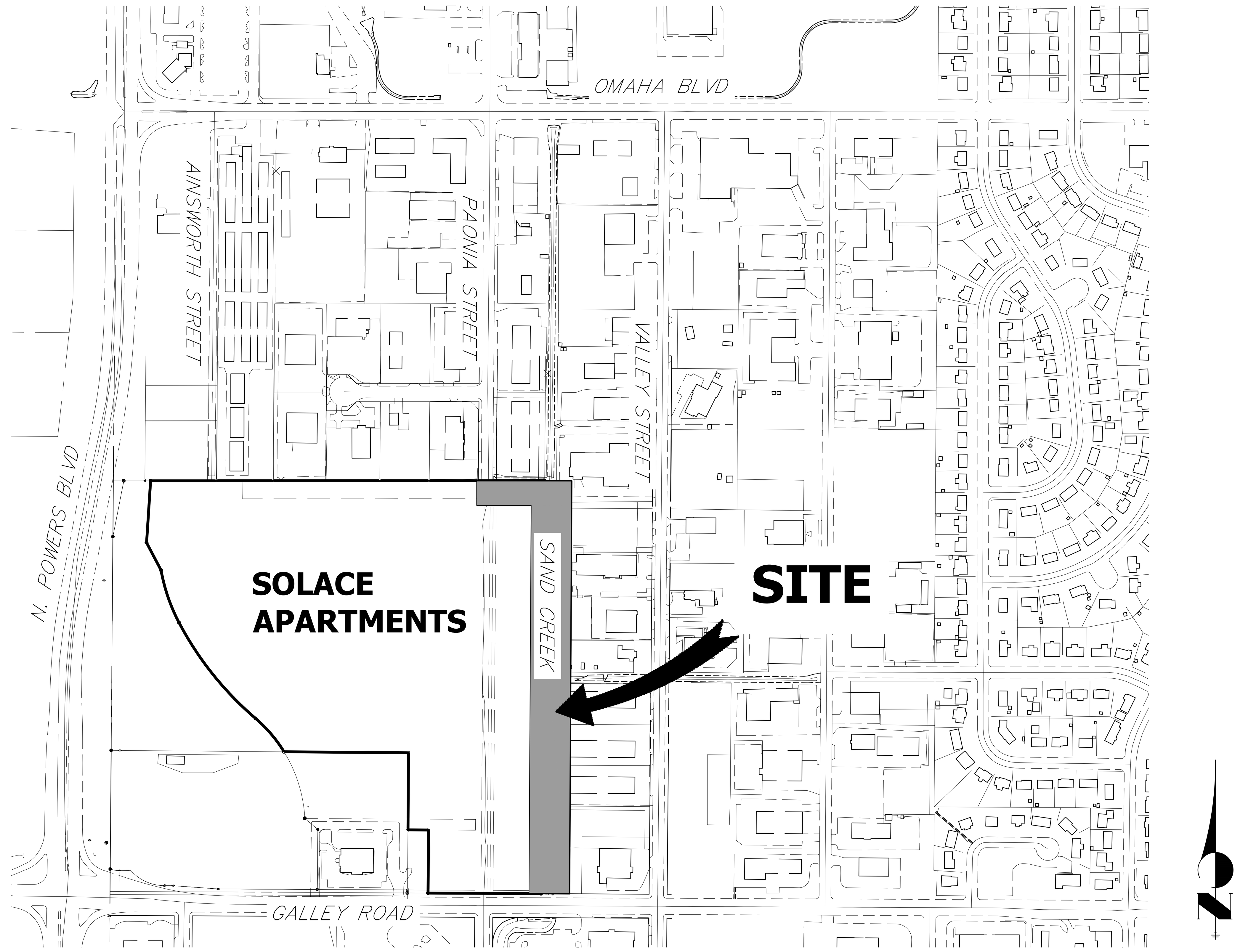
SOLACE APARTMENTS - SAND CREEK CENTER TRIBUTARY

A PORTION OF SECTION 7, TOWNSHIP 14 SOUTH, RANGE 65 WEST OF THE 6TH P.M.
EL PASO COUNTY, COLORADO

CHANNEL IMPROVEMENTS

ABBREVIATIONS

AC	ACRE
AD	ALGEBRAIC DIFFERENCE
AH	AHEAD
ARCH	ARCHITECT
ASCE	AMERICAN SOCIETY OF CIVIL ENGINEERS
ASS'Y	ASSEMBLY
AVE	AVENUE
BB	BOX BASE
BK	BACK
BNDY	BOUNDARY
BOP	BOTTOM OF PIPE
BOV	BLOW OFF VALVE
BFV	BUTTERFLY VALVE
BLVD	BOULEVARD
BW	BOTTOM OF WALL
C&G	CURB & GUTTER
CATV	CABLE TELEVISION
CB	CATCH BASIN
CBC	CONCRETE BOX CULVERT
CDOT	COLORADO DEPARTMENT OF TRANSPORTATION
CDS	CUL-DE-SAC
CFS	CUBIC FEET PER SECOND
CL	CENTER LINE
CLOMR	CONDITIONAL LETTER OF MAP REVISION
CLR	CLEAR
CMP	CORRUGATED METAL PIPE
CO	CLEAN OUT
CONC	CONCRETE
CR	CIRCLE
CSP	CORRUGATED STEEL PIPE
CT	COURT
CTRB	CONCRETE THRUST REDUCER BLOCK
CY	CUBIC YARD
DBPS	DRAINAGE BASIN PLANNING STUDY
DE	DRAINAGE EASEMENT
DIA	DIAMETER
DIP	DUCTILE IRON PIPE
DR	DRIVE
DRC	DESIGN REVIEW COMMITTEE
DU	DWELLING UNITS
E	EAST
EA	EACH
EGL	ENERGY GRADE LINE
EL	ELEVATION
ELEC	ELECTRIC
EOA	EDGE OF ASPHALT
ESMT	EASEMENT
EST	ESTIMATE
EX	EXISTING
FDP	FINAL DEVELOPMENT PLAN
FDR	FINAL DRAINAGE REPORT
FES	FLARED END SECTION
FG	FINISHED GRADE
FH	FIRE HYDRANT
FL	FLOWLINE
FIL	FILING
FO	FIBER OPTIC CABLE
GB	GRADE BREAK
GE	GAS EASEMENT
GIS	GEOGRAPHIC INFORMATION SYSTEM
GL	GAS LINE
GPS	GLOBAL POSITIONING SYSTEM
GV	GATE VALVE
HC	HANDICAP
HDC	HIGH DEFLECTION COUPLING
HDPE	HIGH DENSITY POLYETHYLENE
HGL	HYDRAULIC GRADE LINE
HOA	HOME OWNERS ASSOCIATION
HP	HIGH POINT
I	INLET
IE	IRRIGATION EASEMENT
INT	INTERSECTION
INV	INVERT
IRR	IRRIGATION
KB	KICK (THRUST) BLOCK
LE	LANDSCAPE EASEMENT
LF	LINEAR FEET
LN	LANE
LOMR	LETTER OF MAP REVISION
LP	LOW POINT
LS	LUMP SUM
LT	LEFT
MAX	MAXIMUM
MDDP	MASTER DEVELOPMENT DRAINAGE PLAN
MH	MANHOLE
MIN	MINIMUM
N	NORTH
NRCP	NON-REINFORCED CONCRETE PIPE
ODP	OFFICIAL DEVELOPMENT PLAN
OHE	OVERHEAD ELECTRIC
OHU	OVERHEAD UTILITY
PC	POINT OF CURVATURE
PCC	POINT OF COMPOUND CURVATURE
PCR	POINT OF CURB RETURN
PDP	PRELIMINARY DEVELOPMENT PLAN
PE	PROFESSIONAL ENGINEER
PI	POINT OF INTERSECTION
PKWY	PARKWAY
PL	PROPERTY LINE
PR	PROPOSED
PRC	POINT OF REVERSE CURVATURE
PT	POINT OF TANGENCY
PV	PLUG VALVE
PVC	POLYVINYL CHLORIDE
R	RADIUS
RCP	REINFORCED CONCRETE PIPE
RD	ROAD
ROW	RIGHT OF WAY
RT	RIGHT
S	SOUTH
STE	STEEL
SAN	SANITARY SEWER
SF	SQUARE FEET
ST	STREET
STA	STATION
STM	STORM SEWER
SY	SQUARE YARD
SY-IN	SQUARE YARD INCH
TB	THRUST BLOCK
TBC	TOP BACK OF CURB
TBW	TOP BACK OF WALK
TEL	TELEPHONE
TOA	TOP OF ASPHALT
TOB	TOP OF BOX
TOC	TOP OF CURB OR CONCRETE
TOF	TOP OF FOUNDATION
TOP	TOP OF PIPE
TW	TOP OF WALL
TYP	TYPICAL
UDFCD	URBAN DRAINAGE AND FLOOD CONTROL DISTRICT
UE	UTILITY EASEMENT
U&DE	UTILITY & DRAINAGE EASEMENT
UGE	UNDERGROUND ELECTRIC
VCP	VITRIFIED CLAY PIPE
VPC	VERTICAL POINT OF CURVATURE
VPI	VERTICAL POINT OF INTERSECTION
VPT	VERTICAL POINT OF TANGENCY
VTC	VEHICLE TRACKING CONTROL
W	WEST
WL	WATER LINE
WM	WATER MAIN
WRD	WATER RESOURCES DEPARTMENT
WS	WATER SURFACE
WSE	WATER SURFACE ELEVATION
WTR	WATER
YR	YEAR



VICINITY MAP
SCALE: 1" = 300'

APPLICANT/OWNER

JACKSON DEARBORN PARTNERS
404 S. WELLS ST.
SUITE 400
CHICAGO, IL 60607
P~734.216.2577

CIVIL ENGINEER

JR ENGINEERING
5475 TECH CENTER DR
SUITE 235
COLORADO SPRINGS, CO 80919
CONTACT: MIKE BRAMLETT
C~719.659.7679

PLANNER

N.E.S. INC.
619 N. CASCADE AVE
SUITE 200
COLORADO SPRINGS, CO 80903
CONTACT: TAMARA BAXTER
P~719.471.0073

GEOTECHNICAL ENGINEER

CTL THOMPSON, INC
5170 MARK DABLING BLVD
COLORADO SPRINGS, CO 80918
P~719.528.8300

SHEET INDEX

1	COVER SHEET
2	GENERAL NOTES
3	SITE AND DEMO PLAN
4-6	CHANNEL PLAN AND PROFILES
7	CHANNEL DETAILS
8	DROP STRUCTURES PLAN AND PROFILE
9	DROP STRUCTURE DETAIL SHEETS
10	PAONIA STREET OVERFLOW PLAN
TOTAL	10

BASIS OF BEARINGS

BENCHMARK

THE LOCATIONS OF EXISTING ABOVE GROUND AND UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK. THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE CAUSED BY HIS FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL ABOVE GROUND AND UNDERGROUND UTILITIES.

811
Know what's below.
Call before you dig.

OWNER/DEVELOPER STATEMENT

I, THE OWNER/DEVELOPER HAVE READ AND WILL COMPLY WITH ALL OF THE REQUIREMENTS SPECIFIED IN THESE DETAILED PLANS AND SPECIFICATIONS.

DANE OLMSTEAD   DATE

JACKSON DEARBORN PARTNERS
404 S. WELLS ST. SUITE 400
CHICAGO, IL 60607

EL PASO COUNTY STATEMENT

COUNTY PLAN REVIEW IS PROVIDED ONLY FOR GENERAL CONFORMANCE WITH COUNTY DESIGN CRITERIA. THE COUNTY IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND/OR ELEVATIONS WHICH SHALL BE CONFIRMED AT THE JOB SITE. THE COUNTY THROUGH THE APPROVAL OF THIS DOCUMENT ASSUMES NO RESPONSIBILITY FOR COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

FILED IN ACCORDANCE WITH THE REQUIREMENTS OF THE EL PASO COUNTY LAND DEVELOPMENT CODE, DRAINAGE CRITERIA MANUAL, VOLUMES 1 AND 2, AND ENGINEERING CRITERIA MANUAL AS AMENDED.

IN ACCORDANCE WITH ECM SECTION 1.12, THESE CONSTRUCTION DOCUMENTS WILL BE VALID FOR CONSTRUCTION FOR A PERIOD OF 2 YEARS FROM THE DATE SIGNED BY THE EL PASO COUNTY ENGINEER. IF CONSTRUCTION HAS NOT STARTED WITHIN THOSE 2 YEARS, THE PLANS WILL NEED TO BE RESUBMITTED FOR APPROVAL, INCLUDING PAYMENT OF REVIEW FEES AT THE PLANNING AND COMMUNITY DEVELOPMENT DIRECTORS DISCRETION.

JENNIFER IRVINE, P.E.   DATE

COUNTY ENGINEER/ECM ADMINISTRATOR

ENGINEER'S STATEMENT

STANDARD DETAILS SHOWN WERE REVIEWED ONLY AS TO THEIR APPLICATION ON THIS PROJECT

COLORADO REGISTERED MIKE A. BRAMLETT 32314 PROFESSIONAL ENGINEER

MIKE A. BRAMLETT, P.E.   DATE
COLORADO P.E. 32314
FOR AND ON BEHALF OF JR ENGINEERING, LLC

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY THE APPROPRIATE REVIEWING AGENCIES, JR ENGINEERING APPROVES THEIR USE ONLY FOR THE PURPOSES DESIGNATED BY WRITTEN AUTHORIZATION.

PREPARED FOR
JACKSON DEARBORN PARTNERS
404 S. WELLS ST.
SUITE 400
CHICAGO, ILL 60607
OFFICE PHONE
(734) 216-2577

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Fort Collins 970-491-9888 • www.jrengineering.com

No.	REVISION	BY	DATE

H-SCALE	1"=300'
V-SCALE	N/A
DATE	11/16/20
DESIGNED BY	JBP
DRAWN BY	JBP
CHECKED BY	

SAND CREEK CENTER TRIBUTARY
COVER SHEET

SHEET 1 OF 10
JOB NO. 25174.00

LAYER LINETYPE LEGEND

EXISTING | *PROPOSED*

- MATCH LINE
- SECTION LINE
- BOUNDARY LINE
- PROPERTY LINE
- EASEMENT LINE
- RIGHT OF WAY
- CENTERLINE
- FENCE
- GUARDRAIL
- CABLE TV (TV)
- ELECTRIC (E)
- FIBER OPTIC (FO)
- GAS MAIN (G)
- IRRIGATION MAIN (IRR)
- OVERHEAD UTILITY (OHU)
- SANITARY SEWER (S)
- STORM DRAIN
- TELEPHONE (T)
- WATER MAIN (W)
- SWALE/WATERWAY FLOWLINE
- DIVERSION DITCH
- TOP OF SLOPE
- TOE OF SLOPE
- 100 YEAR FLOODPLAIN (100YR)
- 5 YEAR HGL
- 100 YEAR HGL

UTILITIES LEGEND

EXISTING | *PROPOSED*

STORM SEWER

- MANHOLE
- STORM INLET
- AREA INLET – SQUARE
- FLARED END SECTION
- RIPRAP

SANITARY SEWER

- LINE MARKER (Mkr San)
- SERVICE MARKER
- CLEAN-OUT
- MANHOLE W/ DIRECTIONAL FLOW ARROW

WATER LINE

- LINE MARKER (Mkr W)
- SERVICE MARKER
- FIRE HYDRANT
- MANHOLE
- BEND
- BLOW-OFF VALVE
- WELL (WELL)
- METER
- VALVE
- REDUCER
- CROSS
- PLUG W/ THRUST BLOCK
- TEE
- AIR & VACUUM VALVE ASSEMBLY

GAS LINE

- MARKER (Mkr G)
- SERVICE MARKER
- METER
- VALVE
- PLUG

DRY UTILITIES

- CABLE TV MARKER (Mkr TV)
- CABLE TELEVISION PEDESTAL
- ELECTRIC MARKER (Mkr E)
- ELECTRIC SERVICE MARKER
- ELECTRICAL PEDESTAL
- ELECTRICAL METER
- ELECTRICAL MANHOLE
- FIBER-OPTIC MARKER (Mkr FO)
- IRRIGATION PEDESTAL
- TELEPHONE MARKER (Mkr T)
- TELEPHONE PEDESTAL
- TELEPHONE MANHOLE
- UTILITY POLE
- GUY ANCHOR
- GUY POLE

MONUMENTATION LEGEND

- ALUMINUM CAP – FOUND (AC)
- BRASS CAP – FOUND (BC)
- BENCHMARK – FOUND
- CROSS – FOUND
- MONUMENT – SET
- MONUMENT – FOUND (DEFAULT)
- MONUMENT – FOUND (ALTERNATE 1)
- MONUMENT – FOUND (ALTERNATE 2)
- MONUMENT – FOUND (ALTERNATE 3)
- MONUMENT – FOUND (ALTERNATE 4)
- MONUMENT – FOUND (ALTERNATE 5)
- MONUMENT – FOUND (ALTERNATE 6)
- MONUMENT – FOUND (ALTERNATE 7)
- NAIL & WASHER – FOUND (NAIL & WASHER)
- PANEL – FOUND
- PK NAIL – FOUND (PK NAIL)
- ROW MONUMENT – FOUND
- ROW MARKER – FOUND
- SECTION CORNER – FOUND
- SECTION CORNER – SET
- QUARTER-SECTION CORNER – FOUND
- QUARTER-SECTION CORNER – SET
- SECTION CENTER – FOUND
- SECTION CENTER – FOUND
- CONTROL/TRAVERSE POINT – SET

DRAINAGE REPORT PLANS

KEY

- BASIN DESIGNATION (NO COEFFICIENT)
- BASIN DESIGNATION (1 COEFFICIENT)
- BASIN DESIGNATION (2 COEFFICIENTS)
- ANALISYS POINT IDENTIFIER
- BASIN DESIGNATION (HISTORIC)
- BASIN DESIGNATION (DEVELOPED)
- SUB-BASIN DESIGNATION (DEVELOPED)
- DRAINAGE PIPE IDENTIFIER
- DRAINAGE POINT IDENTIFIER (HEXAGONAL)
- DRAINAGE POINT IDENTIFIER (TRIANGULAR)
- SWMM DESIGNATION 1
- SWMM DESIGNATION 2
- SWMM DESIGNATION 3
- SWMM DESIGNATION 4

LANDSCAPE LEGEND

EXISTING | *PROPOSED*

- TREE – CONIFEROUS
- TREE – DECIDUOUS
- SHRUB/BUSH
- SHRUBS AND BUSHES
- IRRIGATION BOX
- IRRIGATION SPRINKLER
- IRRIGATION VALVE
- BOLLARD
- FLAGPOLE (FP)

STANDARD NOTES FOR EL PASO COUNTY CONSTRUCTION PLANS

1. ALL DRAINAGE AND ROADWAY CONSTRUCTION SHALL MEET THE STANDARDS AND SPECIFICATIONS OF THE CITY OF COLORADO SPRINGS/EL PASO COUNTY DRAINAGE CRITERIA MANUAL, VOLUMES 1 AND 2, AND THE EL PASO COUNTY ENGINEERING CRITERIA MANUAL.

2. CONTRACTOR SHALL BE RESPONSIBLE FOR THE NOTIFICATION AND FIELD NOTIFICATION OF ALL EXISTING UTILITIES, WHETHER SHOWN ON THE PLANS OR NOT, BEFORE BEGINNING CONSTRUCTION. LOCATION OF EXISTING UTILITIES SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION. CALL 811 TO CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO (UNCC).

3. CONTRACTOR SHALL KEEP A COPY OF THESE APPROVED PLANS, THE GRADING AND EROSION CONTROL PLAN, THE STORMWATER MANAGEMENT PLAN (SWMP), THE SOIL AND GEOTECHNICAL REPORT, AND THE APPROPRIATE DESIGN AND CONSTRUCTION STANDARDS AND SPECIFICATIONS AT THE JOB SITE AT ALL TIMES, INCLUDING THE FOLLOWING:
   - 3.1. EL PASO COUNTY ENGINEERING CRITERIA MANUAL (ECM)
   - 3.2. CITY OF COLORADO SPRINGS/ EL PASO COUNTY DRAINAGE CRITERIA MANUAL, VOLUMES 1 AND 2
   - 3.3. COLORADO DEPARTMENT OF TRANSPORTATION (CDOT) STANDARD SPECIFICATIONS AND BRIDGE CONSTRUCTION
   - 3.4. CDOT M&S STANDARDS

4. NOTWITHSTANDING ANYTHING DEPICTED IN THESE PLANS IN WORDS OR GRAPHIC REPRESENTATION, ALL DESIGN AND CONSTRUCTION RELATED TO ROADS, STORM DRAINAGE AND EROSION CONTROL SHALL CONFORM TO THE STANDARDS AND REQUIREMENTS OF THE MOST RECENT VERSIONS OF THE RELEVANT ADOPTED EL PASO COUNTY STANDARDS, INCLUDING THE LAND DEVELOPMENT CODE, THE EINGEERI9NG CRITERIA MANUAL, THE DRAINAGE CRITERIA MANUAL, AND THE DRAINAGE CRITERIA MANUAL VOLUME 2. ANY DEVIATIONS FROM REGULATIONS AND STANDARDS MUST BE REQUESTED, AND APPROVED, IN WRITING. ANY MODIFICATIONS NECESSARY TO MEET CRITERIA AFTER-THE-FACT WILL BE ENTIRELY THE DEVELOPER'S RESPONSIBILITY TO RECTIFY.

5. IT IS THE DESIGN ENGINEER'S RESPONSIBILITY TO ACCURATELY SHOW EXISTING CONDITIONS, BOTH ONSITE AND OFFSITE, ON THE CONSTRUCTION PLANS. ANY MODIFICATIONS NECESSARY DUE TO CONFLICTS, OMISSIONS, OR CHANGED CONDITIONS WILL BE ENTIRELY THE DEVELOPER'S RESPONSIBILITY TO RECTIFY.

6. CONTRACTOR SHALL SCHEDULE A PRE-CONSTRUCTION MEETING WITH EL PASO COUNTY PLANNING AND COMMUNITY DEVELOPMENT INSPECTIONS, PRIOR TO STARTING CONSTRUCTION.

7. IT IS THE CONTRACTOR'S RESPONSIBILITY TO UNDERSTAND THE REQUIREMENTS OF ALL JURISDICTIONAL AGENCIES TO OBTAIN ALL REQUIRED PERMITS, INCLUDING BUT NOT LIMITED TO EL PASO COUNTY EROSION AND STORMWATER QUALITY CONTROL PERMIT (ESQCP), REGIONAL BUILDING FLOODPLAIN DEVELOPMENT PERMIT, U.S. ARMY CORPS OF ENGINEERS-ISSUED 401 AND/OR 404 PERMITS, AND COUNTY AND STATE FUGITIVE DUST PERMITS.

8. CONTRACTOR SHALL NOT DEVIATE FROM THE PLANS WITHOUT FIRST OBTAINING WRITTEN APPROVAL FROM THE DESIGN ENGINEER AND PCD. CONTRACTOR SHALL NOTIFY THE DESIGN ENGINEER IMMEDIATELY UPON DISCOVERY OF ANY ERRORS OR INCONSISTENCIES.

9. ALL STORM DRAIN PIPE SHALL BE CLASS III RCP UNLESS OTHERWISE NOTED AND APPROVED BY PLANNING AND COMMUNITY DEVELOPMENT.

10. CONTRACTOR SHALL COORDINATE GEOTECHNICAL TESTING PER ECM STANDARDS. PAVEMENT DESIGN SHALL BE APPROVED BY EL PASO COUNTY PCD PRIOR TO PLACEMENT OF CURB AND GUTTER AND PAVEMENT.

11. ALL CONSTRUCTION TRAFFIC MUST ENTER/EXIT THE SITE AT APPROVED CONSTRUCTION ACCESS POINTS.

12. SIGHT VISIBILITY TRIANGLES ARE IDENTIFIED IN THE PLANS SHALL BE PROVIDED AT ALL INTERSECTIONS. OBSTRUCTIONS GREATER THAN 18 INCHES ABOVE FLOWLINE ARE NOT ALLOWED IN SIGHT TRIANGLES.

13. SIGNING AND STRIPING SHALL COMPLY WITH EL PASO COUNTY DEPARTMENT OF PUBLIC WORKS AND MUTCD CRITERIA.

14. CONTRACTOR SHALL OBTAIN ANY PERMITS REQUIRED BY EL PASO COUNTY DEPARTMENT OF PUBLIC WORKS, INCLUDING WORK WITHIN THE RIGHT-OF-WAY AND SPECIAL TRANSPORT PERMITS.

15. THE LIMITS OF CONSTRUCTION SHALL REMAIN WITHIN THE PROPERTY LINE UNLESS OTHERWISE NOTED. THE OWENER/DEVELOPER SHALL OBTAIN WRITTEN PERMISSION AND EASEMENTS, WHERE REQUIRED, FROM ADJOINING PROPERTY OWNER(S) PRIOR TO ANY OFF-SITE DISTURBANCE, GRADING, OR CONSTRUCTION.

ENGINEER'S STATEMENT

STANDARD DETAILS SHOWN WERE REVIEWED ONLY AS TO THEIR APPLICATION ON THIS PROJECT

MIKE A. BRAMLETT, P.E. — DATE
COLORADO P.E. 32314
FOR AND ON BEHALF OF JR ENGINEERING, LLC

PREPARED FOR
JACKSON DEARBORN PARTNERS
404 S. WELLS ST.
SUITE 400
CHICAGO, ILL 60607
OFFICE PHONE
(734) 216-2577

J·R ENGINEERING
A Westrian Company
Centennial 303-740-9393 • Colorado Springs 719-593-2593
Fort Collins 970-491-9888 • www.jrengineering.com

No.	REVISION	BY	DATE

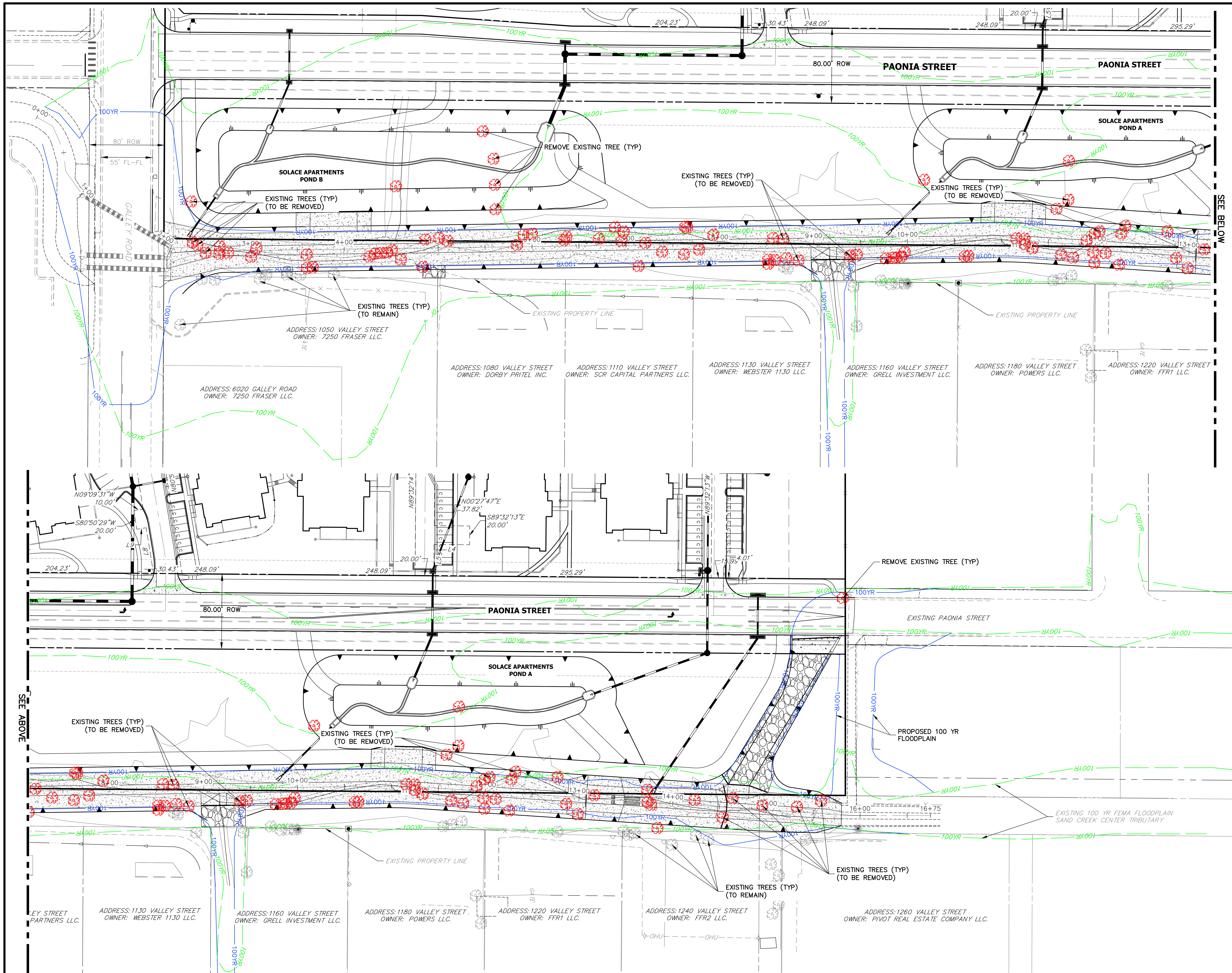
H-SCALE	N/A
V-SCALE	N/A
DATE	11/16/20
DESIGNED BY	JRM
DRAWN BY	JRM
CHECKED BY	

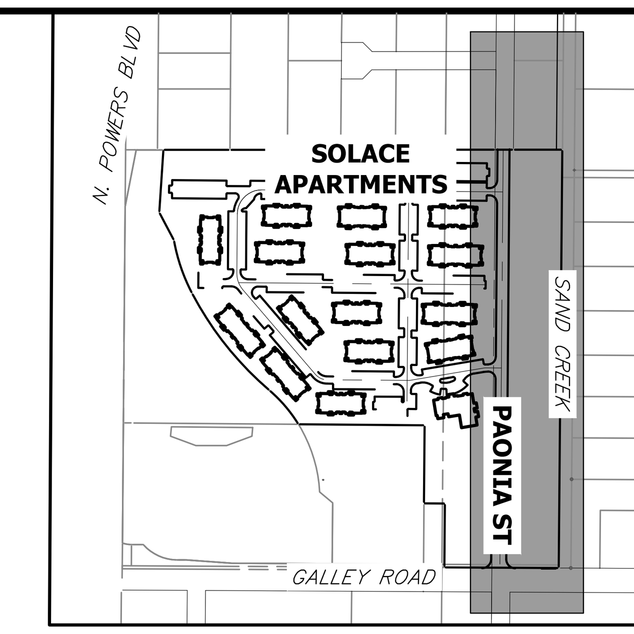
SAND CREEK CENTER TRIBUTARY

GENERAL NOTES

SHEET 2 OF 10

JOB NO. 25174.00





KEY MAP
SCALE 1"=500'

50 25 0 50 100
ORIGINAL SCALE: 1" = 50'

Know what's below. Call before you dig.

ENGINEER'S STATEMENT

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No.	REVISION	BY	DATE

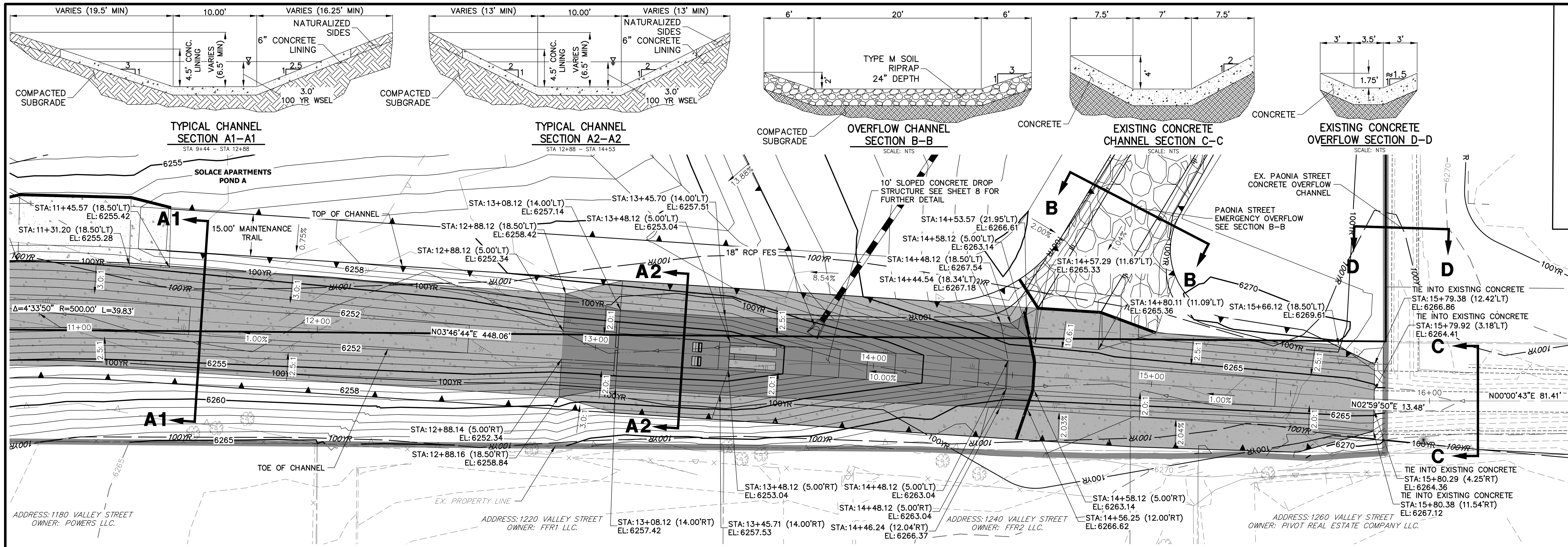
H-SCALE	1"=50'
V-SCALE	N/A
DATE	11/16/20
DESIGNED BY	JBP
DRAWN BY	JBP
CHECKED BY	

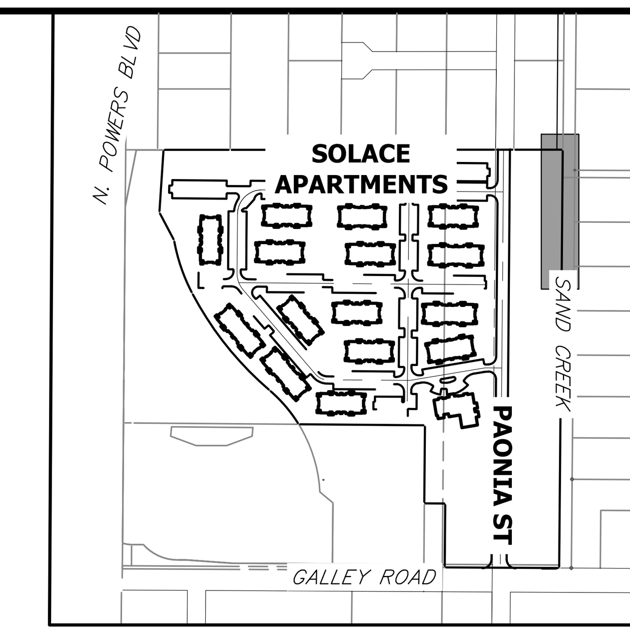
SAND CREEK CENTER TRIBUTARY

SITE AND DEMO PLAN

SHEET 3 OF 10

JOB NO. 25174.00

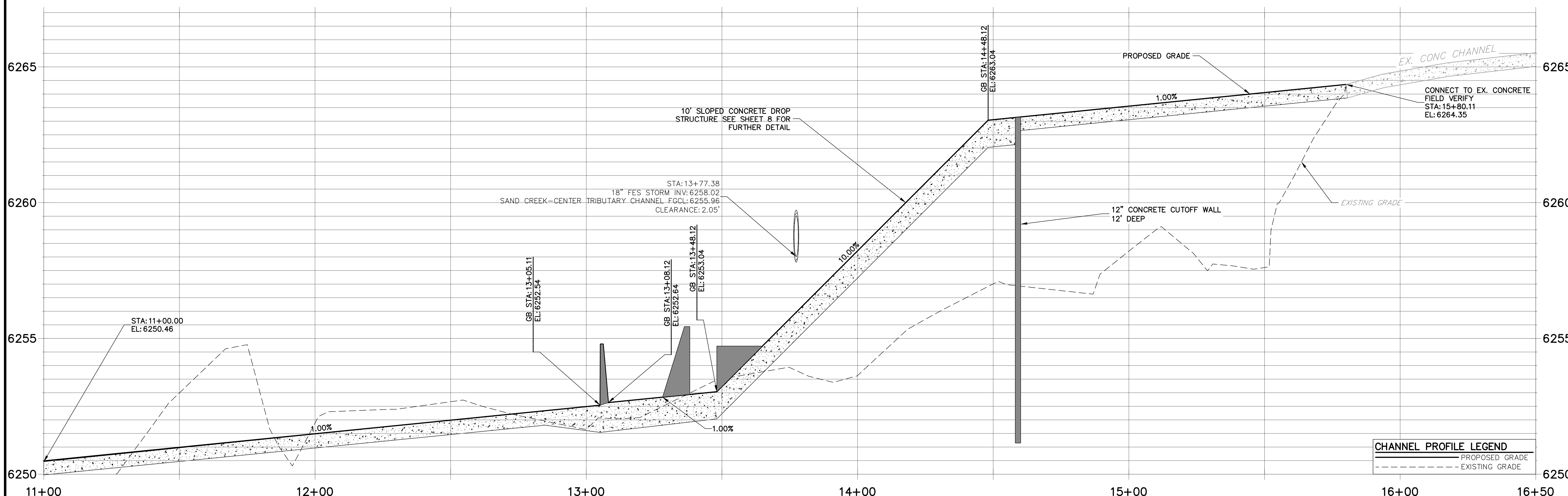




KEY MAP

SCALE 1"=500'

SAND CREEK-CENTER TRIBUTARY CHANNEL PROFILE (4)
STA 11+00.00 TO 16+50.00



Know what's **below.** Call before you dig.

HORIZONTAL ORIGINAL SCALE: 1" = 20'
VERTICAL ORIGINAL SCALE: 1" = 2'

LEGEND

PROPOSED MAJOR CONTOURS	6100
EXISTING MAJOR CONTOUR	6100
LIMITS OF GRADING	
6" THICK CONCRETE CHANNEL LINING	
12" THICK CONCRETE CHANNEL LINING	

ENGINEER'S STATEMENT

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DATE

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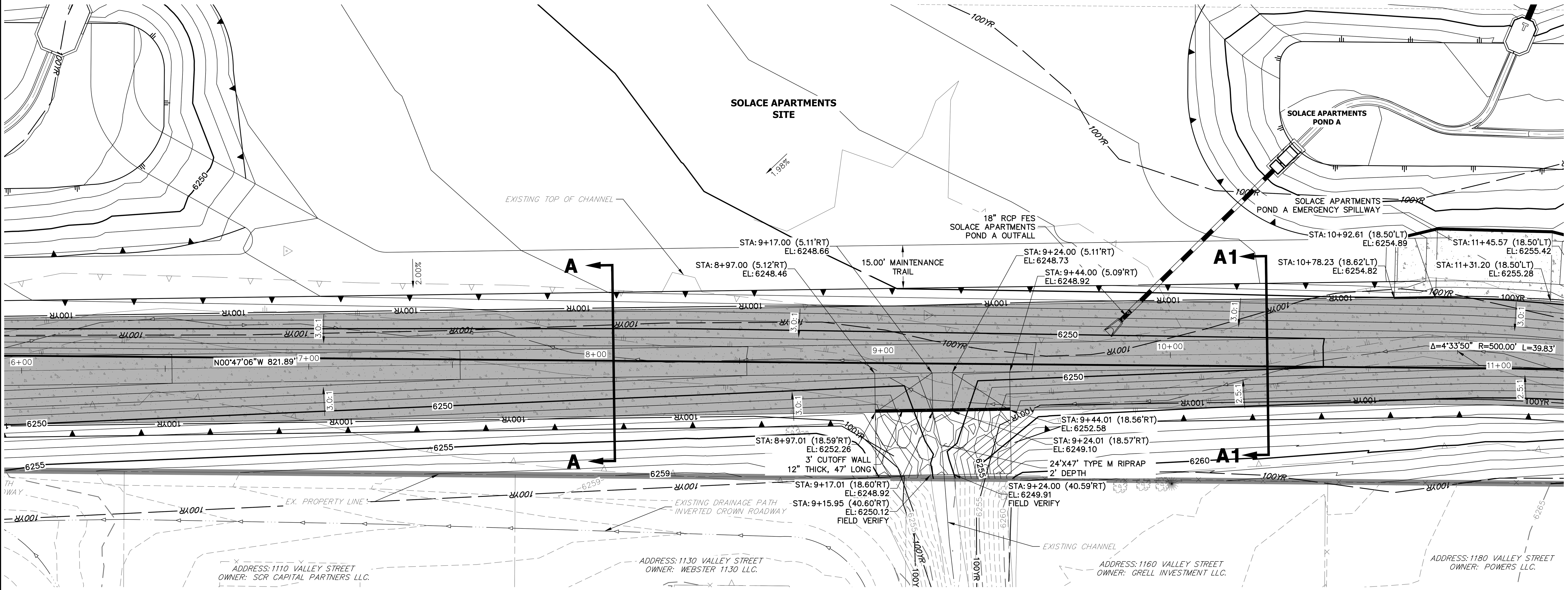
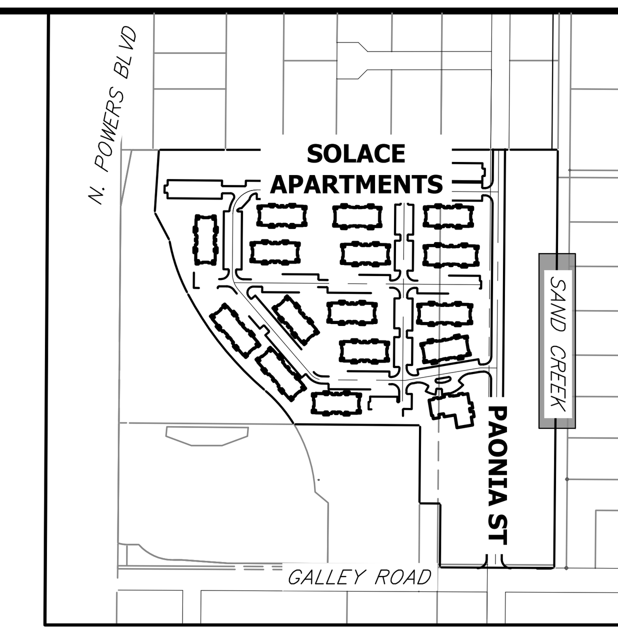
No.	REVISION	BY	DATE

H-SCALE	1"=20'
V-SCALE	1"=2'
DATE	11/16/20
DESIGNED BY	JBP
DRAWN BY	JBP
CHECKED BY	

SAND CREEK CENTER TRIBUTARY
CHANNEL PLAN AND PROFILES

SHEET 4 OF 10
JOB NO. 25174.00

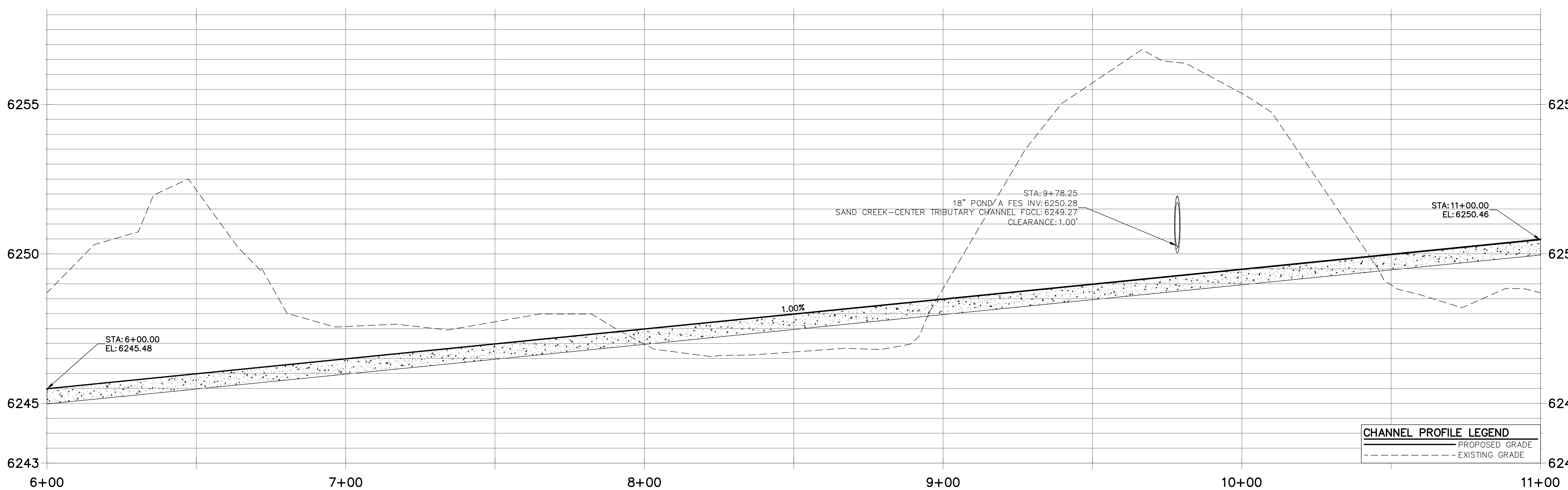


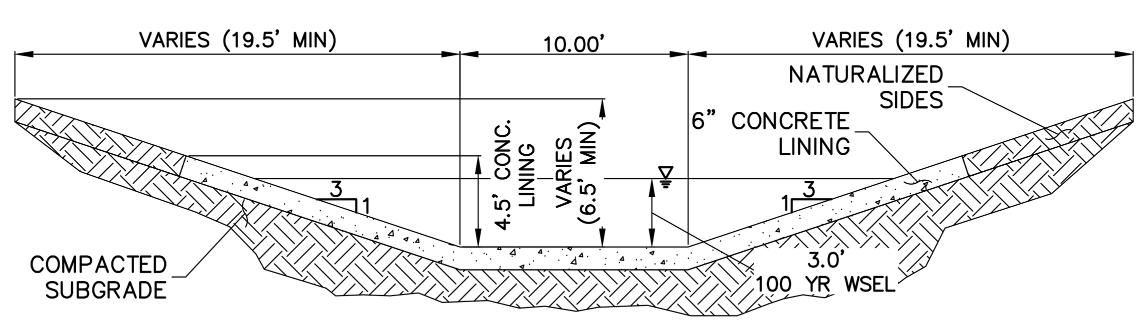


KEY MAP

SCALE 1"=500'

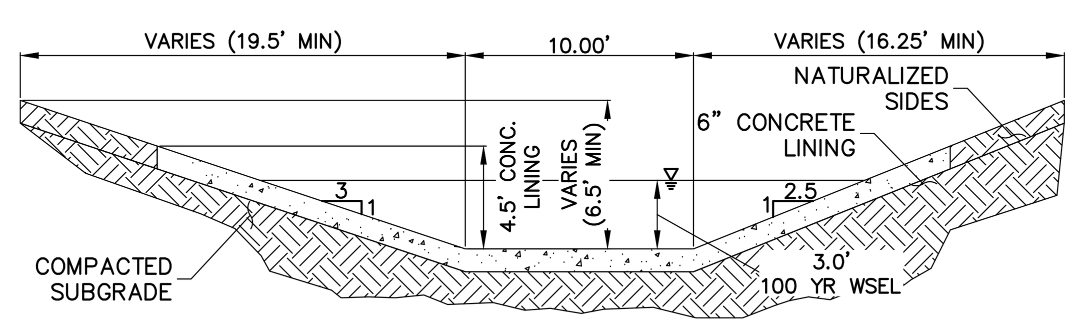
SAND CREEK-CENTER TRIBUTARY CHANNEL PROFILE (3)
STA 6+00.00 TO 11+00.00





TYPICAL CHANNEL SECTION A–A

STA 5+50 – STA 9+44



TYPICAL CHANNEL SECTION A1–A1

STA 9+44 – STA 12+88

20 10 0 20 40

HORIZONTAL
ORIGINAL SCALE: 1" = 20'
VERTICAL
ORIGINAL SCALE: 1" = 2'

LEGEND

- PROPOSED MAJOR CONTOURS (6100)
- EXISTING MAJOR CONTOUR (6100)
- LIMITS OF GRADING
- 6" THICK CONCRETE CHANNEL LINING
- 12" THICK CONCRETE CHANNEL LINING

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COLORADO P.E. 32314
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No.	REVISION	BY	DATE

H-SCALE	1"=20'
V-SCALE	1"=2'
DATE	11/16/20
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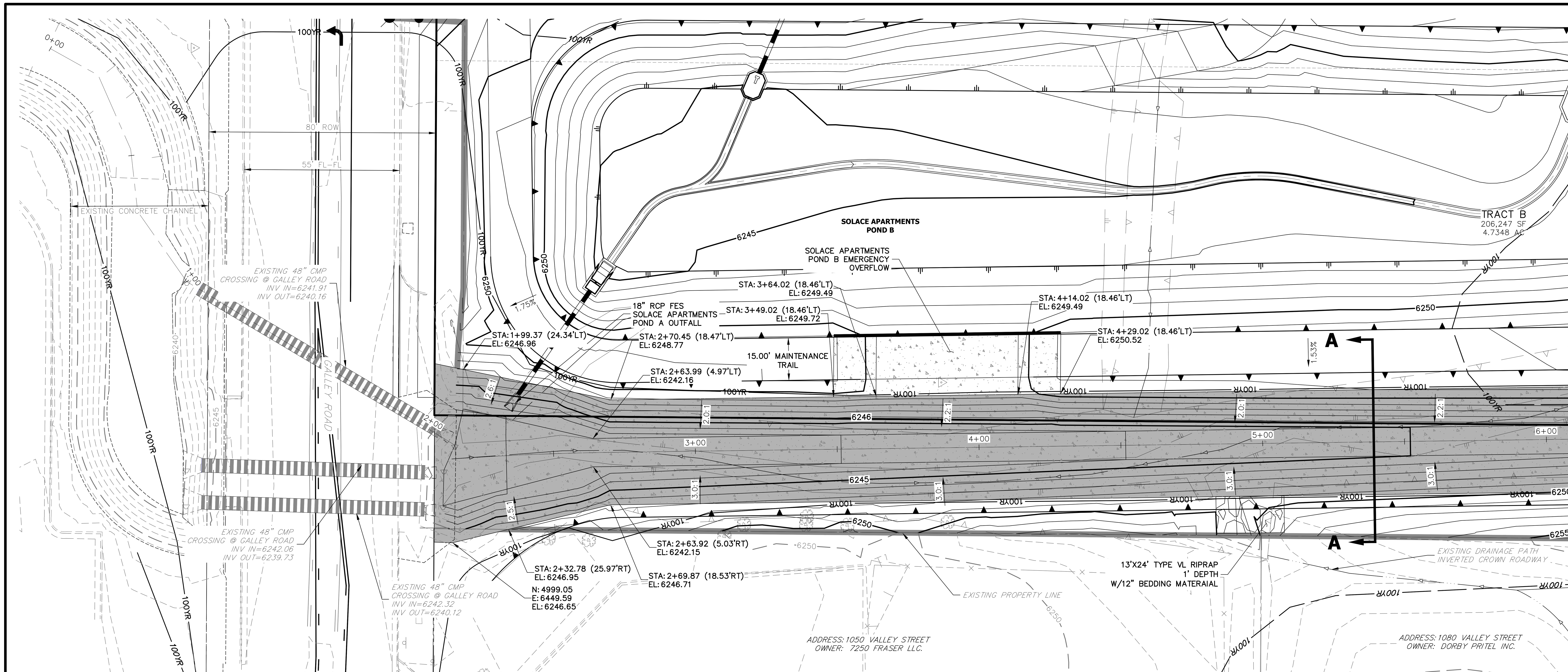
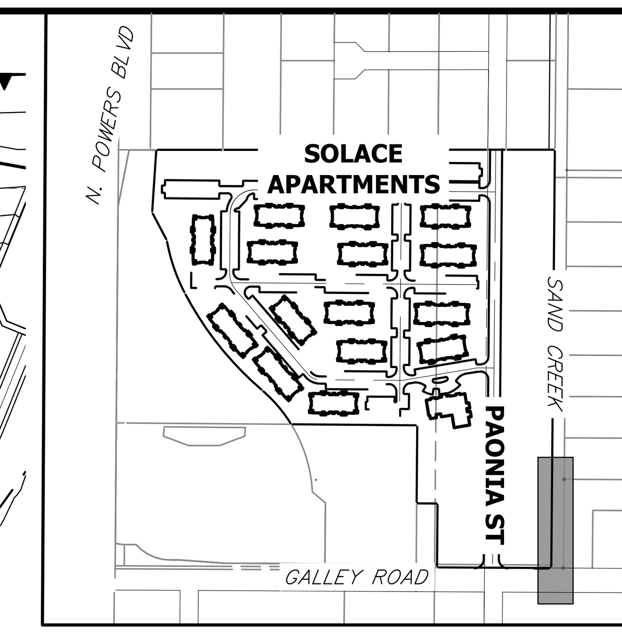
DRAWN BY	JBP
CHECKED BY	

SAND CREEK CENTER TRIBUTARY
CHANNEL PLAN AND PROFILES

SHEET 5 OF 10
JOB NO. 25174.00

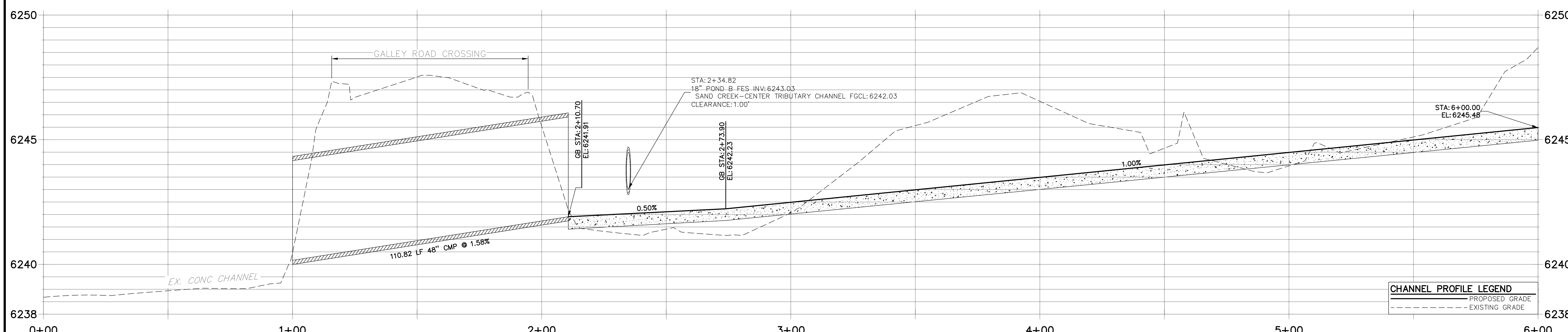


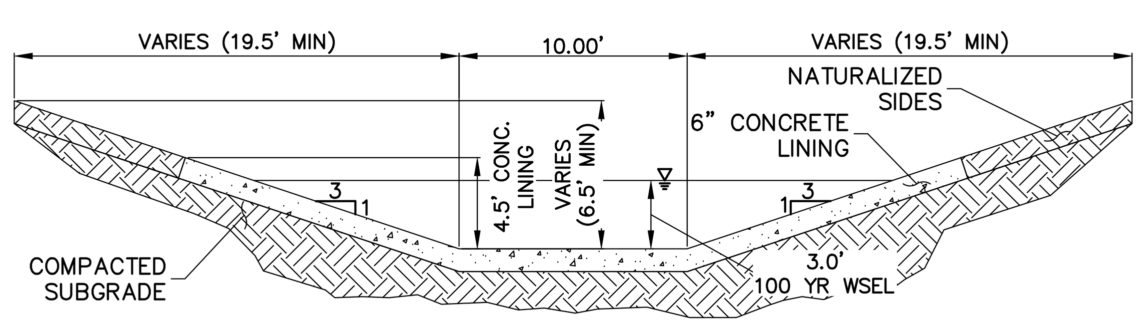


KEY MAP

SCALE 1"=500'

SAND CREEK-CENTER TRIBUTARY CHANNEL PROFILE
STA 0+00.00 TO 6+00.00





TYPICAL CHANNEL SECTION A-A

STA 5+50 – STA 9+44

LEGEND

PROPOSED MAJOR CONTOURS — 6100

EXISTING MAJOR CONTOUR — 6100

LIMITS OF GRADING

6" THICK CONCRETE CHANNEL LINING

12" THICK CONCRETE CHANNEL LINING

20 10 0 20 40

HORIZONTAL ORIGINAL SCALE: 1" = 20'

VERTICAL ORIGINAL SCALE: 1" = 2'

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V-SCALE	1"=2'
DATE	11/16/20
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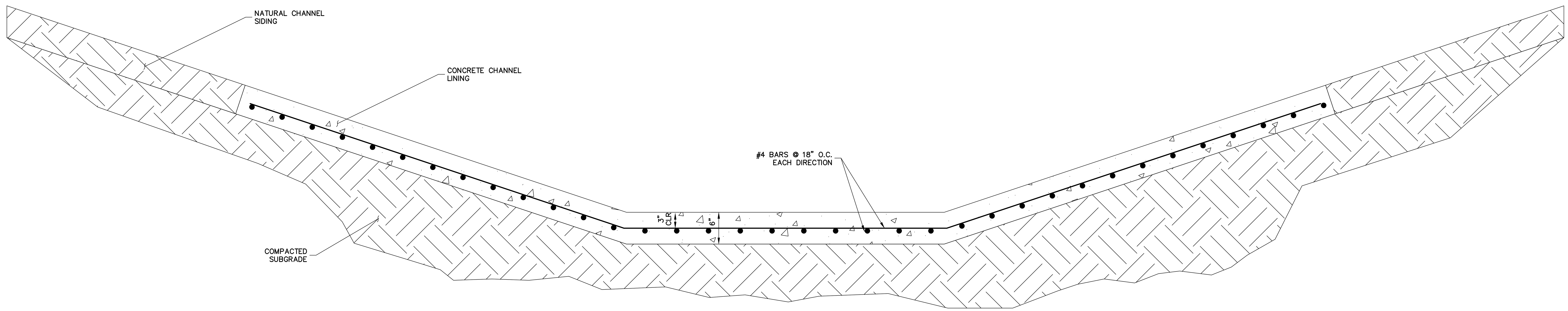
DRAWN BY	JBP
CHECKED BY	

SAND CREEK CENTER TRIBUTARY

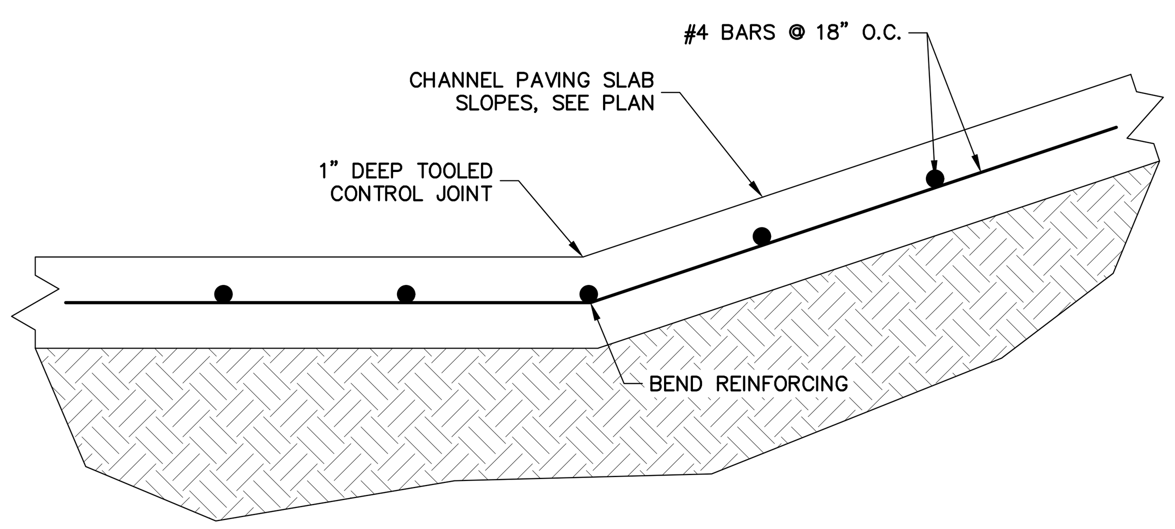
CHANNEL PLAN AND PROFILES

SHEET 6 OF 10

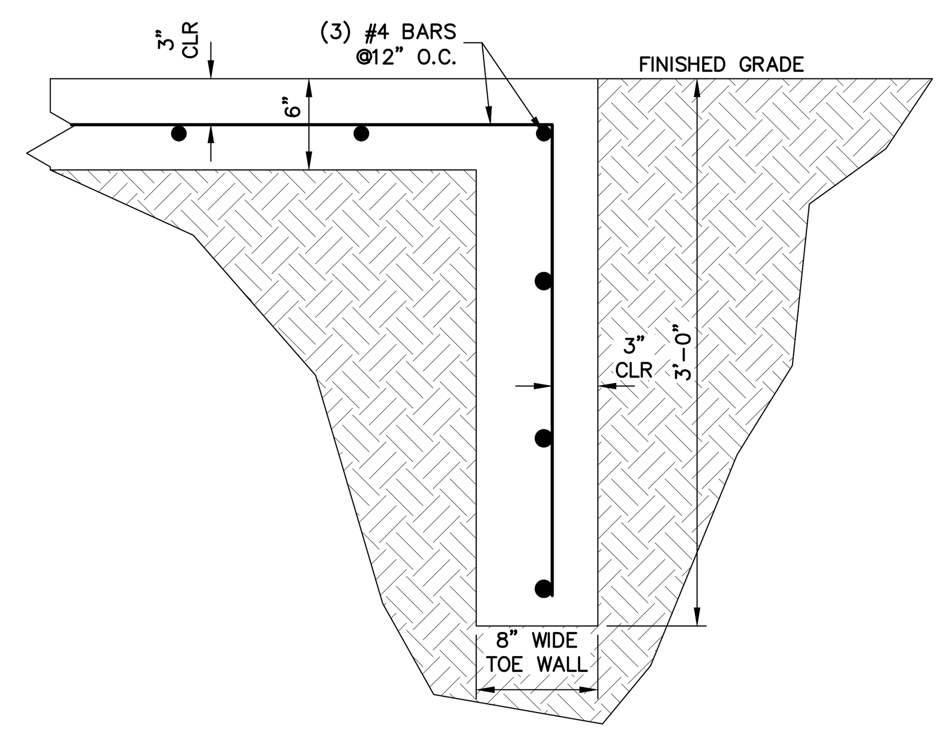
JOB NO. 25174.00



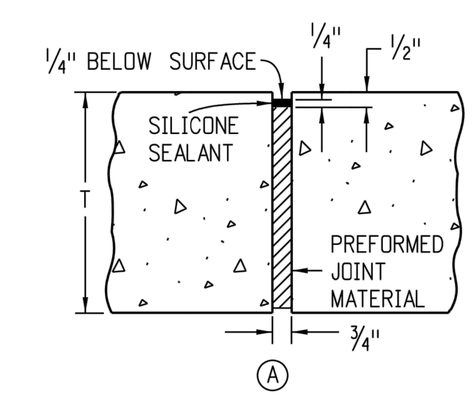
TYPICAL CONCRETE CHANNEL SECTION
SCALE: N.T.S.



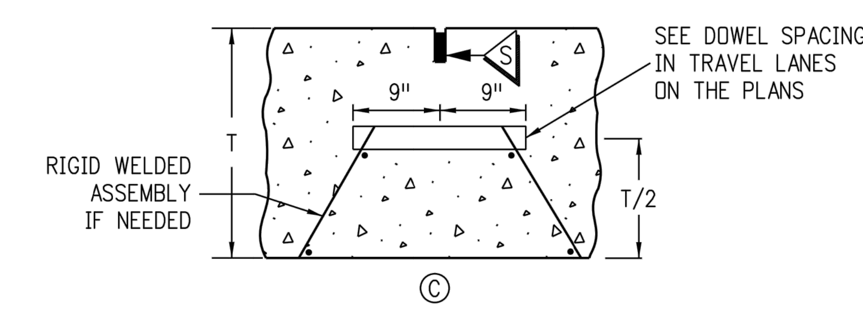
SLOPE CHANGE AT CHANNEL PAVING SLAB
SCALE: N.T.S.



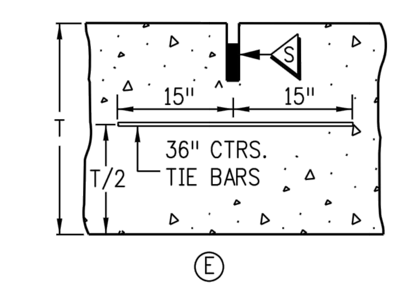
CUTOFF/APRON TOE WALL @ TIE INTO EXISTING
SCALE: N.T.S.



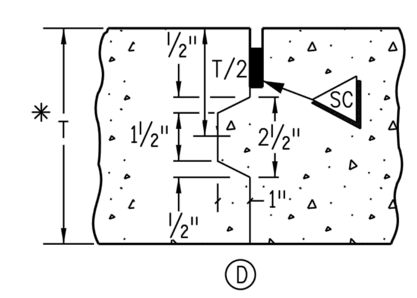
EXPANSION JOINT



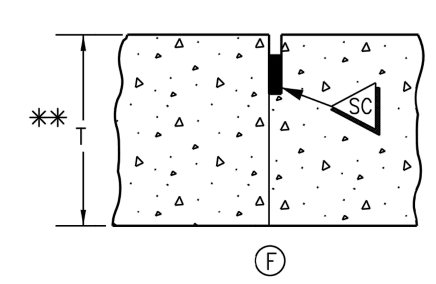
DOWELED TRANSVERSE CONSTRUCTION OR CONTRACTION JOINT
(TRANSVERSE WEAKENED PLANE JOINT)



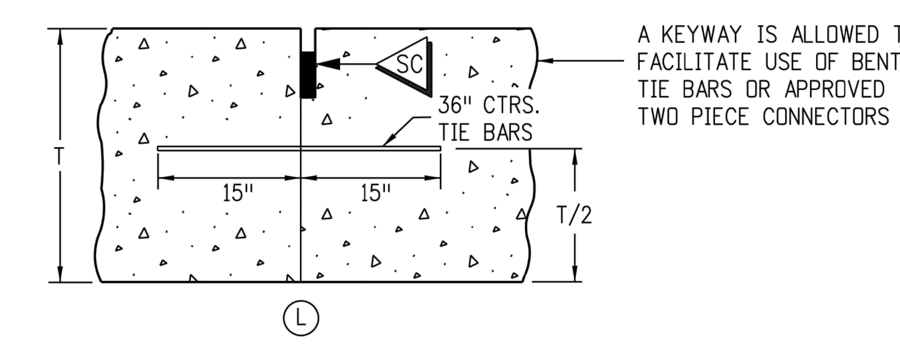
LONGITUDINAL CONTRACTION JOINT
(LONGITUDINAL WEAKENED PLANE JOINT)



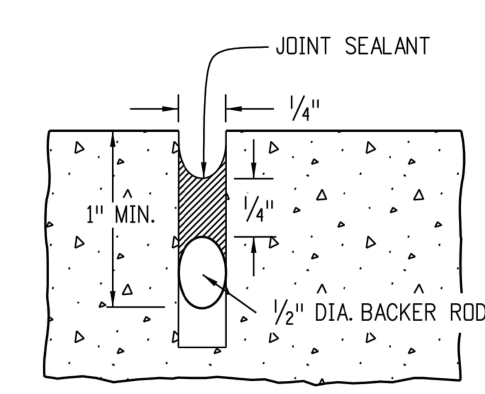
LONGITUDINAL CONSTRUCTION JOINT
* USE ONLY IF T ≥ 8 IN. FORM ONLY FEMALE KEYWAY



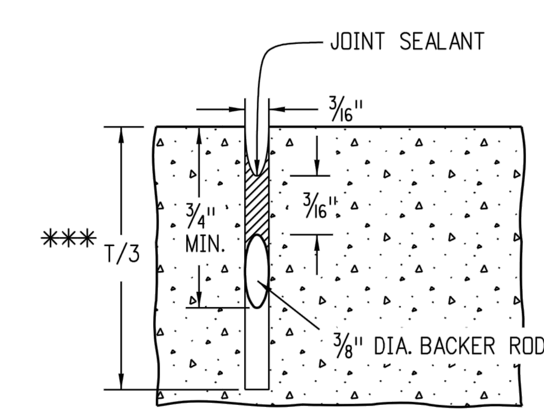
LONGITUDINAL CONSTRUCTION JOINT
** USE ONLY IF T < 8 IN.



LONGITUDINAL CONSTRUCTION JOINT



SEAL AT CONSTRUCTION JOINT



SAWED JOINT
*** USE T/4 WHEN T < 8 IN.

811 Know what's below. Call before you dig.

ENGINEER'S STATEMENT
STANDARD DETAILS SHOWN WERE REVIEWED ONLY AS TO THEIR APPLICATION ON THIS PROJECT

MIKE A. BRAMLETT, P.E. DATE
COLORADO P.E. 32314
FOR AND ON BEHALF OF JR ENGINEERING, LLC

PREPARED FOR
JACKSON DEARBORN PARTNERS
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SUITE 400
CHICAGO, ILL 60607
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V-SCALE	N/A
DATE	11/16/20
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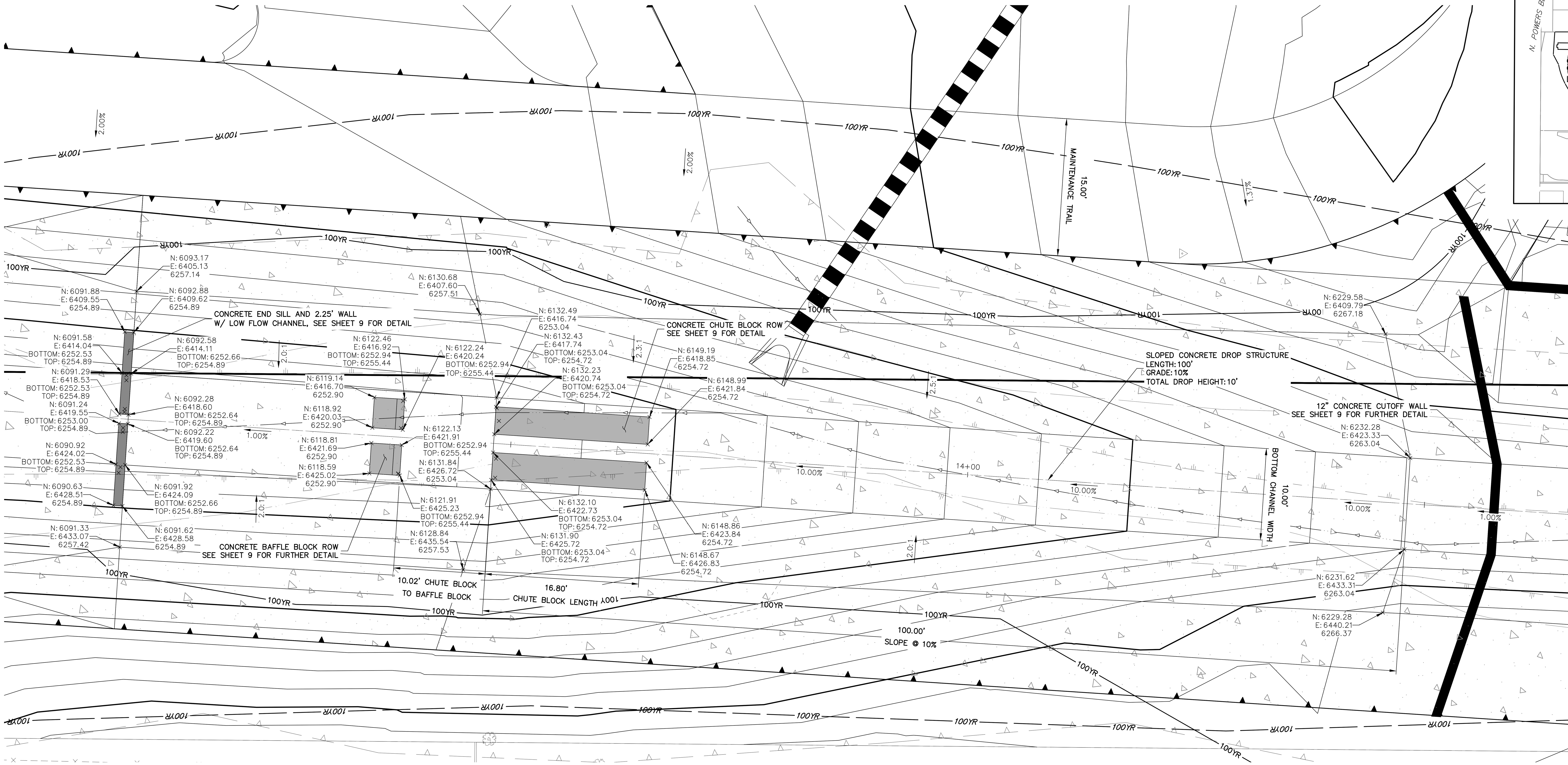
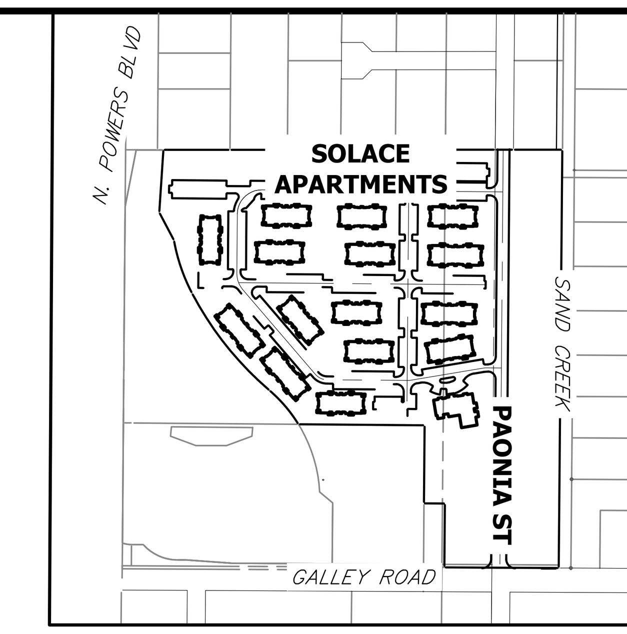
SAND CREEK CENTER TRIBUTARY
CHANNEL DETAILS

SHEET 7 OF 10
JOB NO. 25174.00

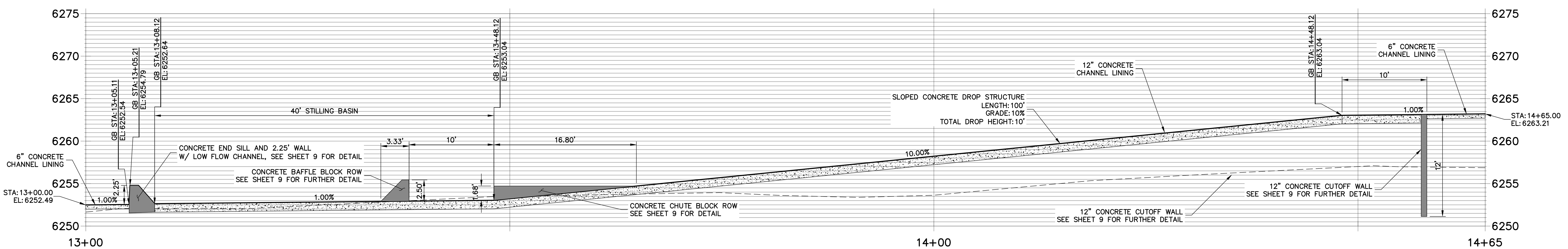




KEY MAP

SCALE 1"=500'

DROP 1 PROFILE
STA 13+00.00 TO 14+65.00



HORIZONTAL ORIGINAL SCALE: 1" = 6
VERTICAL ORIGINAL SCALE: 1" = 6

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V-SCALE	1"=6'
DATE	11/16/20
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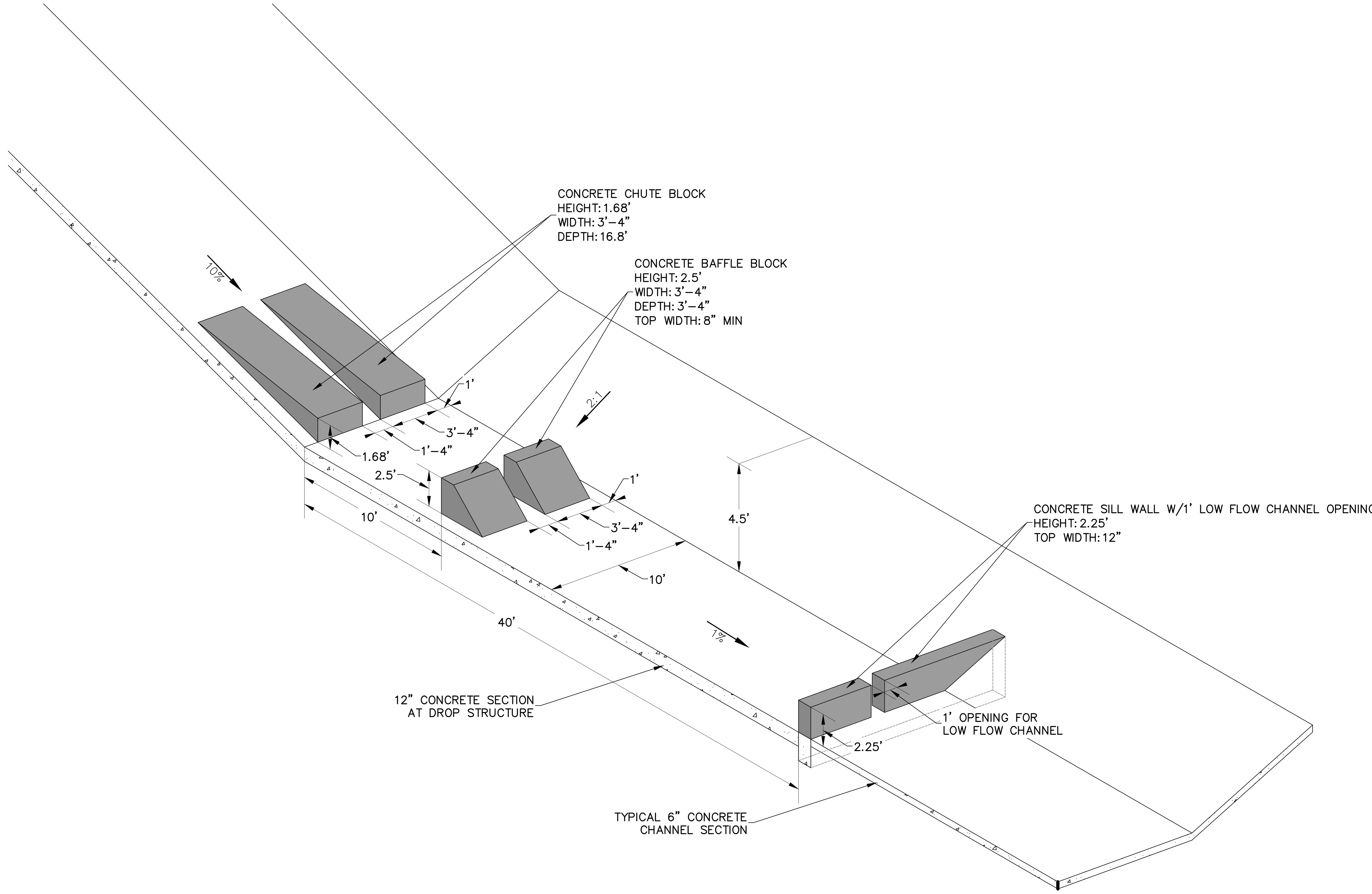
DRAWN BY	JBP
CHECKED BY	

SAND CREEK CENTER TRIBUTARY

DROP STRUCTURES PLAN AND PROFILE

SHEET 8 OF 10

JOB NO. 25174.00



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V-SCALE	N/A
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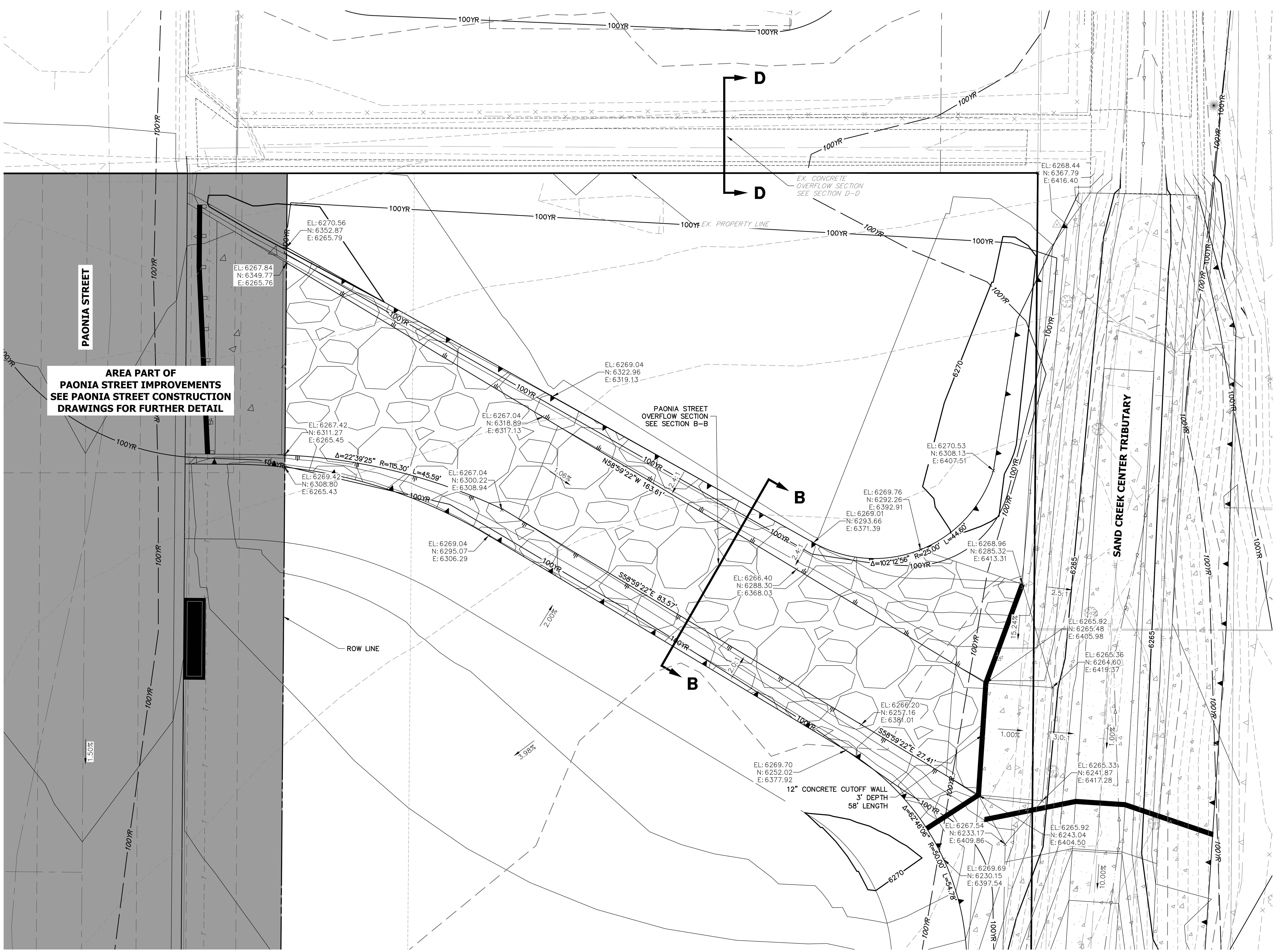
DRAWN BY	JBP
CHECKED BY	

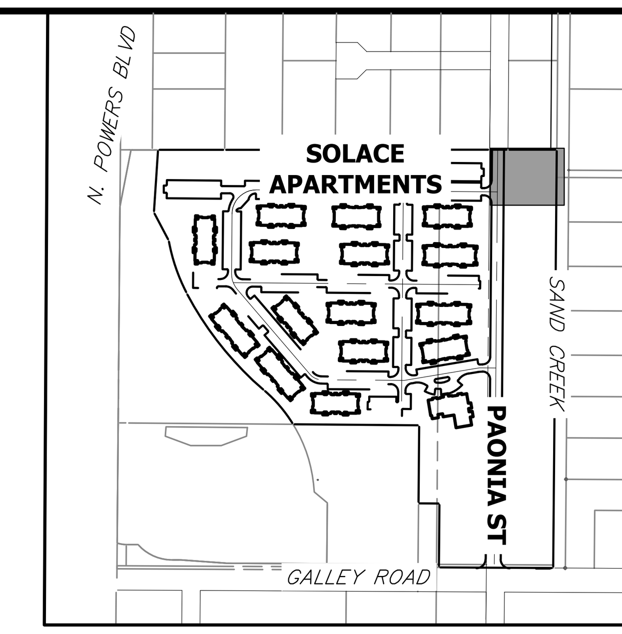
SAND CREEK CENTER TRIBUTARY

DROP STRUCTURE DETAIL SHEETS

SHEET 9 OF 10

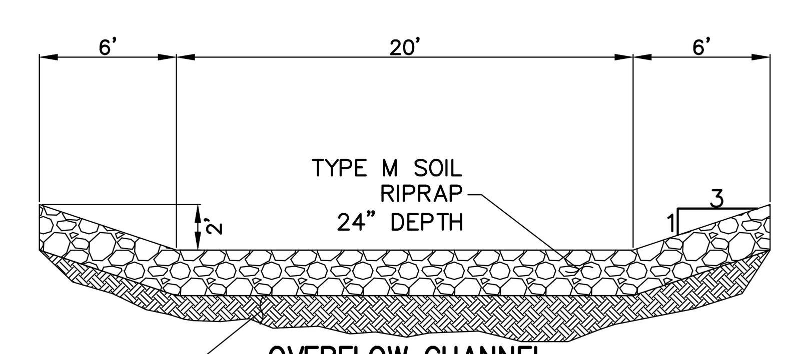
JOB NO. 25174.00





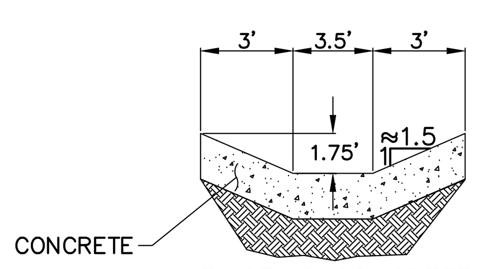
KEY MAP

SCALE 1"=500'



OVERFLOW CHANNEL SECTION B-B

SCALE: NTS



EXISTING CONCRETE OVERFLOW SECTION D-D

SCALE: NTS

10 5 0 10 20

ORIGINAL SCALE: 1" = 10'

811 Know what's below. Call before you dig.

ENGINEER'S STATEMENT

PREPARED UNDER MY DIRECT SUPERVISION AND ON BEHALF OF JR ENGINEERING

MIKE A. BRAMLETT, P.E.
COLORADO P.E. 32314
FOR AND ON BEHALF OF JR ENGINEERING, LLC

DATE

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No.	REVISION	BY	DATE

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V-SCALE	N/A
DATE	11/16/20
DESIGNED BY	JBP
DRAWN BY	JBP
CHECKED BY	

SAND CREEK CENTER TRIBUTARY

PAONIA STREET OVERFLOW PLAN

SHEET 10 OF 10

JOB NO. 25174.00

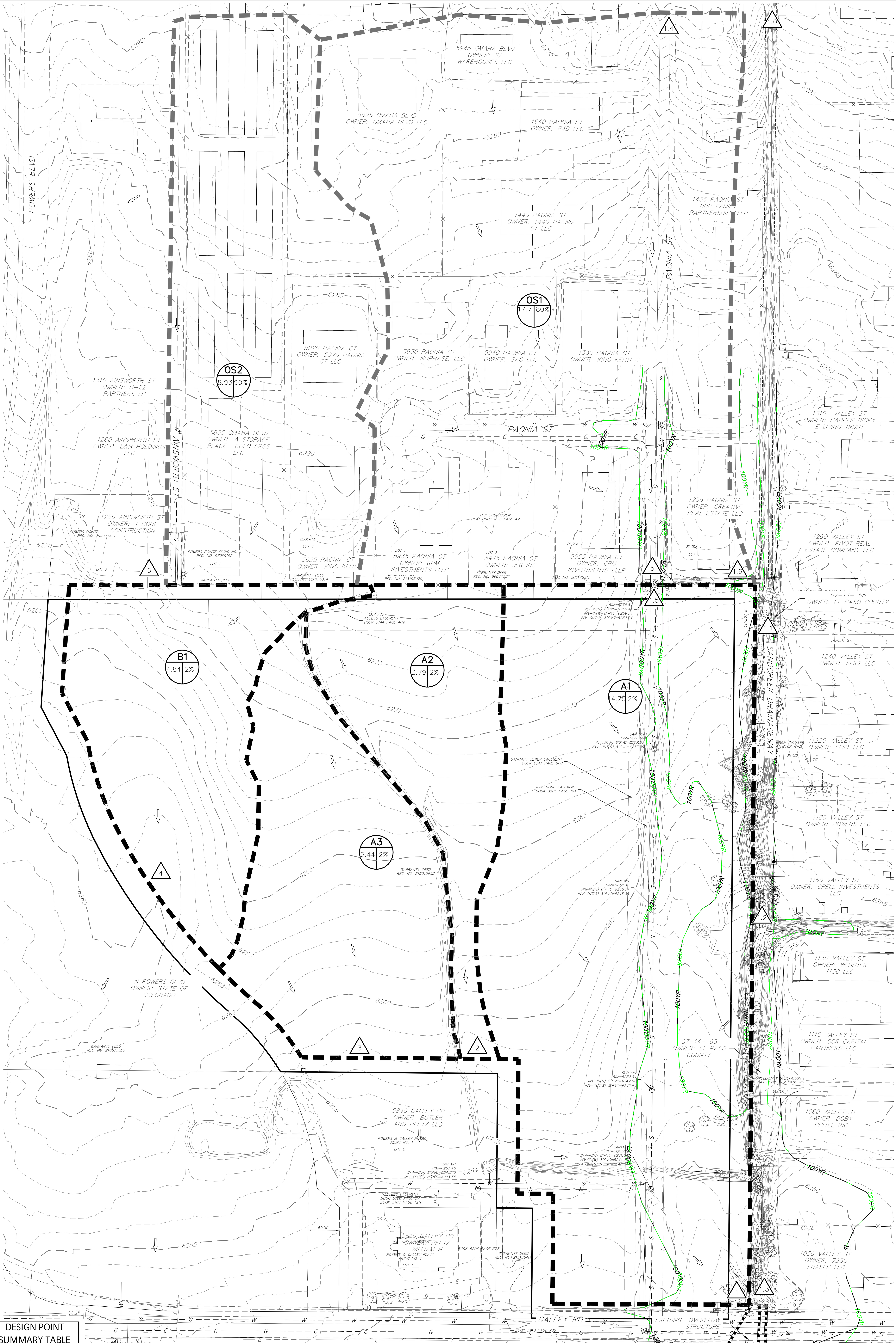
TABLE VIII-2: SAND CREEK DRAINAGE BASIN PLANNING STUDY
CONT'D DRAINAGEWAY CONVEYANCE COST ESTIMATE
CENTER TRIBUTARY SAND CREEK

SEGMENT NUMBER	REACH NUMBER	SEGMENT LENGTH (FT)	IMPROVEMENT TYPE	IMPROVEMENT LENGTH (FT)	UNIT COST ($/LF)	NUMBER OF GRADE CONTROLS	LENGTH OF GRADE CONTROL (FT)	TOTAL REIMBURSABLE COSTS	TOTAL COST
141	CT-1	2600	EX. RIPRAP TO REMAIN	1500	195	5	400	$338,500	$338,500
142	"	4100	100-YR RIPRAP (1)	1300	195	10	600	$322,500	$322,500
143	"	2300	100-YR RIPRAP (1)	2300	195	8	480	$0	$503,700
144	CT-2	2800	EX. CHANNEL TO REMAIN	200	195	0	0	$39,000	$39,000
145	"	720	100-YEAR CONCRETE	720	195	2	100	$151,900	$151,900
146-1	"	680	"	680	195	0	0	$132,600	$132,600
146-2	"	1300	EX. CHANNEL TO REMAIN	1200	0	0	0	$0	$0
TOTAL CENTER TRIBUTARY SAND CREEK DRAINAGEWAYS								$984,500	$1,488,200

(1) A PORTION OF THESE IMPROVEMENTS TO BE CONSTRUCTED AS PART OF THE US 24 BYPASS PROJECT, PHASE II.

APPENDIX E

DRAINAGE MAPS & PLANS



DESIGN POINT SUMMARY TABLE		
DP	Q5	Q100
	Total	Total
1	3.1	21.0
2	0.9	6.2
3	1.4	9.5
4	1.3	9.0
5	36.7	573.1
6	28.4	52.9
1.0	-	820.0
1.1	-	820.0
1.2	-	1037.0
1.3	-	1100.0
1.4	-	500.0
1.5	-	244.0
1.6	-	42.1

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A1	14.75	2%	0.09	0.36	32.5	3.1	21.0
A2	3.79	2%	0.09	0.36	25.4	0.9	6.2
A3	5.44	2%	0.09	0.36	22.7	1.4	9.5
B1	4.84	2%	0.09	0.36	20.3	1.3	9.0
OS1	17.73	80%	0.59	0.70	15.1	36.7	73.1
OS2	8.93	90%	0.73	0.81	8.6	28.4	52.9

LEGEND:

- 6200 — EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- DRAINAGE BASIN
- A / B C — A = BASIN DESIGNATION, B = AREA IN ACRES, C = PERCENT IMPERVIOUS
- 1 — DESIGN POINT
- HP — HIGH POINT
- LP — LOW POINT
- EXISTING DRAINAGE ARROW

N

85 43 0 85 170

ORIGINAL SCALE: 1" = 85'

EXISTING DRAINAGE MAP
SOLACE AT CIMARRON HILLS
JOB NO. 25174.00
3/12/21
SHEET 1 OF 1

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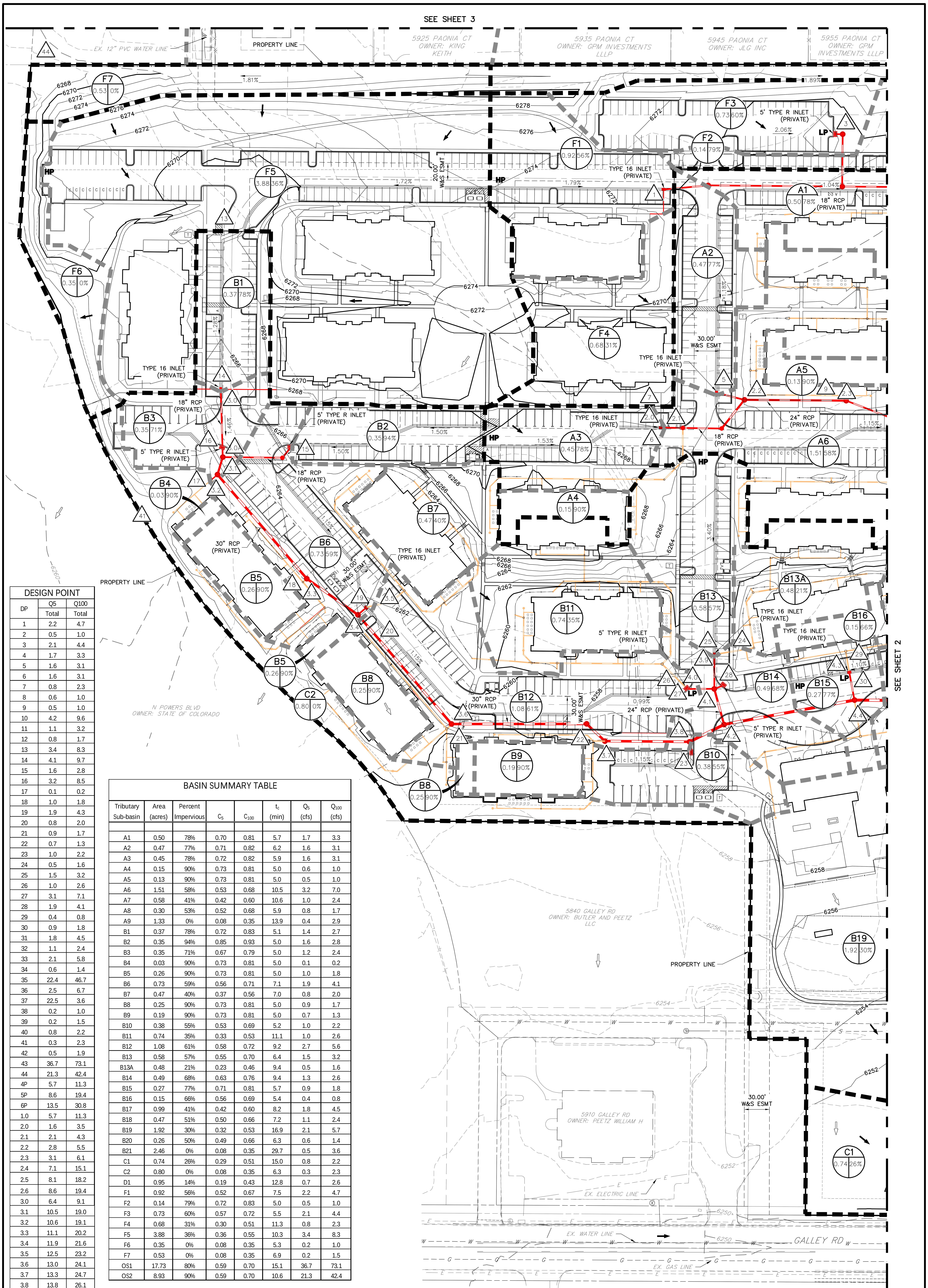

DESIGN POINT

DP	Q5 Total	Q100 Total
1	2.2	4.7
2	0.5	1.0
3	2.1	4.4
4	1.7	3.3
5	1.6	3.1
6	1.6	3.1
7	0.8	2.3
8	0.6	1.0
9	0.5	1.0
10	4.2	9.6
11	1.1	3.2
12	0.8	1.7
13	3.4	8.3
14	4.1	9.7
15	1.6	2.8
16	3.2	8.5
17	0.1	0.2
18	1.0	1.8
19	1.9	4.3
20	0.8	2.0
21	0.9	1.7
22	0.7	1.3
23	1.0	2.2
24	0.5	1.6
25	1.5	3.2
26	1.0	2.6
27	3.1	7.1
28	1.9	4.1
29	0.4	0.8
30	0.9	1.8
31	1.8	4.5
32	1.1	2.4
33	2.1	5.8
34	0.6	1.4
35	22.4	46.7
36	2.5	6.7
37	22.5	3.6
38	0.2	1.0
39	0.2	1.5
40	0.8	2.2
41	0.3	2.3
42	0.5	1.9
43	36.7	73.1
44	21.3	42.4
4P	5.7	11.3
5P	8.6	19.4
6P	13.5	30.8
1.0	5.7	11.3
2.0	1.6	3.5
2.1	2.1	4.3
2.2	2.8	5.5
2.3	3.1	6.1
2.4	7.1	15.1
2.5	8.1	18.2
2.6	8.6	19.4
3.0	6.4	9.1
3.1	10.5	19.0
3.2	10.6	19.1
3.3	11.1	20.2
3.4	11.9	21.6
3.5	12.5	23.2
3.6	13.0	24.1
3.7	13.3	24.7
3.8	13.8	26.1
3.9	1.2	2.9
4.0	4.1	9.5
4.1	6.9	15.7
4.2	20.0	40.8
4.3	1.3	2.7
4.4	20.7	42.3
4.5	21.7	45.0
4.6	22.4	46.7
4.7	2.5	6.7
5.0	-	820.0
5.1	-	820.0
5.2	-	1037.0
5.3	-	1100.0

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A1	0.50	78%	0.70	0.81	5.7	1.7	3.3
A2	0.47	77%	0.71	0.82	6.2	1.6	3.1
A3	0.45	78%	0.72	0.82	5.9	1.6	3.1
A4	0.15	90%	0.73	0.81	5.0	0.6	1.0
A5	0.13	90%	0.73	0.81	5.0	0.5	1.0
A6	1.51	58%	0.53	0.68	10.5	3.2	7.0
A7	0.58	41%	0.42	0.60	10.6	1.0	2.4
A8	0.30	53%	0.52	0.68	5.9	0.8	1.7
A9	1.33	0%	0.08	0.35	13.9	0.4	2.9
B1	0.37	78%	0.72	0.83	5.1	1.4	2.7
B2	0.35	94%	0.85	0.93	5.0	1.6	2.8
B3	0.35	71%	0.67	0.79	5.0	1.2	2.4
B4	0.03	90%	0.73	0.81	5.0	0.1	0.2
B5	0.26	90%	0.73	0.81	5.0	1.0	1.8
B6	0.73	59%	0.56	0.71	7.1	1.9	4.1
B7	0.47	40%	0.37	0.56	7.0	0.8	2.0
B8	0.25	90%	0.73	0.81	5.0	0.9	1.7
B9	0.19	90%	0.73	0.81	5.0	0.7	1.3
B10	0.38	55%	0.53	0.69	5.2	1.0	2.2
B11	0.74	35%	0.33	0.53	11.1	1.0	2.6
B12	1.08	61%	0.58	0.72	9.2	2.7	5.6
B13	0.58	57%	0.55	0.70	6.4	1.5	3.2
B13A	0.48	21%	0.23	0.46	9.4	0.5	1.6
B14	0.49	68%	0.63	0.76	9.4	1.3	2.6
B15	0.27	77%	0.71	0.81	5.7	0.9	1.8
B16	0.15	66%	0.56	0.69	5.4	0.4	0.8
B17	0.99	41%	0.42	0.60	8.2	1.8	4.5
B18	0.47	51%	0.50	0.66	7.2	1.1	2.4
B19	1.92	30%	0.32	0.53	16.9	2.1	5.7
B20	0.26	50%	0.49	0.66	6.3	0.6	1.4
B21	2.46	0%	0.08	0.35	29.7	0.5	3.6
C1	0.74	26%	0.29	0.51	15.0	0.8	2.2
C2	0.80	0%	0.08	0.35	6.3	0.3	2.3
D1	0.95	14%	0.19	0.43	12.8	0.7	2.6
F1	0.92	56%	0.52	0.67	7.5	2.2	4.7
F2	0.14	79%	0.72	0.83	5.0	0.5	1.0
F3	0.73	60%	0.57	0.72	5.5	2.1	4.4
F4	0.68	31%	0.30	0.51	11.3	0.8	2.3
F5	3.88	36%	0.36	0.55	10.3	3.4	8.3
F6	0.35	0%	0.08	0.35	5.3	0.2	1.0
F7	0.53	0%	0.08	0.35	6.9	0.2	1.5
OS1	17.73	80%	0.59	0.70	15.1	36.7	73.1
OS2	8.93	90%	0.59	0.70	10.6	21.3	42.4

LEGEND:

- PROPOSED STORM SEWER
- PROPOSED ROOF DRAIN SEWER
- 6200 PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 6200 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- MAJOR DRAINAGE BASIN
- MINOR DRAINAGE BASIN
- A = BASIN DESIGNATION
- B = AREA IN ACRES
- C = PERCENT IMPERVIOUS
- 1 DESIGN POINT
- HP HIGH POINT
- LP LOW POINT
- DRAINAGE ARROW
- EXISTING DRAINAGE ARROW

50 25 0 50 100

ORIGINAL SCALE: 1" = 50'

DRAINAGE MAP
SOLACE AT CIMARRON HILLS
JOB NO. 25174.00
3/12/21
SHEET 1 OF 3

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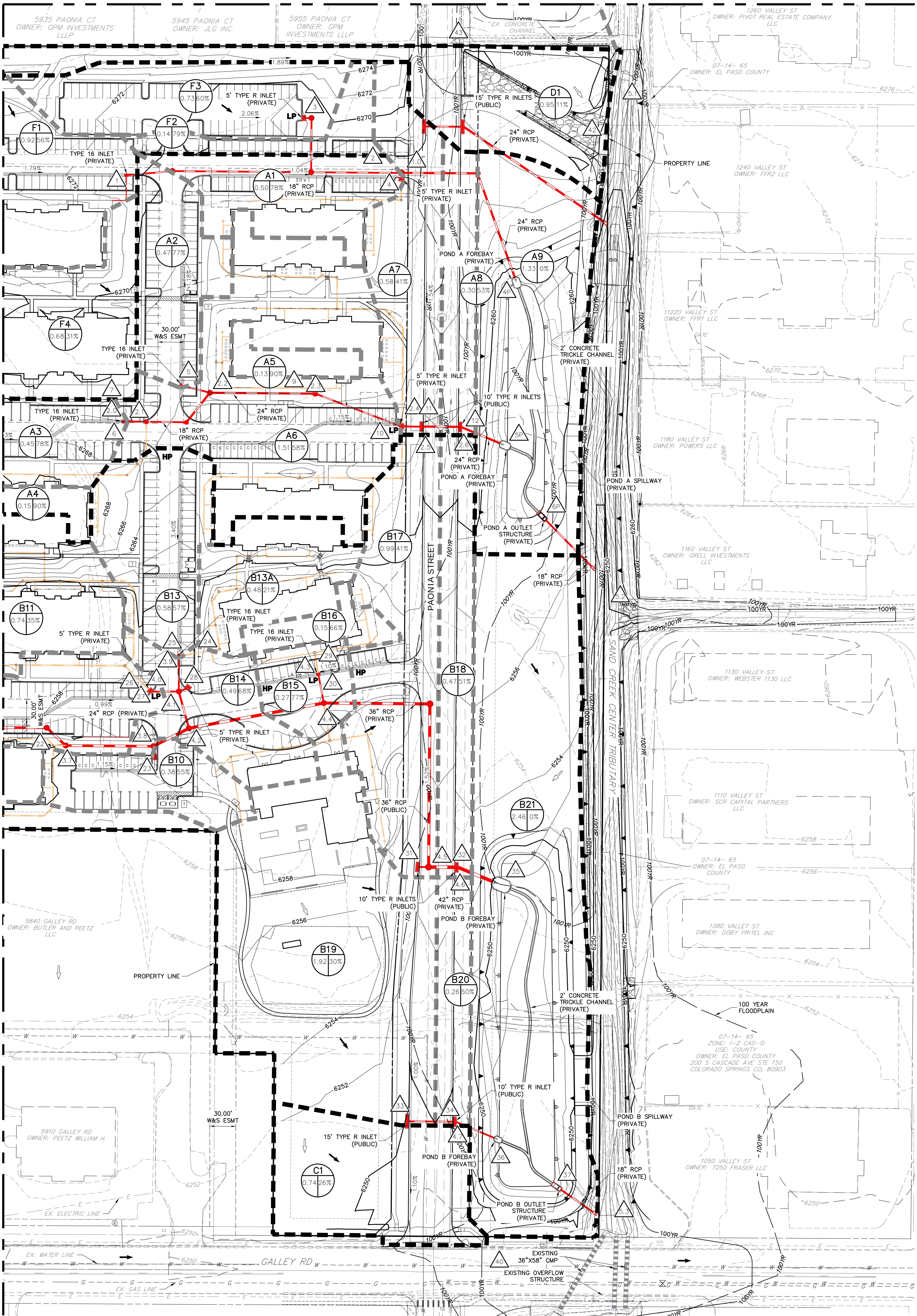
SEE SHEET 3



LEGEND:

- PROPOSED STORM SEWER
- PROPOSED ROOF DRAIN SEWER
- 6200 PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 6200 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- MAJOR DRAINAGE BASIN
- MINOR DRAINAGE BASIN
- A B C: A = BASIN DESIGNATION, B = AREA IN ACRES, C = PERCENT IMPERVIOUS
- 1 DESIGN POINT
- HP HIGH POINT
- LP LOW POINT
- DRAINAGE ARROW
- EXISTING DRAINAGE ARROW

50 25 0 50 100
ORIGINAL SCALE: 1" = 50'

DRAINAGE MAP
SOLACE AT CIMARRON HILLS
JOB NO. 25174.00
3/12/21
SHEET 2 OF 3

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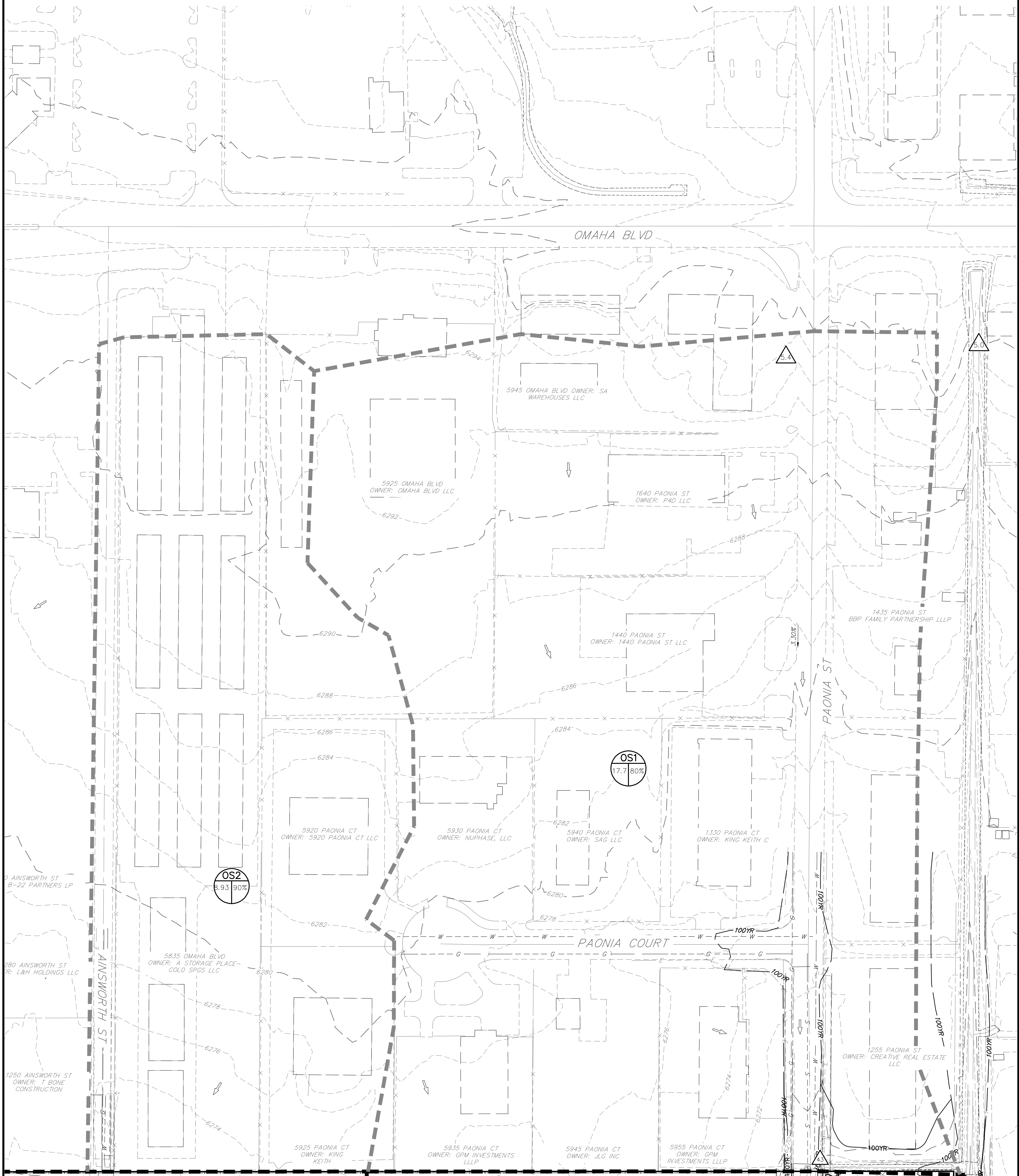

SEE SHEET 1

SEE SHEET 2

LEGEND:

- PROPOSED STORM SEWER
- PROPOSED ROOF DRAIN SEWER
- 6200 PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 6200 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- MAJOR DRAINAGE BASIN
- MINOR DRAINAGE BASIN
- A = BASIN DESIGNATION
- B = AREA IN ACRES
- C = PERCENT IMPERVIOUS
- 1 DESIGN POINT
- HP HIGH POINT
- LP LOW POINT
- DRAINAGE ARROW
- EXISTING DRAINAGE ARROW

N

60 30 0 60 120

ORIGINAL SCALE: 1" = 60'

DRAINAGE MAP
SOLACE AT CIMARRON HILLS
JOB NO. 25174.00
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SHEET 3 OF 3

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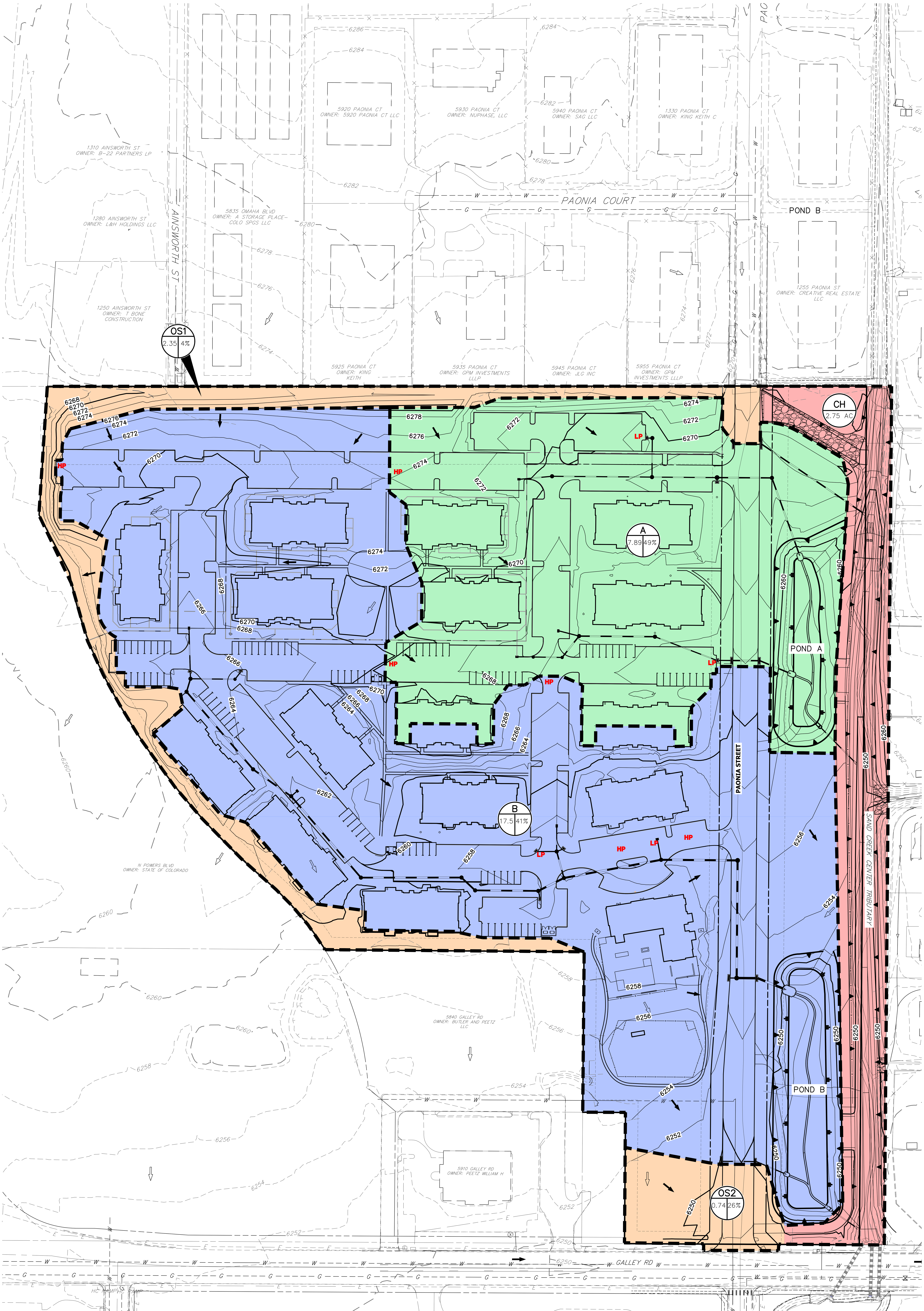

LEGEND:

POND A CAPTURE AREA

POND B CAPTURE AREA

OFFSITE FLOW AREA

SAND CREEK CAPTURE AREA

70 35 0 70 140

ORIGINAL SCALE: 1" = 70'

DRAINAGE EXCLUSION MAP
SOLACE AT CIMARRON HILLS
JOB NO. 25174.00
03/10/21
SHEET 1 OF 1

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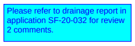
Drainage Report - Final_V2.pdf Markup Summary

lpackman (1)



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Please refer to drainage report in application SF-20-032 for review 2 comments.