MASTER DEVELOPMENT DRAINAGE PLAN
FOR
THE SANDS INDUSTRIAL PARK FILING NO.1
AND THE
PRELIMINARY/FINAL DRAINAGE REPORT
FOR
THE SANDS INDUSTRIAL PARK
FILING NO. 1, LOT 6

November 2019

Prepared for:

Landuis Company
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Project #43-129

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DRAINAGE REPORT STATEMENTS

ENGINEER'S STATEMENT

This report and plan for the drainage design of The Sands Industrial Park Filing No.1 was prepared under my supervision and is correct to the best of my knowledge and belief. Said drainage report and plan has been prepared in accordance with the City of Colorado Springs Drainage Criteria Manual and is in conformity with the master plan of the drainage basin. I understand that the City of Colorado Springs does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

_____

Virgil A. Sanchez, P.E. #37160
For and on Behalf of M & S Civil Consultants, Inc.

DEVELOPER'S STATEMENT

The Landuis Company hereby certifies that the drainage facilities for The Sands Industrial Park Filing No.1 shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Colorado Springs pursuant to Section 7.7.906 of the City Code; and cannot, on behalf of The Sands Industrial Park guarantee that final drainage design review will absolve the Landius Company and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

BY: _____ DATE: _____

Mr. Jeff Mark
TITLE: Owner and Manager
ADDRESS: Landuis Company
212 N. Washatch Ave, Suite 301
Colorado Springs, CO 80903

CITY OF COLORADO SPRINGS

Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs} 2001, as amended,

BY: _____ DATE: _____

For the City Engineer

CONDITIONS:

MASTER DEVELOPMENT DRAINAGE PLAN FOR THE SANDS INDUSTRIAL PARK FILING NO.1 AND THE PRELIMINARY/FINAL DRAINAGE REPORT FOR THE SANDS INDUSTRIAL PARK FILING NO.1, LOT 6

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MASTER DEVELOPMENT DRAINAGE PLAN FOR THE SANDS INDUSTRIAL PARK AND THE PRELIMINARY/FINAL DRAINAGE REPORT FOR THE SANDS INDUSTRIAL PARK FILING NO.1, LOT 6

PURPOSE

This document is the Master Development Drainage Plan for the Sands Industrial Park Filing No. 1 and the Preliminary/Final Drainage Report for The Sands Industrial Park Filing No.1, Lot 6. The purpose of this report is to identify the existing and proposed runoff patterns and to identify and evaluate proposed drainage improvements which are intended to safely convey runoff through the site and to downstream outfalls. Evaluation of tributary basins, conveyance structures, and detention facilities has been carried out in this report using the recommended procedures in The City of Colorado Springs Drainage Criteria Manual (DCM) Volumes 1 and 2, as well as the Urban Storm Drainage Criteria Manual Volumes 1-3.

GENERAL LOCATION AND DESCRIPTION

The Sands Industrial Park Filing No. 1, located within a portion of the northwest quarter of Section 33, Township 13 South, Range 65 West of the Sixth Principal Meridian, El Paso County, Colorado. The site is bounded to the north by Marksheffel Industrial Park Lots 13-15, to the west by the East Sand Creek Sub Tributary and The Sands Filing No.1, to the south by the Rocky Mountain Industrial Park Filing No.1 and to the east by existing Capitol Road Rights of Way and Un-platted property which houses the Weatherford Industrial Site. A vicinity map has been included in the appendix of this report.

The Sands Industrial Park Filing No. 1 site is 15.091 acres and will develop six (6) industrial zoned subdivision lots. In addition to the lots the development will provide public access roadway, a private drive, storm water conveyance pipes and channels, storm inlets, private utilities, and a full spectrum detention pond with an outfall.

With the exception of Lot 6, site specific development of the remaining 5 interior lots is not known at this time and will be evaluated in subsequent individual drainage letters or reports, however master planned storm sewer infrastructure is being extended at this time to each lot to aid with collection of runoff from future development and will be discussed in detail within this document.

Prior to development the site consists of gradually sloping agricultural grazing land which steepens along the eastern boundary. Generally the slopes northeast to southwest at grades that range between 2 and 10% Existing runoff typically flows across the site as sheet flow with the exception a shallow channel at the north end of the site which quickly broadens as it traverses the site, prior to reaching the channel. A slightly more consolidated constructed earthen channel is located along the southern property of the site. Both channels function to convey drainage from offsite areas from the north and east of the site.

There are existing underground utilities located along the both the western and southern boundaries of the site, which include gas, electric, water and sewer, there are no known irrigation facilities on site.

The subject property is located within the Sand Creek Basin.

SOILS

The Soil for this project is delineated by the map in the appendix as shown as “Blendon Sandy Loam” (10) and “Ellicot Loamy Coarse Sand” (28) has been classified as a Hydrologic Soil Types "B" and “A” respectively. This Soil data has been determined using the USDA NRCS web soils survey for El Paso County Area, Colorado. A map delineating the soil types and the subject site is included in the appendix.

HYDROLOGIC CALCULATIONS

Hydrologic calculations were performed using the City of Colorado Springs Storm Drainage Design Criteria manual. The Rational Method was used to estimate storm water runoff anticipated from design storms with minor (5-year) and major (100-year) recurrence intervals. Basins were analyzed and delineated (see drainage map in Appendix) in order to determine areas and assign ‘C’ coefficients. Overland flow and channelized flow paths were analyzed for each sub-basin in order to determine times of concentration. A minimum of 5 minutes was utilized for urban areas. The proposed project consists of light industrial and Table 6-6 Volume 1 of DCM was used for corresponding runoff coefficients. IDF equations presented in Chapter of the DCM where utilized to calculate flow rates.

HYDRAULIC CALCULATIONS

Hydraulic calculations were estimated using the methods described in the City of Colorado Springs Storm Drainage Design Criteria Manual (DCM) along with the Urban Drainage and Flood Control District (UDFCD). Manning’s Equation was used for estimation of required pipe sizes. HGL calculations will be submitted after the initial review of this document and subsequent Final Drainage Report. The pertinent data sheets are included in the appendix of this report.

FLOODPLAIN STATEMENT

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel No. 08041C0753 G, effective date December 7, 2018, a portion of The Sands Industrial Park Filing No. 1, is located within a 100 year floodplain. Based upon the current floodplain mapping, **No portion of Lot 6,** of The Sands Industrial Park Filing No. 1 lies within an effective 100 year floodplain.

A Conditional Letter of Map Revision (CLOMR) was prepared the adjacent “The Sands Filing No. 1” development by MS Civil Consultants and accepted by FEMA (CLOMR Case No. 18-08-0610R) in October of 2018 to allow for construction of channel improvements to the East Fork Sand Creek Sub tributary. Upon the completion of channel construction (which is scheduled to the end in mid November of 2019), a Letter of Map Revision (LOMR) will be prepared and submitted to FEMA. Upon its approval, the effective floodplain will be remapped, thereby removing the developable portions of The Sands Industrial Park Filing No. 1 from encroachment. An effective and annotated FIRM Panel, CLOMR work maps and CLOMR approval letter are included in the appendix.

DRAINAGE CRITERIA

This drainage analysis has been prepared in accordance with the current City of Colorado Springs Drainage

Criteria Manual. Calculations were performed to determine runoff quantities for the 5-year and 100-year frequency storms for developed conditions using the Rational Method as required for basins having areas less than 100 acres.

FOUR STEP PROCESS

In accordance with the City of Colorado Springs Drainage Manual, Volume 2, this site has implemented the four step process to minimize adverse impacts of urbanization and help manage runoff from frequent storm events.

Step 1 Employ Runoff Reduction Practices. Whenever possible roof drains will be directed to vegetated landscaping buffer areas and islands prior to release to streets aiding in minimizing direct connection of impervious surfaces.

Step 2 Implement BMPs that provide a water quality capture volume with slow release. – A Full Spectrum Detention basin is being proposed at the south end of the site. This pond will capture restrict discharge rates to below historic and slowly release the Water Quality volume over 40 hours and the EURV over 72 hours.

Step 3 Stabilize streams. – The drainage from the site will be conveyed by stable underground storms sewer systems to stabilized outfalls and to the recently improved Sand Creek Sub-Tributary Channel. Drainage fees paid by at the time of platting will be used to the aid in the reimbursement of the channel improvements per the Sand Creek Drainage Basin Planning Study.

Step 4 Implement site specific and other source control BMPs. – The proposed development will implement a Stormwater Management Plan including property housekeeping practices and spill containment procedures.

EXISTING DRAINAGE CONDITIONS

The existing site consists of gradually sloping agricultural grazing land which slopes northeast to southwest at grades that range between 2 and 10% with steeper embankments ranging from 5% to 33% along the eastern boundary. The site possesses limited vegetation typical of sparse native grasses and small brush. Runoff typically flows across the site as sheet flow with the exception a shallow channel at the north end of the site which quickly broadens as it traverses the site, prior to reaching the channel north of the southern property line. Runoff reaching this location comes from a large 90+ acre area located to the north and east of the subject site which includes a small segment of existing Capitol Drive below Industry Drive. A second slightly more consolidated partially constructed earthen channel is located along the southern property of the site which comes from a large 30+ acres area located to the east of the site which includes the adjacent Weatherford Artificial Lift Systems complex. The following paragraphs further detail the existing drainage patterns and existing infrastructure.

Basin OS1 was estimated to consist of approximately 92.13 acres. At the time of writing of this report, the offsite watershed (located to the north and east of the subject site) is currently undeveloped. The existing flow rates calculated for the 5-year and 100-year events were estimated to be 21.0 and 135.7 cfs. Two existing 42" culverts daylight along the east side of existing Capitol Drive (at **Design Point 1**(Q5 = 21.0 cfs, Q100 = 135.7 cfs)**)** to convey runoff from the east to the west side of the existing roadway.

Basin OS2 is located to the north of the planned industrial lots of the subject site and consists of approximately 4.52 acres of existing light industrial buildings, warehouses, landscaping, gravel parking areas and storage lots. The size of the contributing offsite watershed and site topography and flow patterns were validated using the MIP Drainage Map, USGS contours and onsite inspection. Runoff produced by the watershed is calculated to reach peak flow rates of 13.8 cfs for the minor storm event (5-Year) and 25.7 cfs for the major storm event (100-Year).

In the existing condition runoff from **Basin OS2** combines with flows from **DP1**, and discharges to an existing swale which enters the subject site at **DP3**. Cumulative flows at **DP3** have been estimated to be 28.8 cfs for the minor storm event (5-Year) and 150.4 cfs for the major storm event (100-Year). The runoff discharges into **Basin EX A** and ultimately into the EFSCST.

Basin OS3 is located to the west of **Basin OS2** and consists of approximately 3.97 acres of existing light industrial buildings, warehouses, landscaping, gravel parking areas and storage lots. Similarly to Basin OS2, the size of the offsite watershed, site topography and general flow patterns were estimated using the Marksheffel Industrial Park Drainage Map, and confirmed with onsite inspection and aerial imagery.

Runoff produced by the basin of 12.4 cfs in the minor storm event (5-Year) and 23.1 cfs for the major storm event (100-Year) is directed west to **Design Point 2**. Runoff from **DP2** outfalls into the existing EFSCST, via a trapezoidal depression in the existing concrete lining of the channel sideslope protection. The calculated flow rates are just slightly higher that the developed flows shown on the MIP Drainage plan of 8.1 and 16.7 cfs.

Basin OS4 consists of approximately 33.11 offsite acres located to the east of the proposed industrial site, of which a portion has been partially developed into industrial/commercial buildings, warehouses and production facilities associated with Weatherford Artificial Lift Systems facilities. Although two drainage reports have been provided by El Paso County which discuss various portions of the site, limited information was obtained regarding how the runoff from Weatherford development in its entirety is to function. Given this, detention was not considered when estimating runoff.

The size of the offsite watershed, topography, ground cover and development conditions for **Basin OS4** were estimated to using USGS topography maps and aerial imagery and was verified using the Weatherford drainage report data and field observation. Runoff produced by the basin in the existing condition has been estimated to be 32.9 cfs for the minor storm event (5-Year) and 86.4 cfs for the major storm event (100-Year).

Basin OS5 consists of approximately 1.00 offsite acres located to the east of the existing site, of which a majority is undeveloped and a portion has been partially prepared as an access road into the Weatherford site. Runoff produced by the basin has been estimated to be 0.8 cfs for the minor storm event (5-Year) and 2.3 cfs for the major storm event (100-Year). Runoff from Basin OS5, combines with runoff from **Basin OS4** at southwest corner of the basin at **Design Point 4** (Q5 = 1.6 cfs, Q100 = 3.2 cfs). Currently, an existing 24" culvert and 48" CMP culvert are located at the southeast corner of the Weatherford property which convey the runoff from **Basins OS-4** and **OS-5** to a existing unlined swale within the subject site.

Basin EXA consists of approximately 15.27 acres (subject site), which is currently undeveloped. Runoff produced by this basin is estimated to be 3.6 cfs for the minor storm event (5-Year) and 24.5 cfs for the major storm event (100-Year). The cumulative flows estimated to reach the EFSCST at **Design Point 5** (**EXA+DP2+DP3+DP4+**), are estimated to be 59.6 cfs for the minor storm event (5-Year) and 229.4 cfs for the major storm event (100-Year). The cumulative runoff at **DP5** can be compared to the total discharge in the proposed condition.

It should be noted that the The Sands Filing No.1 Master Development Drainage Plan Existing Condition Map was included with the maps in the appendix to show previous assumption and additional detail not showing up on the larger scale map. The rates provided on that map are superseded by the Sands Industrial Filing No. 1 Offsite Existing Condition map.

PREVIOUS STUDIES

The area which encompasses The Sands Industrial Park Filing No.1 has been previously studied. Below is short outline of the assumptions regarding the lands of the subject site and those based upon the previously assembled and approved drainage reports and those that may include or be adjacent to the subject site.

"Sand Creek Drainage Basin Planning Study, prepared by Kiowa Engineering, revised December 1998

- Indicates runoff from area to be discharged to SCEFST
- Assumes Land Use to be Industrial.

"Master Development Drainage Plan for The Sands and Preliminary Drainage Report prepared by M&S Civil Consultants, Inc., March 2018.

- Indicated offsite drainage areas and established recommendation for bypassing flows
- Indentified need for on-site water quality/detention.
- Continued assumption of land use.

PROPOSED DRAINAGE CONDITIONS

The Sands Industrial Park Filing No. 1 will develop six (6) industrial zoned subdivision lots. In addition to the lot development the development will provide public access roadway, a private drive, storm water conveyance pipes and channels, storm inlets, private utilities, and a full spectrum detention pond with an outfall.

With the exception of Lot 6, site specific development of the remaining 5 interior lots is not known at this time and will be evaluated in subsequent individual drainage letters or reports, however master planned storm sewer infrastructure has been extended to each lot to aid with collection of runoff from future development.

Generally, runoff reaching the site from offsite areas and developed flows produced onsite will follow historic drainage patterns draining east to west ultimately reaching the East Fork Sand Creek Sub-Tributary (EFSCST) channel. A brief overview of the site improvements and proposed drainage patterns are as follows: A 2' deep concrete trapezoidal channel will be extended from the east to west along the north boundary of Lot 1 to aid in directing offsite water reaching the northeast corner of the site to the EFSCST while also functioning to intercept the runoff from the offsite lots to the north of the property. Two separate proposed private storm sewer collection systems will be extended from the northwest and northeast corners of the proposed full spectrum detention facility to aid in collecting runoff from Lots 1-5 and a portion of Lot 6. Another private storm sewer system will be extended to the east from the southeast corner of the pond to collect runoff from Proposed Capitol Drive and the remaining portions of Lot 6. A large 48" storm sewer will be extended from a pair of existing 36" stub which outfall into the EFSCST to the east property line to collect runoff from the property to the east of the site. An overflow swale will be constructed along the southern boundary to protect the property should the existing culverts opening become clogged and aid to intercept flow from portions of the site which will remain undeveloped. The private FSD facility (Pond 1) is being utilized for detention

storage and water quality treatment of pollutants prior to discharge to downstream existing systems.

The following paragraphs further detail the proposed drainage patterns.

Basin OS1 (Q5 = 19.8 cfs, Q100 = 132.7 cfs), was estimated to be 92.13 acres in size. At the time of writing of this report, the watershed (located to the north and east of the subject site) remains undeveloped (refer to Existing Condition Map). Currently two existing 42" culverts are located at D**esign Point 1** to aid in conveying runoff from the east to the west side of Capitol Drive. As discussed within "The Sands Master Development Drainage Report" a master development drainage plan for this offsite watershed was not able to be found within County Records. Any future development within this basin will be required to provide onsite water quality and detention storage and release to predevelopment rates in accordance with the City of Colorado and El Paso County Drainage Criteria manuals and MS4 permits, so it anticipated that flows reaching **DP1** will not exceed the report rate.

Basin OS2 (Q5 = 1.6 cfs, Q100 = 3.2 cfs), 0.65 acres, is located north of the property and consists of a segment of existing Capitol Drive and existing lot frontages adjacent to the roadway. Runoff from this basin will continue to flow south to the northern boundary of the site within the existing curb and gutter.

Basin A (Q5 = 0.7 cfs, Q100 = 1.3 cfs), 0.16 acres, is located in the northeastern portion of the site and consists of a small portion of proposed Capitol Drive. Runoff from this basin combines with flows from Basin OS2 and shall be directed to a proposed 5'w curb opening at the low point within Capitol Drive. The total peak runoff anticipated to reach **Design Point 2** is Q5 = 3.0 cfs, Q100 = 5.8 cfs. A small riprap rundown D_{50}=12" 24" thick will convey runoff from the street to the existing earthen swale. Runoff from **DP1** and **DP2** combine at **Design Point 3** (Q5 = 3.0 cfs, Q100 = 5.8 cfs). Should the existing 42" RCPs or proposed curb opening become clogged runoff would overtop the curb to the existing/proposed swale.

Basin OS3 (Q5 = 0.7 cfs, Q100 = 1.3 cfs), 4.52 acres, is located to the north of the planned industrial lots of the subject site and consists of light industrial warehouses, landscaping, gravel parking areas and storage lots. Runoff from basin discharges along the northern property line as sheet flow.

Basin OS4 (Q5 = 0.7 cfs, Q100 = 1.3 cfs), 3.97 acres, is located to the west of **Basin OS3** and consists of approximately of existing light industrial buildings, warehouses, landscaping, gravel parking areas and storage lots. Runoff from basin discharges along the northern property line as sheet flow. .

Basin B (Q5 = 0.7 cfs, Q100 = 1.3 cfs), 0.27 acres consists proposed shared drainage corridor located along the north boundary of the site. The proposed onsite basin will consist of a 25'-30'wide drainage easement with a proposed 2.5' deep, 8' bottom width, 2:1 SS concrete lined trapezoidal swale at 0.5% which would collect runoff from **Basins A, OS3, OS3** and **DP 3** and convey them to **Design Point 4**. The proposed swale would terminate at the EFSCST where an existing cutout had been previously constructed in the existing concrete channel (refer to background information in appendix). The swale will convey peak flow rates of 33.2 cfs for the minor storm event (5-Year) and 149.4 cfs for the major storm event (100-Year) have been calculated to reach DP4 with 1' of freeboard. It is important to note that the construction of the proposed swale will need to be coordinated with the land onwer to the north as it will like require the removal of existing fencing and will require offsite grading within the existing offsite 10-14.5' wide drainage easement.

Basin C (Q5 = 7.0 cfs, Q100 = 13.9 cfs), 3.38 acres, which is planned to consists of building structures, asphalt and/or gravel parking lots, and landscaping typically associated with the light industrial development of a portion of Lot 1. Runoff produced within **Basin C** is to be collected by a private 24" polypropylene storm sewer (**Pipe 1**) (Q5 = 7.0 cfs, Q100 = 13.9 cfs).

Until the lot is fully developed, runoff from the basin will be conveyed overland to a local depression at **Design Point 5** (Q5 = 7.0 cfs, Q100 = 13.9 cfs). Riprap (D50=9", 18" deep) atop filter fabric shall be placed on the step slopes adjacent to the proposed flared end section (FES) to prevent erosion. In the event that the pipe were to become clogged, runoff reaching **DP5** would overtop the access road curb and gutter and safely flow toward other downstream facilities at the roadways low point..

Basin D (Q5 = 1.5 cfs, Q100 = 3.0 cfs), 0.53 acres, is planned to consists of asphalt and/or gravel parking lots, and landscaping areas associated with the remainder of Lot 1 development. Runoff produced within **Basin D** is to be collected by a private 18" polypropylene storm sewer (**Pipe 2**) (Q5 = 1.5 cfs, Q100 = 3.0 cfs).

Until Lot 1 is developed and the two aforementioned storm sewer extended, runoff from the basin will be conveyed overland to a local depression at **Design Point 6** (Q5 = 7.0 cfs, Q100 = 13.9 cfs). Riprap (D50=9", 18" deep) should be placed adjacent to the proposed flared end section (FES) to prevent erosion. Runoff from **Pipes 1 and 2** are to combine at a Proposed 5' Dia. Type II Manhole, and continue downstream within **Pipe 3**, a private 24" polypropylene storm sewer at peak flow rates of (Q5 = 8.0 cfs, Q100 = 16.0 cfs). Should the pipe system become clogged runoff reaching **DP6** would overtop the adjacent embankment and continue downstream toward the proposed pond.

Basin E (Q5 = 2.7 cfs, Q100 = 4.9 cfs), 0.65 acres, consists of a proposed private drive and a portion of the frontages of Lots 3-5. The private roadway is planned to be 28' in width and super elevated at 2% with flows retained and conveyed by a 6" Type 5 curb and gutter located along the south edge. Runoff from Basin E continue south via curb & gutter and cross pan to **Design Point 7** (Q5 = 2.7 cfs, Q100 = 4.9 cfs). A 10' type R sump inlet shall collect the runoff reaching the design point. Runoff intercepted by the inlet shall combine with flows in **Pipe 3** and continue south within a private 30" polypropylene storm sewer (**Pipe 4**) at peak flow rates of (Q5 = 9.8 cfs, Q100 = 19.3 cfs). Should the inlet/pipe system become clogged runoff reaching **DP7** would overtop the adjacent embankment and continue downstream toward the proposed pond.

Basin F (Q5 = 2.5 cfs, Q100 = 5.0 cfs), 0.92 acres, which is planned to consists of building structures, asphalt and/or gravel parking lots, and landscaping typically associated with the light industrial development of a portion of Lot 5. Runoff produced within **Basin F** is to be collected by a private Type C inlet and private 18" polypropylene storm sewer (**Pipe 5**) (Q5 = 7.0 cfs, Q100 = 13.9 cfs) located as the southwest corner of the property. The intercepted runoff combines with flows from **Pipe 4** in **Pipe 6** a private 30" polypropylene storm sewer at peak flow rates of (Q5 = 11.5 cfs, Q100 = 22.7 cfs). Should the pipe system become clogged runoff reaching **DP8** would overtop the adjacent embankment and continue downstream toward the proposed pond.

Basin G (Q5 = 2.8 cfs, Q100 = 5.5 cfs), 0.99 acres, which is planned to consists of building structures, asphalt and/or gravel parking lots, and landscaping typically associated with the light industrial development of a portion of Lot 2. Runoff produced within **Basin G** is to be collected by a private Type C inlet and private 18" polypropylene storm sewer (**Pipe 7**) (Q5 = 2.8 cfs, Q100 = 5.5 cfs) located as the southwest corner of the lot at **Design Point 9** (Q5 = 2.8 cfs, Q100 = 5.5 cfs). Should the pipe system become clogged runoff reaching **DP9** would overtop the adjacent embankment and continue downstream toward the proposed pond within the rear lot drainage easement.

Basin H (Q5 = 2.7 cfs, Q100 = 5.4 cfs), 0.99 acres, which is planned to consists of building structures, asphalt and/or gravel parking lots, and landscaping typically associated with the light industrial development of a portion of Lot 3. Runoff produced within **Basin H** is to be collected by a private 18" polypropylene storm sewer (**Pipe 8**) (Q5 = 2.7 cfs, Q100 = 5.4 cfs) located as the southwest corner of the lot at **Design Point 10** (Q5 = 2.7 cfs, Q100 = 5.4 cfs). The intercepted runoff combines with flows from **Pipe 7** in **Pipe 9** a private 24"

polypropylene storm sewer at peak flow rates of Q5 = 5.4 cfs, Q100 = 10.7 cfs. Should the pipe system become clogged runoff reaching **DP10** would overtop the adjacent embankment and continue downstream toward the proposed pond within the rear lot drainage easement.

Basin I (Q5 = 4.3 cfs, Q100 = 8.6 cfs), 1.85 acres, is a portion of Lot 6 which is planned to be utilized for storage associated with the development of the light industrial parcel. Runoff produced within **Basin I** is to be conveyed along the north and west property lines in side lot swales to **Design Point 11** (Q5 = 4.3 cfs, Q100 = 8.6 cfs), where flows will be intercepted by a private Type C inlet and private 18" polypropylene storm sewer (**Pipe 10**) (Q5 = 4.3 cfs, Q100 = 8.6 cfs). The intercepted runoff combines with flows from **Pipe 9** in **Pipe 11** a private 24" polypropylene storm sewer at peak flow rates of Q5 = 8.9 cfs, Q100 = 17.7cfs. Should the pipe system become clogged runoff reaching **DP11** would overtop the adjacent embankment and continue downstream toward the proposed pond within the rear lot drainage easement.

Basin J (Q5 = 2.5 cfs, Q100 = 5.0 cfs), 0.92 acres, which is planned to consists of building structures, asphalt and/or gravel parking lots, and landscaping typically associated with the light industrial development of a portion of Lot 4. Runoff produced within **Basin J** is to be collected by a private 18" polypropylene storm sewer (**Pipe 12**) (Q5 = 2.5 cfs, Q100 = 5.0 cfs) located as the southwest corner of the lot at **Design Point 10** (Q5 = 2.5 cfs, Q100 = 5.0 cfs). The intercepted runoff combines with flows from **Pipe 9 and Pipe 10** in **Pipe 13** a private 30" polypropylene storm sewer at peak flow rates of Q5 = 11.0 cfs, Q100 = 22.0 cfs. Should the pipe system become clogged runoff reaching **DP12** would overtop the adjacent embankment and continue downstream toward the proposed pond within the rear lot drainage easement. It should be noted that until Lots 2, 3, and 4 (Basins G, H and J) are developed runoff from the empty lots are to be conveyed to the inlet an pipe (low points) at Design Point 8 and 12. Given a conservative assumption of 2.0cfs/acre in the undeveloped condition and approximately 2 acres to each design point the interim drainage is considerable less than the planned amount for each design point.

Basin J1 (Q5 =3.4 cfs, Q100 = 6.0 cfs), 0.92 acres, consists of a portion of proposed Capitol Drive. The public roadway is planned to be 28' in width and super elevated at 2% with flows retained and conveyed by a 8" Type 1 curb and gutter located along the western side. Runoff from **Basin J1** continues south via curb & gutter to **Design Point 13** (Q5 = 3.4 cfs, Q100 = 6.0 cfs). Runoff intercepted by a public 12' Type D-10R at-grade inlet. Runoff intercepted by the inlet will continue south within a private 18" polypropylene storm sewer (**Pipe 14)** at peak flow rates of (Q5 = 3.4 cfs, Q100 = 6.0 cfs). Should the inlet/pipe system become clogged runoff reaching **DP13** would continue south within Capitol Drive.

Basin K (Q5 = 3.0 cfs, Q100 = 5.6 cfs), 0.68 acres, which is planned to consists of landscaping, parking lots and a building structure associated with the development of a portion of light industrial Lot 6. Runoff produced within **Basin K** is to be collected within Type 5 curb and gutter directed to a low point and a private Type R sump inlet at Design Point 14 (Q5 = 3.0 cfs, Q100 = 5.6 cfs). Runoff intercepted by the inlet will continue west underground within a private 18" polypropylene storm sewer (**Pipe 15**) (Q5 = 2.8 cfs, Q100 = 5.5 cfs) The intercepted runoff combines with flows from **Pipe 14** in **Pipe 16** a private 24" polypropylene storm sewer at peak flow rates of Q5 = 6.1 cfs, Q100 = 10.9cfs. Should the pipe system become clogged runoff reaching **DP14** would overtop the local highpoint in southwestern corner of the parking lot and continue within an earthen swale toward the proposed pond.

Basin L (Q5 = 2.8 cfs, Q100 = 5.6 cfs), 1.01 acres, is a portion of Lot 6 which is planned to be utilized for storage associated with the development of the light industrial parcel. Runoff produced within **Basin L** is to be conveyed along the south and west property lines in side lot swales to **Design Point 15** (Q5 = 2.8 cfs, Q100 = 5.6 cfs), where flows will be intercepted by a private Type C inlet and private 18" polypropylene storm sewer (**Pipe 17**) (Q5 = 2.8 cfs, Q100 = 5.6 cfs). The intercepted runoff combines with flows from **Pipe 16** in **Pipe 18**

a private 24" polypropylene storm sewer at peak flow rates of Q5 = 8.8 cfs, Q100 = 16.5cfs. Should the pipe system become clogged runoff reaching **DP15** would overtop the adjacent embankment and continue downstream toward the proposed pond.

Basin M (Q5 =0.6 cfs, Q100 = 3.5 cfs), 1.24 acres, is located at the south end of the property and consists of Tract A, which houses a Full Spectrum Detention Pond. Runoff from this basin is captured within the pond and combines within flows within Pipes 6, 13, 18. The total peak runoff anticipated to reach Pond 1 at Design Point 16 is Q5 = 32.4 cfs, Q100 = 65.2 cfs. The private full spectrum detention pond will discharge to predevelopment flow rates and discharge the water quality volume and excess urban runoff volume over 40 hours and 72 hours respectively. Refer to drainage facility design section of the report for additional information regarding the facility

Basin O (Q5 =0.6 cfs, Q100 = 3.5 cfs), 0.16 acres, is located at the southeast corner of the property which consists of a portion of proposed Capitol Drive and landscaping adjacent to the entrance into Lot 6. Runoff from **Basin O** is planned to continue south offsite within the existing west curb and gutter of Existing Capitol Drive to (**Design Point 17**) at peak flow rates of Q5 = 0.6 cfs, Q100 = 3.5 cfs.

Basin OS5, 33.11 offsite acres, is located to the east of the proposed site of which a portion has been partially developed into buildings, warehouses and production facilities associated with Weatherford Artificial Lift Systems facilities. As The size of the offsite watershed, topography, ground cover and development conditions for **Basin OS5** were estimated to using USGS topography maps and aerial imagery and Weatherford drainage report data (see offsite existing condition drainage map in appendix). Runoff produced by the basin is anticipated to be conveyed overland to **Design Point 18** at calculated peak flow rates of Q5 = 0.6 cfs, Q100 = 3.5 cfs.

Basin OS6, 1.00 offsite acres, is located to the east of the existing site. Basin **OS6** encompasses primarily undeveloped land covered in native grasses and a portion of an access road into the Weatherford site. Runoff produced by the basin has been estimated to be 0.8 cfs for the minor storm event (5-Year) and 2.3 cfs for the major storm event (100-Year). A existing 48" elliptical CMP culvert (**Pipe 20**) is located at the southeast corner of the Weatherford property at **Design Point 19** (Q5 = 33.3 cfs, Q100 = 88.8 cfs) to collect runoff from the basin. The existing culvert is planned to remain in place and continue to function to convey offsite flows underneath the newly constructed Proposed Capitol Drive. A proposed public 48" RCP (Pipe 21, (Q5 = 33.3 cfs, Q100 = 88.8 cfs)) will connect to the existing pipe providing an underground bypass of the flows previously conveyed within a narrow earthen ditch, which will aid in protecting the surrounding utilities. The proposed public line will be housed within a 45' utility easement. Should the culvert become clogged runoff reaching DP19 will overtop the roadway and will be conveyed both within Capitol Drive and within an overflow swale that is to be graded within **Basin N**.

Basin N (Q5 =0.2 cfs, Q100 = 1.3 cfs), 0.46 acres, is a strip of land located along the south boundary of the property which houses landscaping, storm sewer and other utilities as well as functions as an overflow swale for upstream runoff. The limited runoff from **Basin N** is planned to continue down-gradient to the west into **Basin OS7**.

Basin OS7 (Q5 =0.2 cfs, Q100 = 1.3 cfs), 0.18 acres, is an offsite area, native grassed area, near the southwest corner of the site. This area was platted as Tract U with the adjacent Sands Filing No.1 subdivision and amongst it uses was dedicated for public utility, public improvement, and drainage. The runoff from basin N will combine at with flows from **Basin N** at **Design Point 20** with flow totaling Q5 = 0.3 cfs, Q100 = 1.7 cfs A modified type D inlet at DP20 will be constructed to allow for a connection between the proposed 48" PP pipe and the two existing 36" RCPs. The box will function as both a manhole and an inlet two collect the

minor runoff from Basin O and N but also sized to collect the runoff reaching DP-19 in the case the inlet upstream became clogged and the emergency overflow swale became effective. As the junction box will also serve as a inlet a variance from City drainage criteria will be required. This variance will be submitted after the initial review and this comment will be amended.

Design Point 21 accounts for all developed runoff leaving the site reaching the EFSCST (from DP4, DP9 and Pipe Run19 (Pond Outfall)), without accounting for lag created by the ponding element. Total runoff is estimated to be 56.5 cfs and 212.3 cfs for the 5 year and 100 year events respectively. This compares to Existing Conditions analysis DP5, where the total runoff from the site prior to development was estimated to be 59.6 cfs and 229.4 cfs respectively.

DRAINAGE FACILITY DESIGN

A Full Spectrum Detention Pond is being proposed for this site to address water quality from 14.04 acres at 76.0% imperviousness. The pond has been sized utilizing UD-BMP v3.07 from Urban Drainage and Flood Control District (UDFCD). The pond is not expected to carry future additional flows other than from this project. The pond is being constructed with an outlet control structure which limits the release rate of the pond through the use of and orifice plate, weirs and a restricted 18" RCP outlet pipe. The pond has been sized to store the WCQV, EURV, and a portion of the flood control volumes for the 2, 5, 10, 25, 50 and 100 year storm events. The WQCV will be slowly released over 40 hours, while the EURV will be slowly released across 72 hrs. An overflow emergency weir is proposed along the southwest embankment to safely convey flows to the nearby channel in the event of outlet clogging. The emergency overflow weir will be at an elevation of 6501.56 feet and will have a length of 20 feet; with 10:1 SS and a spillway design flow depth of approx. 0.65 feet across the crest, should the outlet become clogged. The top of the proposed embankment will need to be constructed at approximately 6503.21 to provide a min of one foot of freeboard.

WQCV Pond A (UD-Det V3.07 worksheet)	**WQCV**	**EURV**	**5 Year**	**100 Year**
Maximum Volume Stored (acre-ft)	0.328	1.190	1.200	1.903
Maximum WS Elevation (ft)	6498.49	6500.32	6500.35	6501.56
Peak Inflow (cfs)	5.7	20.1	20.3	40.4
Peak Outflow (cfs)	0.2	0.5	0.5	10.2

EROSION CONTROL

It is the policy of the City of Colorado Springs that we submit an erosion control plan with the drainage report. At this time we respectfully request that the erosion control plan be submitted in conjunction with the final grading plan. Proposed straw bale check dams, silt fence, inlet protection, sediment basin, vehicle traffic control, and reseeding are proposed as erosion control measures.

DRAINAGE, BRIDGE, AND POND FEES

The project is located within the Sand Creek Drainage Basin. The "2019 Drainage, Bridge, and Pond Fees-City of Colorado Springs", effective January 1, 2019 table identifies the following fees associated with the basin. These fees have been applied and summarized here for this 15.091 acre site.

Basin Fees 2019	Total area (acres)	Basin Fee (per acre)	Total Cost Basin Fee
Drainage Fee	15.091	$12,645	$190,825.70
Bridge Fee	15.091	$761	$11,484.25
Pond Fee – Land	15.901	$1,070	$16,147.37
Pond Fee - Facility	15.091	$3,676	$55,474.52
Surcharge	NOT APPLICABLE		$0.00
Total			$273,931.83

CONSTRUCTION COST ESTIMATE

(Private Storm Sewer System, Non-Reimbursable)

Item	Description	Quantity	Unit Cost	Cost
1.	18" FES	1 EA	$700/EA	$ 700.00
2.	18" RCP	80 EA	$50/LF	$ 4,000.00
2.	18" ADS PP	405LF	$35/LF	$ 14,175.00
3.	24" FES	1 EA	$950/EA	$ 1,900.00
4.	24" ADS PP	521 LF	$48/LF	$ 25,008.00
5.	30" FES	1 LF	$1100/EA	$ 2,200.00
6.	30" ADS PP	410 LF	$85/LF	$ 34,850.00
7.	4' Type II MH	1 EA	$3,500/EA	$ 3,500.00
8.	5' Type II MH	4 EA	$4,500/EA	$ 18,000.00
9.	6' Type II MH	2 EA	$6,000/EA	$ 12,000.00
10.	5' TYPE-R Sump	1 EA	$3,600/EA	$ 3,600.00
11.	10' TYPE-R Sump	1 EA	$5,500/EA	$ 5,500.00
12.	CDOT Type C Area Inlet	3 EA	$3,000/EA	$ 9,000.00
13.	Conc. Trap Channel t	510 LF	$200/LF	$ 102,000.00
14.	Conc. Headwall/Outlet t	1 EA	$6,500/LF	$ 6,500.00

SubTotal = $242,933.00

(Private Permanent BMP, Non-Reimbursable)

1.	Sand Filter Detention Pond	1 EA	$35,000/EA	$ 35,000.00
2.	Pond Outlet Structure	1 EA	$10,000/EA	$ 10,000.00

SubTotal = $ 45,000.00

(Public Storm Sewer System, Non-Reimbursable)

Item	Description	Quantity	Unit Cost	Cost
1.	12' CS D-10-R At-Grade	1 EA	$6,400/EA	$ 6,400.00
2.	48" ADS PP	550 LF	$150/LF	$ 82,500.00
3.	Mod CDOT Type D Area Inlet	1 EA	$6,500/EA	$ 6,500.00

SubTotal = $ 95,400.00

Combined SubTotal =$ 383,333.00

5% Contingency	**= $**	**19,166.65**
SubTotal	**= $**	**402,499.65**
10%Engineering	**= $**	**40,249.97**
Total	**= $**	**442,749.62**

All proposed facilities onsite are privately owned and maintained and are not reimbursable.
All storm sewer located within the rights of way shall be public and shall be maintained by the City of Colorado Springs.

It should be noted that the DBPS channel improvements adjacent to this site were constructed by and are to be reimbursed under the adjacent The Sands Filing No.1 project as such this project is not responsible for construction or eligible for reimbursement.

M & S Civil Consultants, Inc. (M & S) cannot and does not guarantee the construction cost will not vary from these opinions of probable costs. These opinions represent our best judgment as design professionals familiar with the construction industry and this development in particular. The above is only an estimate of the facility cost and drainage basin fee amounts in 2019.

SUMMARY

The proposed drainage facilities associated with Sands Industrial Filing No. 1 subdivision will adequately convey detain and route runoff from the site to the shown discharge points. With the exception of the facilities located with the public rights of way, the streets, drainage improvements, and drainage facilities described herein and shown on the included drainage map are to be privately owned and maintained. The proposed development of Sands Industrial Filing No. 1 is in general conformance with all other previously approved reports or studies which include this site, and thus the subdivision shall not adversely affect the downstream and surrounding developments.

REFERENCES

1.) "City of Colorado Springs Drainage Criteria Manual", Volumes 1 & 2, City of Colorado May 2014.

2.) Web Soils Survey", United States Department of Agriculture, National Resources Conservation Service, http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm.

3.) FEMA Flood Map Service Center", Federal Emergency Management Agency https://msc.fema.gov/portal

4.) "Urban Storm Drainage Criteria Manual, Volume 1, January 2016, Urban Drainage and Flood Control District.

5.) "Urban Storm Drainage Criteria Manual, Volume 2, Revised November 2016, Urban Drainage and Flood Control District.

6.) "Sand Creek Drainage Basin Planning Study Preliminary Design Report" (DBPS), prepared by Kiowa Engineering, revised December 1998.

7.) "Final Drainage Plan and Erosion Control Plan, Rocky Mountain Industrial Park Filing No.1, El Paso County, Colorado," prepared by Kiowa Engineering Corporation, Revised February 7, 2002.

8.) "Drainage Report, Lot 16, Marksheffel Industrial Park," prepared by Oliver E Watts, March 12, 2001.

9.) "Final Drainage Report, Rocky Mountain Industrial Park, Filing 1A, prepared by LDC, March 2009.

10.) "Final Drainage Report for Weatherford Artificial Lift Systems, LLC, Redevelopment of 2445 N. Marksheffel," prepared by Red River Civil Engineering, Inc, May 2013.

11.) "Minor Site Development Plan for New Chrome Plan Facilities, Weatherford Artificial Lift Systems, LLC, 3445 N. Marksheffel Road," Prepared by Red River Civil Engineering, August 2013.

12.) "Marksheffel Industrial Park, Grading Plan", prepared by Simons & Li Assoc. Inc, October 1985.

13.) "The Sands Master

14.) "Marksheffel Industrial Park, Channel Details," prepared bu Simons & Li Assoc., Inc, March 1986.

15.) Rocky Mountain Industrial Park Filing No.1 Subdivision Construction Drawings", prepared by Kiowa Engineering, November 2001.

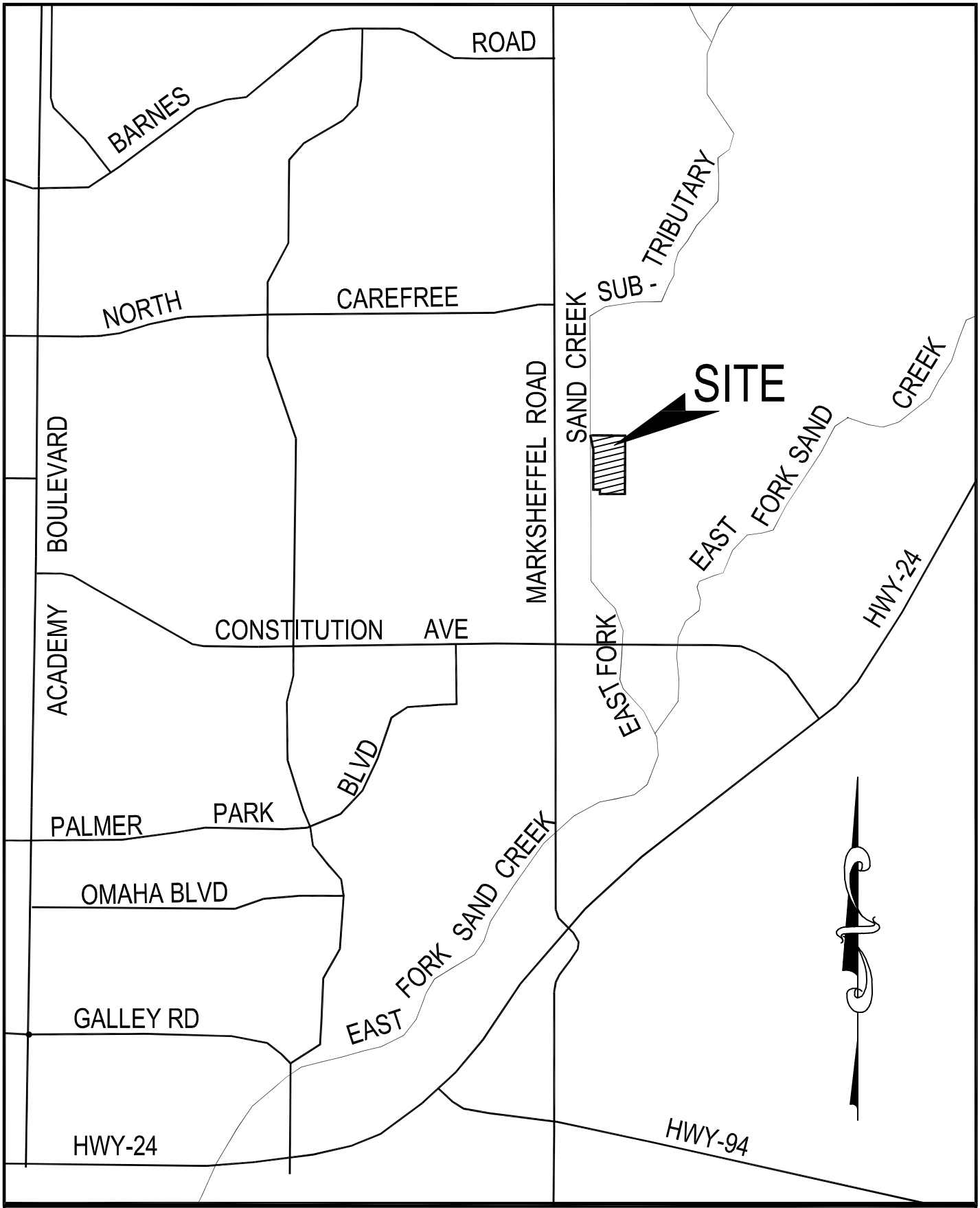
16.) "Marksheffel Road Improvements" prepared by Matrix Design Group, Inc, Dec, 2009.

17.) "The Sands Filing No. 1 Channel Improvement Plans", prepared by M&SCivil Consultants, Inc., December 2018.

18.) "Master Development Drainage Plan for The Sands and Preliminary Drainage Report prepared by M&S Civil Consultants, Inc., March 2018.

APPENDIX

VICINITY MAP

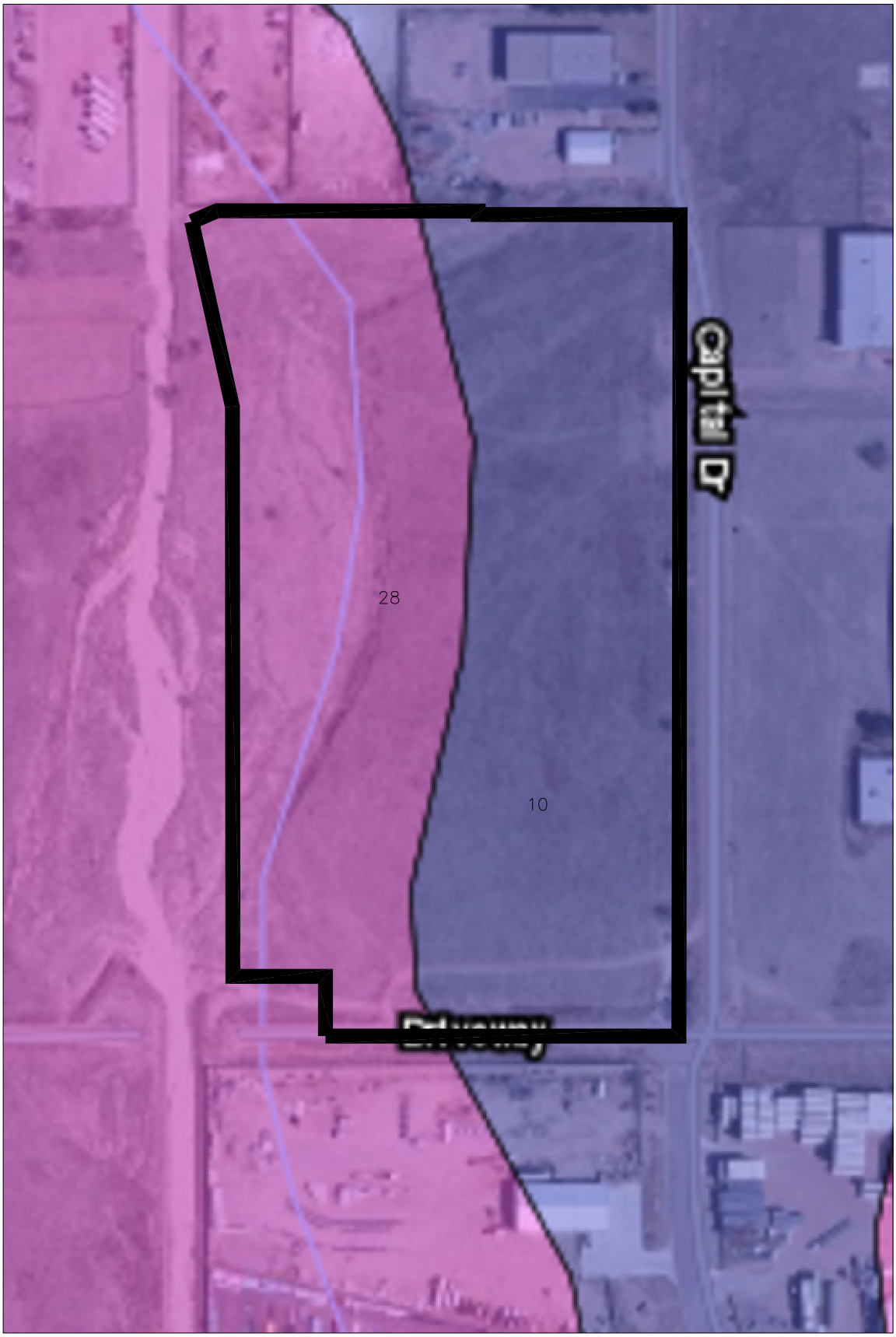


VICINITY MAP

N.T.S.

SOILS

NOT TO SCALE



Tables — Hydrologic Soil Group — Summary By Map Unit

Summary by Map Unit — El Paso County Area, Colorado (CO625)

Map unit symbol	Map unit name	Rating
10	Blendon sandy loam, 0 to 3 percent slopes	B
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	A

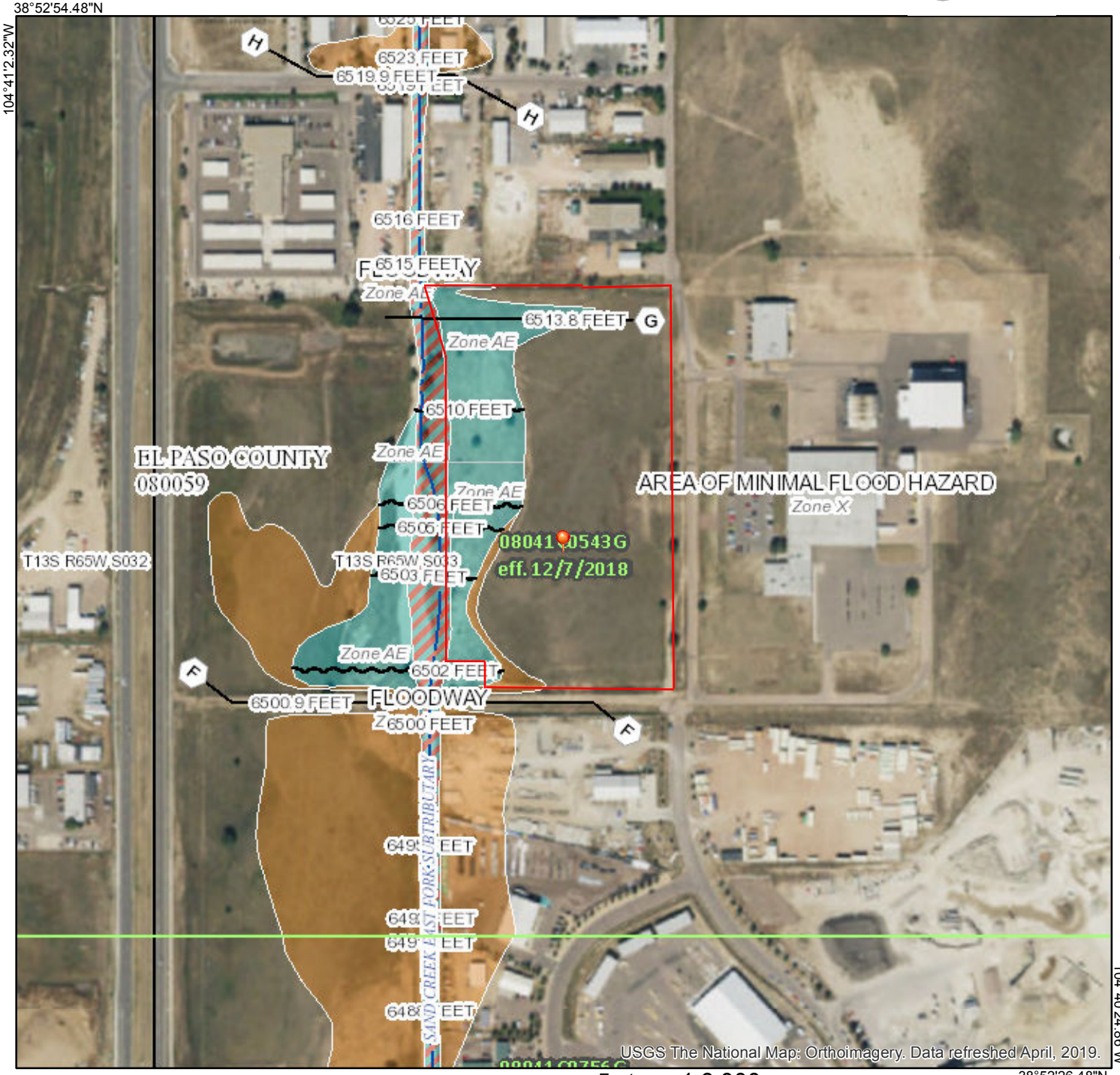
THE SANDS INDUSTRIAL PARK
SOILS MAP

CIVIL CONSULTANTS, INC.

FLOODPLAIN MAP

National Flood Hazard Layer FIRMette

FEMA



Feet

0 250 500 1,000 1,500 2,000

1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/19/2019 at 12:48:05 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Federal Emergency Management Agency

Washington, D.C. 20472

October 19, 2018

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

IN REPLY REFER TO:
Case No.: 18-08-0610R

The Honorable Darryl Glenn
Chairman, El Paso County Board of Commissioners
200 South Cascade Avenue, Suite 100
Colorado Springs, CO 80903

Community Name: El Paso County, CO
Community No.: 080059

Dear Mr. Glenn:

We are providing our comments with the enclosed Conditional Letter of Map Revision (CLOMR) on a proposed project within your community that, if constructed as proposed, could revise the effective Flood Insurance Study report and Flood Insurance Rate Map for your community.

If you have any questions regarding the floodplain management regulations for your community, the National Flood Insurance Program (NFIP) in general, or technical questions regarding this CLOMR, please contact the Director, Mitigation Division of the Federal Emergency Management Agency (FEMA) Regional Office in Denver, at (303) 235-4830, or the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP). Additional information about the NFIP is available on our website at https://www.fema.gov/national-flood-insurance-program.

Sincerely,

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

Enclosure:
Conditional Letter of Map Revision Comment Document

cc: Mr. Keith Curtis, P.E., LEED AP, CFM
Regional Floodplain Administrator
Pikes Peak Regional Building Department

Mr. Darin L. Moffett, P.E., CFM
Vice President/Manager
MS Civil Consultants, Inc.

Federal Emergency Management Agency

Washington, D.C. 20472

CONDITIONAL LETTER OF MAP REVISION
COMMENT DOCUMENT

COMMUNITY INFORMATION		PROPOSED PROJECT DESCRIPTION	BASIS OF CONDITIONAL REQUEST
COMMUNITY	El Paso County Colorado (Unincorporated Areas)	CHANNELIZATION FILL DROP STRUCTURE	FLOODWAY HYDRAULIC ANALYSIS UPDATED TOPOGRAPHIC DATA
	COMMUNITY NO.: 080059		
IDENTIFIER	The Sands Subdivision CLOMR	APPROXIMATE LATITUDE & LONGITUDE: 38.873, -104.680 SOURCE: USGS QUADRANGLE DATUM: NAD 83	

AFFECTED MAP PANELS			
TYPE: FIRM*	NO.: 08041C0543F	DATE: March 17, 1997	* FIRM - Flood Insurance Rate Map
TYPE: FIRM	NO.: 08041C0756F	DATE: March 17, 1997	

FLOODING SOURCE AND REACH DESCRIPTION

Sand Creek East Fork Subtributary – from the upstream side of Constitution Avenue to the downstream side of Industry Road

PROPOSED PROJECT DESCRIPTION

Flooding Source	Proposed Project	Location of Proposed Project
Sand Creek East Fork Subtributary	Channelization	from approximately 30 feet upstream of Constitution Avenue to approximately 30 feet downstream of Industry Road
	Fill Placement	from approximately 30 feet upstream of Constitution Avenue to approximately 30 feet downstream of Industry Road
	Boulder Drop Structure	from approximately 810 feet downstream to approximately 630 feet downstream of Industry Road

SUMMARY OF IMPACTS TO FLOOD HAZARD DATA

Flooding Source	Effective Flooding	Proposed Flooding	Increases	Decreases
Sand Creek East Fork Subtributary	Floodway	Floodway	Yes	Yes
	BFEs*	BFEs	Yes	Yes
	Zone AE	Zone AE	Yes	Yes
	Zone X (shaded)	Zone X (unshaded)	Yes	Yes

* BFEs - Base (1-percent-annual-chance) Flood Elevations

COMMENT

This document provides the Federal Emergency Management Agency's (FEMA's) comment regarding a request for a CLOMR for the project described above. This document is not a final determination; it only provides our comment on the proposed project in relation to the flood hazard information shown on the effective National Flood Insurance Program (NFIP) map. We reviewed the submitted data and the data used to prepare the effective flood hazard information for your community and determined that the proposed project meets the minimum floodplain management criteria of the NFIP. Your community is responsible for approving all floodplain development and for ensuring that all permits required by Federal or State/Commonwealth law have been received. State/Commonwealth, county, and community officials, based on their knowledge of local conditions and in the interest of safety, may set higher standards for construction in the Special Flood Hazard Area (SFHA), the area subject to inundation by the base flood). If the State/Commonwealth, county, or community has adopted more restrictive or comprehensive floodplain management criteria, these criteria take precedence over the minimum NFIP criteria.

This comment is based on the flood data presently available. If you have any questions about this document, please contact the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional information about the NFIP is available on the FEMA website at https://www.fema.gov/national-flood-insurance-program.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency

Washington, D.C. 20472

CONDITIONAL LETTER OF MAP REVISION
COMMENT DOCUMENT (CONTINUED)

COMMUNITY INFORMATION

To determine the changes in flood hazards that will be caused by the proposed project, we compared the hydraulic modeling reflecting the proposed project (referred to as the proposed conditions model) to the hydraulic modeling used to prepare the Flood Insurance Study (FIS) (referred to as the effective model). If the effective model does not provide enough detail to evaluate the effects of the proposed project, an existing conditions model must be developed to provide this detail. This existing conditions model is then compared to the effective model and the proposed conditions model to differentiate the increases or decreases in flood hazards caused by more detailed modeling from the increases or decreases in flood hazards that will be caused by the proposed project.

The table below shows the changes in the BFEs:

BFE Comparison Table

Flooding Source: Sand Creek East Fork Subtributary		BFE Change (feet)	Location of maximum change
Existing vs. Effective	Maximum increase	1.2	Approximately 150 feet downstream of Industry Road
	Maximum decrease	5.0	Approximately 810 feet downstream of Industry Road
Proposed vs. Existing	Maximum increase	0.2	Approximately 940 feet upstream of Constitution Avenue
	Maximum decrease	5.5	Approximately 780 feet downstream of Industry Road
Proposed vs. Effective	Maximum increase	0.03	Approximately 30 feet downstream of Industry Road
	Maximum decrease	7.3	Approximately 810 feet downstream of Industry Road

Increases due to the proposed project that exceed those permitted under Paragraphs (c)(10) or (d)(3) of Section 60.3 of the NFIP regulations must adhere to Section 65.12 of the NFIP regulations. With this request, your community has complied with all requirements of Paragraph 65.12(a) of the NFIP regulations. Compliance with Paragraph 65.12(b) also is necessary before FEMA can issue a Letter of Map Revision when a community proposes to permit encroachments into the effective floodplain and regulatory floodway that will cause BFE increases in excess of those permitted under Paragraph 60.3(d)(3).

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.

This comment is based on the flood data presently available. If you have any questions about this document, please contact the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional information about the NFIP is available on the FEMA website at https://www.fema.gov/national-flood-insurance-program.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency

Washington, D.C. 20472

CONDITIONAL LETTER OF MAP REVISION
COMMENT DOCUMENT (CONTINUED)

COMMUNITY INFORMATION (CONTINUED)

DATA REQUIRED FOR FOLLOW-UP LOMR

Upon completion of the project, your community must submit the data listed below and request that we make a final determination on revising the effective FIRM and FIS report. If the project is built as proposed and the data below are received, a revision to the FIRM and FIS report would be warranted.

• Detailed application and certification forms must be used for requesting final revisions to the maps. Therefore, when the map revision request for the area covered by this letter is submitted, Form 1, entitled "Overview and Concurrence Form," must be included. A copy of this form may be accessed at https://www.fema.gov/media-library/assets/documents/1343.

• The detailed application and certification forms listed below may be required if as-built conditions differ from the proposed plans. If required, please submit new forms, which may be accessed at https://www.fema.gov/media-library/assets/documents/1343, or annotated copies of the previously submitted forms showing the revised information.

Form 2, entitled "Riverine Hydrology and Hydraulics Form." Hydraulic analyses for as-built conditions of the base flood, the 10-percent, 2-percent, and 0.2-percent-annual-chance floods, and the regulatory floodway, must be submitted with Form 2.

Form 3, entitled "Riverine Structures Form."

• A certified topographic work map showing the revised and effective base and 0.2-percent-annual-chance floodplain and floodway boundaries. Please ensure that the revised information ties in with the current effective information at the downstream and upstream ends of the revised reach.

• An annotated copy of the FIRM, at the scale of the effective FIRM, that shows the revised base and 0.2-percent-annual-chance floodplain and floodway boundary delineations shown on the submitted work map and how they tie-in to the base and 0.2-percent- annual-chance floodplain and floodway boundary delineations shown on the current effective FIRM at the downstream and upstream ends of the revised reach.

• As-built plans, certified by a registered Professional Engineer, of all proposed project elements.

• A copy of the public notice distributed by your community stating its intent to revise the regulatory floodway, or a signed statement by your community that it has notified all affected property owners and affected adjacent jurisdictions.

• Documentation of the individual legal notices sent to property owners who will be affected by any widening or shifting of the base floodplain and/or any BFE increases along Sand Creek East Fork Sub-Tributary.

This comment is based on the flood data presently available. If you have any questions about this document, please contact the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional information about the NFIP is available on the FEMA website at https://www.fema.gov/national-flood-insurance-program.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

Federal Emergency Management Agency

Washington, D.C. 20472

CONDITIONAL LETTER OF MAP REVISION
COMMENT DOCUMENT (CONTINUED)

COMMUNITY INFORMATION (CONTINUED)

DATA REQUIRED FOR FOLLOW-UP LOMR (continued)

• FEMA's fee schedule for reviewing and processing requests for conditional and final modifications to published flood information and maps may be accessed at https://www.fema.gov/forms-documents-and-software/flood-map-related-fees. The fee at the time of the map revision submittal must be received before we can begin processing the request. Payment of this fee can be made through a check or money order, made payable in U.S. funds to the National Flood Insurance Program, or by credit card (Visa or MasterCard only). Please either forward the payment, along with the revision application, to the following address:

LOMC Clearinghouse
Attention: LOMR Manager
3601 Eisenhower Avenue, Suite 500
Alexandria, Virginia 22304-6426

or submit the LOMR using the Online LOMC portal at: https://hazards.fema.gov/femaportal/onlinelomc/signin

After receiving appropriate documentation to show that the project has been completed, FEMA will initiate a revision to the FIRM and FIS report. Because the flood hazard information (i.e., base flood elevations, base flood depths, SFHAs, zone designations, and/or regulatory floodways) will change as a result of the project, a 90-day appeal period will be initiated for the revision, during which community officials and interested persons may appeal the revised flood hazard information based on scientific or technical data.

This comment is based on the flood data presently available. If you have any questions about this document, please contact the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional information about the NFIP is available on the FEMA website at http://www.fema.gov/national-flood-insurance-program.

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CONDITIONAL LETTER OF MAP REVISION
COMMENT DOCUMENT (CONTINUED)

COMMUNITY INFORMATION (CONTINUED)

COMMUNITY REMINDERS

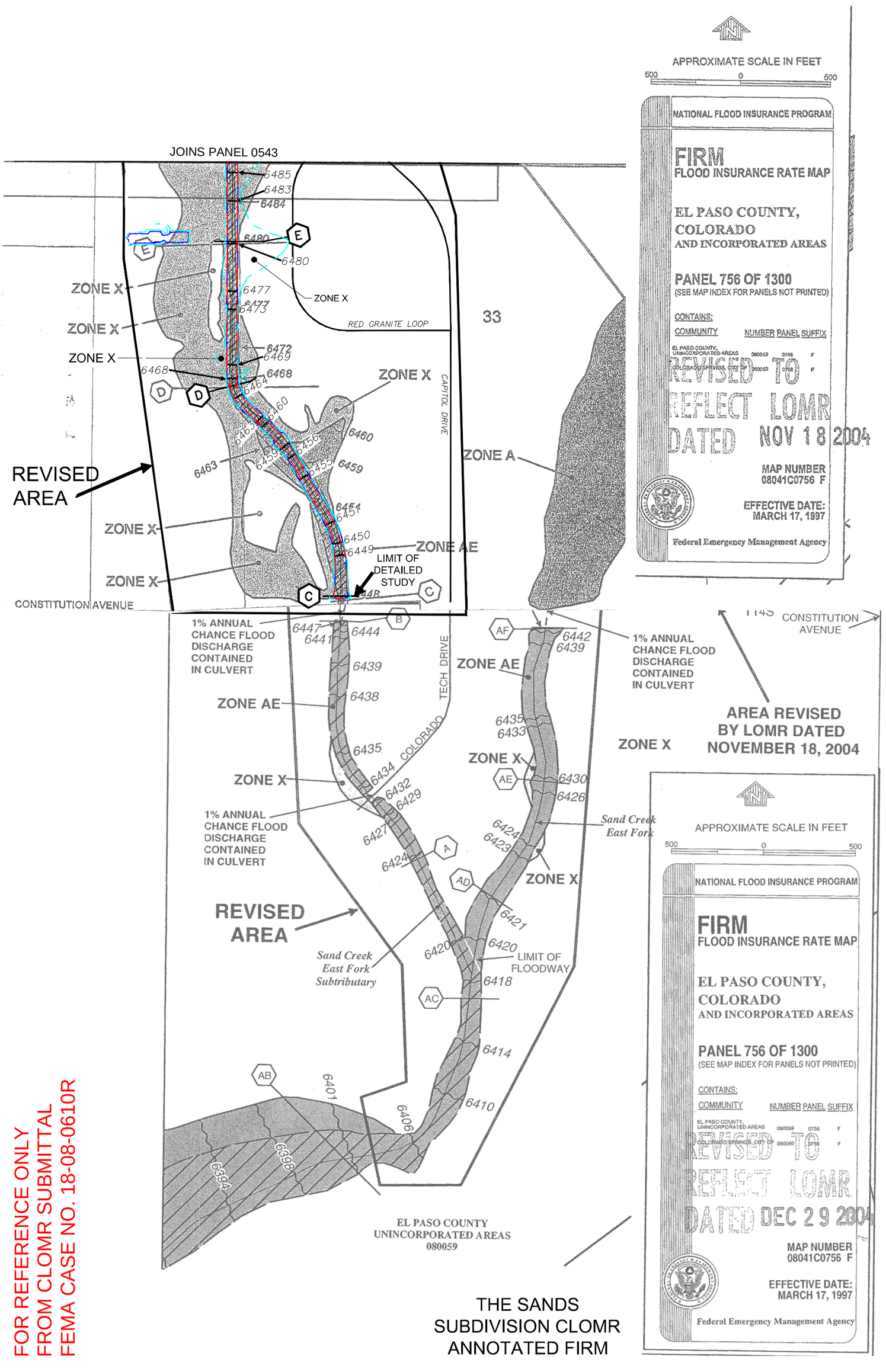
We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

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

A preliminary study is being conducted for El Paso County, Colorado and Incorporated Areas. Preliminary copies of the revised FIRM and FIS report were submitted to your community for review on November 22, 2017, and may become effective before the revision request following this CLOMR is submitted. Please ensure that the data submitted for the revision ties into the data effective at the time of the submittal.

This comment is based on the flood data presently available. If you have any questions about this document, please contact the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on the FEMA website at https://www.fema.gov/national-flood-insurance-program.

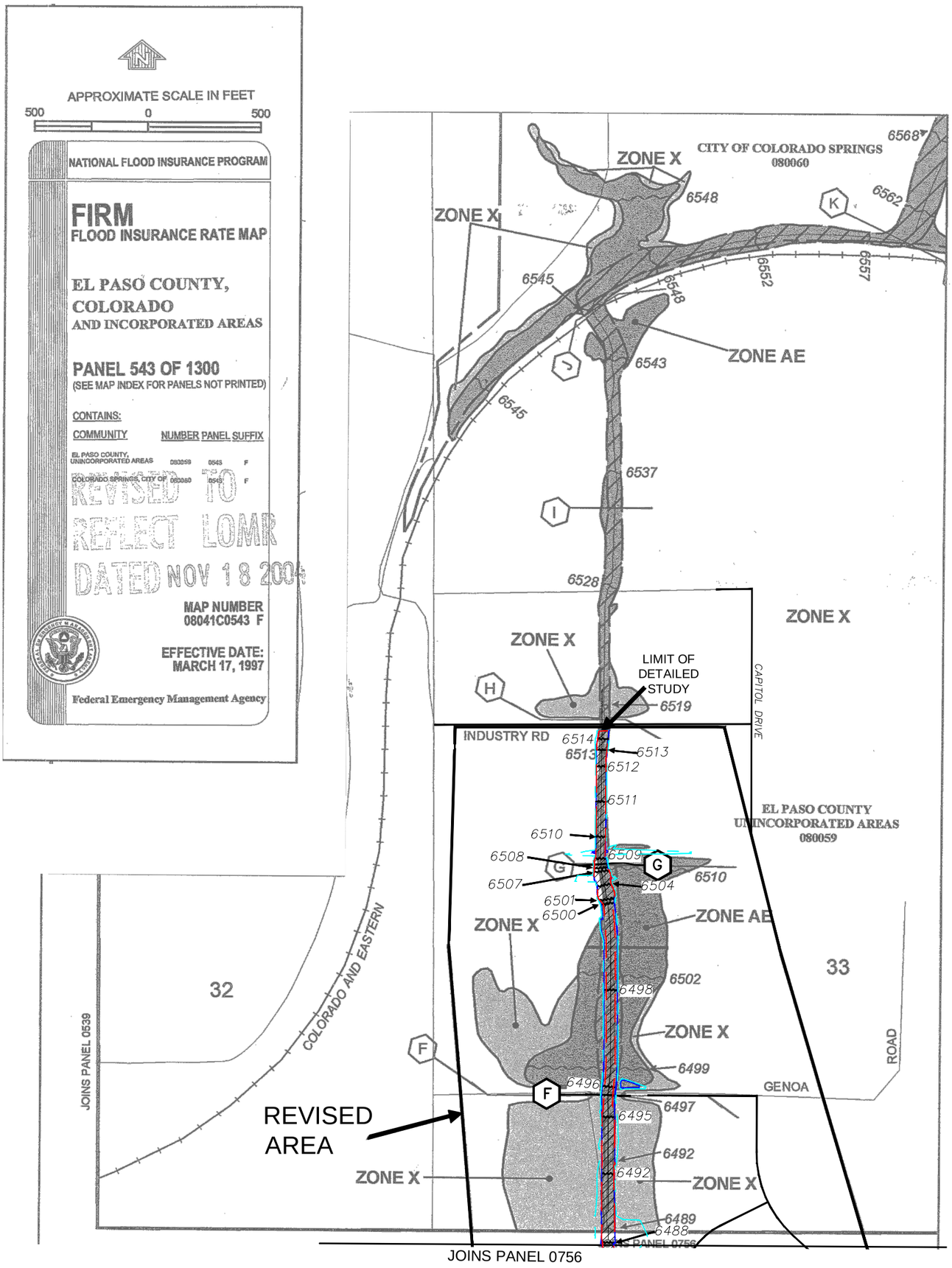
Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration



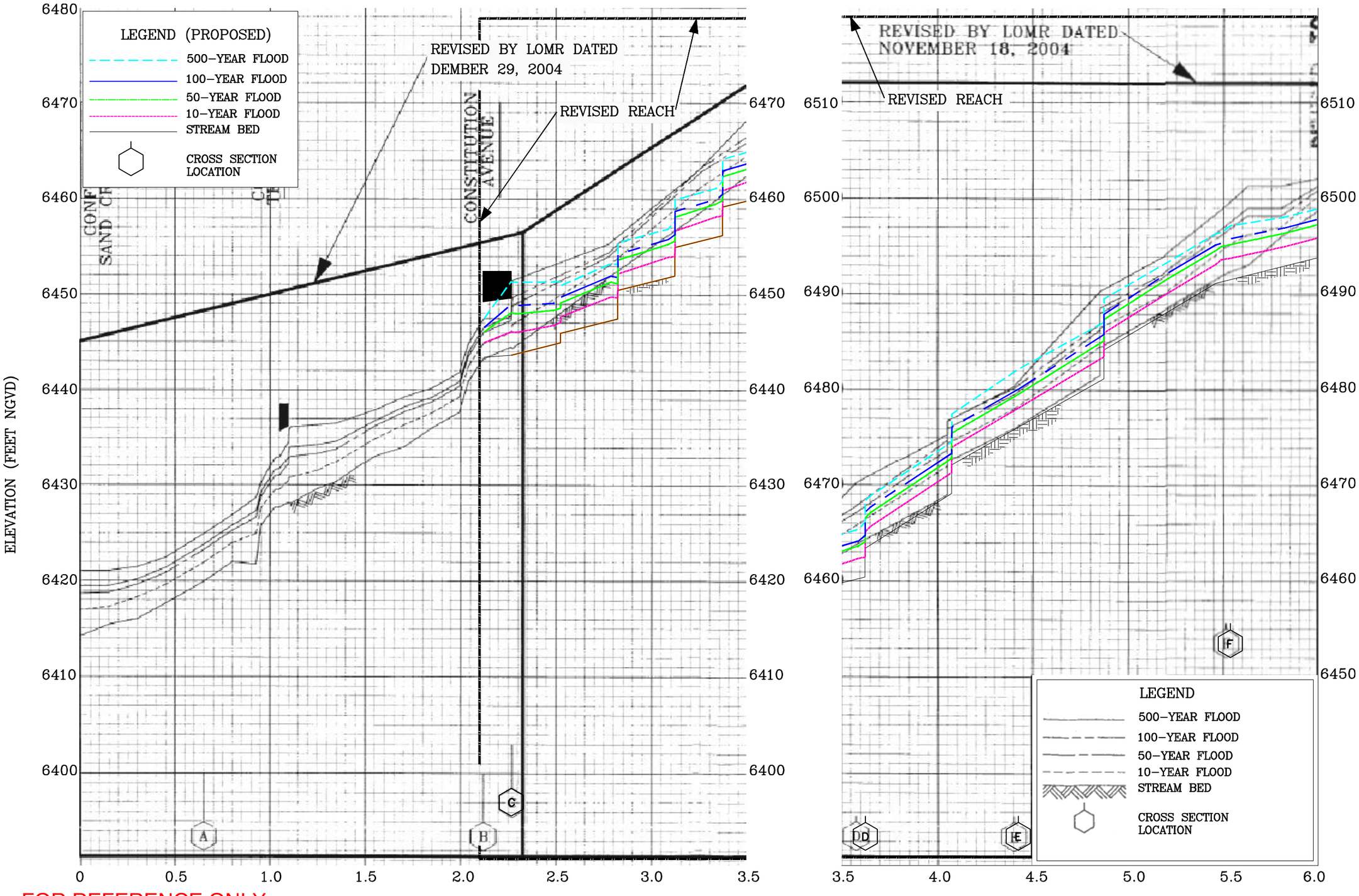
FOR REFERENCE ONLY
FROM CLOMR SUBMITTAL
FEMA CASE NO. 18-08-0610R

THE SANDS
SUBDIVISION CLOMR
ANNOTATED FIRM

FOR REFERENCE ONLY
FROM CLOMR SUBMITTAL
FEMA CASE NO. 18-08-0610R



THE SANDS
SUBDIVISION CLOMR
ANNOTATED FIRM



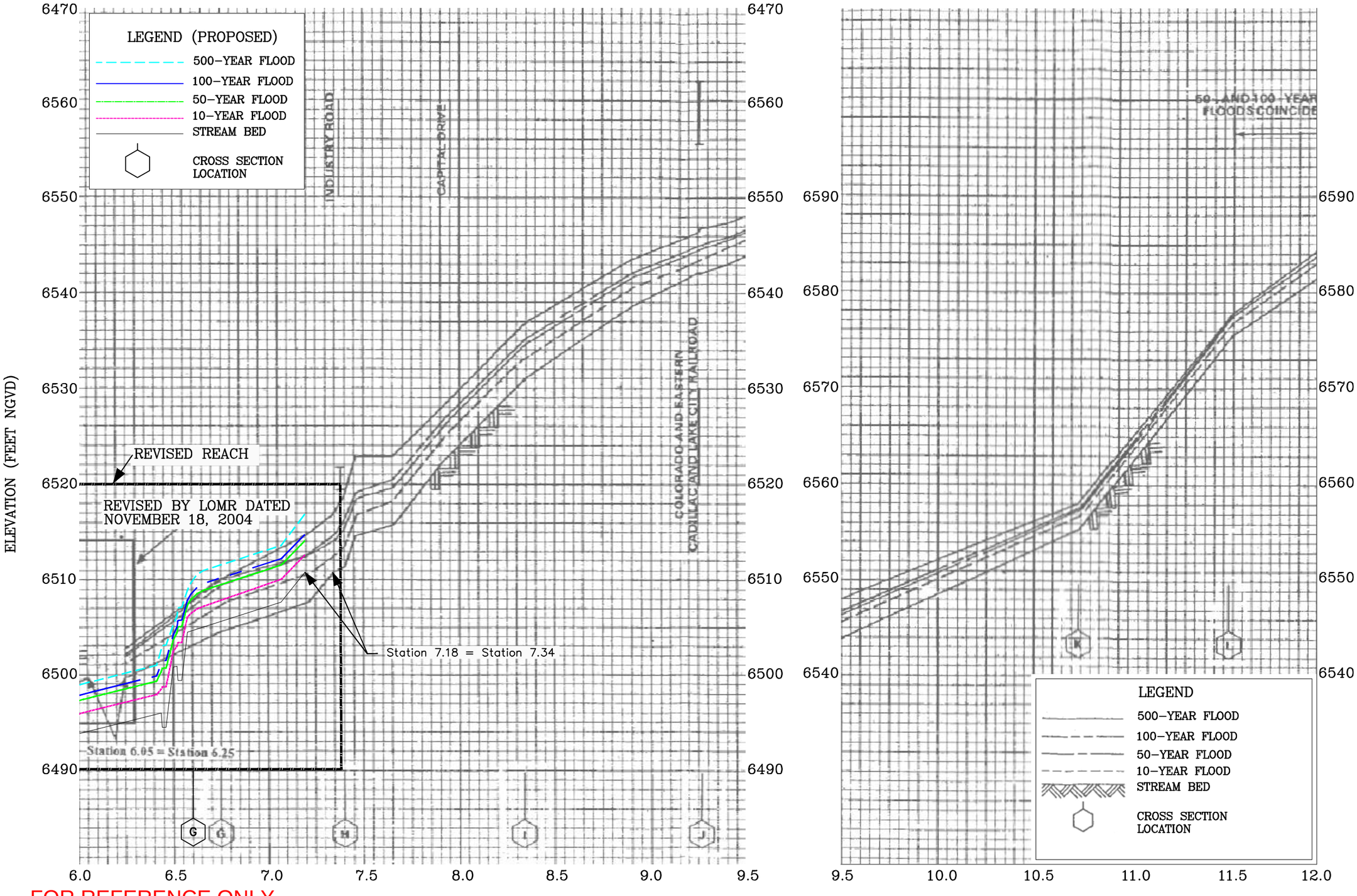
FOR REFERENCE ONLY
FROM CLOMR SUBMITTAL
FEMA CASE NO. 18-08-0610R

FLOOD PROFILES (ANNOTATED)

SAND CREEK EAST FORK SUBTRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY
EL PASO COUNTY, CO
AND INCORPORATED AREAS

214P



FOR REFERENCE ONLY
FROM CLOMR SUBMITTAL
FEMA CASE NO. 18-08-0610R

FLOOD PROFILES (ANNOTATED)

SAND CREEK EAST FORK SUBTRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY
EL PASO COUNTY, CO
AND INCORPORATED AREAS

215P

HYDROLOGIC CALCULATIONS

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis--Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

SANDS INDUSTRIAL FILING NO. 1 MDDP
EXISTING CONDITIONS DRAINAGE CALCULATIONS
(Area Runoff Coefficient Summary)

			STREETS/DEVELOPED			*DEVELOPED LOTS*			*UNDEVELOPED/LANDSCAPE*			*RUNOFF COEFFICIENT*	
BASIN	**TOTAL AREA** *(SF)*	**TOTAL AREA** *(Acres)*	**AREA** *(Acres)*	**C_5**	**C_{100}**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**C_5**	**C_{100}**
EXA	***665368.0018***	15.27	0.00	0.90	0.96	0.00	0.59	0.70	15.27	0.09	0.36	***0.09***	***0.36***
OS1	***4013191.7***	92.78	0.65	0.68	0.80	0.00	0.59	0.70	92.78	0.09	0.36	***0.09***	***0.37***
OS2	***196892***	4.52	0.00	0.90	0.96	4.52	0.73	0.81	0.00	0.09	0.36	***0.73***	***0.81***
OS3	***172934***	3.97	0.00	0.90	0.96	3.97	0.73	0.81	0.00	0.09	0.36	***0.73***	***0.81***
OS4	***1442324***	33.11	10.90	0.90	0.96	0.00	0.30	0.50	22.21	0.09	0.36	***0.36***	***0.56***
OS5	***43376.8***	1.00	0.24	0.90	0.96	0.00	0.30	0.50	0.76	0.09	0.36	***0.29***	***0.51***

* Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: DLM
Date: 11/4/2019
Checked by: VAS

SANDS INDUSTRIAL FILING NO. 1 MDDP
EXISTING CONDITIONS DRAINAGE CALCULATIONS
(Area Drainage Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*STREET / CHANNEL FLOW*				*Time of Travel (T_t)*		*INTENSITY **		*TOTAL FLOWS*	
BASIN	**AREA TOTAL**	**C_5**	**C_{100}**	**C_5**	**Length**	**Height**	**T_C**	**Length**	**Slope**	**Velocity**	**T_t**	**TOTAL**	**CHECK**	**I_5**	**I_{100}**	**Q_5**	**Q_{100}**
	(Acres)	*From DCM Table 5-1*			*(ft)*	*(ft)*	*(min)*	*(ft)*	*(%)*	*(fps)*	*(min)*	*(min)*	*(min)*	*(in/hr)*	*(in/hr)*	*(c.f.s.)*	*(c.f.s.)*
EXA	15.27	0.09	0.36	0.09	100	1.7	15.3	900	1.7%	1.3	11.5	26.8	15.6	2.6	4.4	***3.6***	***24.5***
OS1	92.78	0.09	0.37	0.09	200	16	12.9	TC TAKEN	FROM	SANDS	MDDP	32.0		2.4	4.0	***21.0***	***135.7***
OS2	4.52	0.73	0.81	0.73	100	2.0	5.3	680	1.7%	2.6	4.3	9.7	14.3	4.2	7.0	***13.8***	***25.7***
OS3	3.97	0.73	0.81	0.73	100	2.0	5.3	625	2.0%	2.8	3.7	9.0	14.0	4.3	7.2	***12.4***	***23.1***
OS4	33.11	0.36	0.56	0.36	150	3.0	13.1	2450	2.0%	1.4	28.9	42.0	24.4	2.8	4.7	***32.9***	***86.4***
OS5	1.00	0.29	0.51	0.29	50	1.0	8.3	830	1.4%	0.8	16.7	25.0	14.9	2.8	4.6	***0.8***	***2.3***

* Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: DLM
Date: 11/4/2019
Checked by: VAS

SANDS INDUSTRIAL FILING NO. 1 MDDP
EXISTING CONDITIONS DRAINAGE CALCULATIONS
(Basin Routing Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*PIPE / CHANNEL FLOW*				*Time of Travel (T_t)*	*INTENSITY **		*TOTAL FLOWS*		
DESIGN POINT	**CONTRIBUTING BASINS**	**CA_5**	**CA_{100}**	**C_5**	**Length** *(ft)*	**Height** *(ft)*	**T_C** *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	**T_t** *(min)*	**TOTAL** *(min)*	**I_5** *(in/hr)*	**I_{100}** *(in/hr)*	**Q_5** *(c.f.s.)*	**Q_{100}** *(c.f.s.)*	COMMENTS
1	**OS1**	8.79	33.92									32.0	2.4	4.0	***21.0***	***135.7***	
				See Area Drainage Sheet for Input													
2	**OS3**	2.90	3.22									9.0	4.3	7.2	***12.4***	***23.1***	
				See Area Drainage Sheet for Input													
3	**DP1, OS2**	12.09	37.58									32.0	2.4	4.0	***28.8***	***150.4***	
				Basin C Tc was used													
4	**OS4, OS5**	12.09	18.96									24.4	2.8	4.7	***33.7***	***88.7***	
				Basin OS4 Tc was used													
5	**EXA, DP2, DP3, DP4**	28.46	65.26		Initial		32.0	800	1.7%	2.0	6.8	38.8	2.1	3.5	***59.6***	***229.4***	TOTAL DISCHARGE
				Design Point 2 Tc Used													

SANDS INDUSTRIAL FILING NO. 1 MDDP
PROPOSED DRAINAGE CALCULATIONS
(Area Runoff Coefficient Summary)

			ROOFS 0.73-0.81 COMMERCIAL AREAS 0.81-0.88 ASPHALT DRIVES 0.90-0.96			*GRAVEL STORAGE YARD 0.30-0.50 LIGHT INDUST AREAS 0.59-0.70 HVY INDUST AREAS 0.73-0.81*			*LANDSCAPED AREAS 0.16-0.41 PARKS 0.12-0.39 GREENBELTS/AGRI. 0.09-0.36*			*WEIGHTED*	
BASIN	**TOTAL AREA** *(SF)*	**TOTAL AREA** *(Acres)*	**AREA** *(Acres)*	**C_5**	**C_{100}**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**C_5**	**C_{100}**
A	*6912.0*	**0.16**	0.16	0.90	0.96	0.00	0.25	0.30	0.00	0.09	0.36	***0.90***	***0.96***
B	*11887.3*	**0.27**	0.18	0.90	0.96	0.00	0.59	0.70	0.09	0.09	0.36	***0.64***	***0.76***
C	*147067.3*	**3.38**	3.38	0.59	0.70	0.00	0.30	0.50	0.00	0.12	0.39	***0.59***	***0.70***
D	*23033.6*	**0.53**	0.53	0.59	0.70	0.00	0.16	0.41	0.00	0.09	0.36	***0.59***	***0.70***
E	*28273.4*	**0.65**	0.44	0.90	0.96	0.20	0.59	0.70	0.00	0.09	0.36	***0.80***	***0.88***
F	*40068.3*	**0.92**	0.92	0.59	0.70	0.00	0.30	0.50	0.00	0.12	0.39	***0.59***	***0.70***
G	*43236.6*	**0.99**	0.99	0.59	0.70	0.00	0.30	0.50	0.00	0.16	0.41	***0.59***	***0.70***
H	*43085.5*	**0.99**	0.99	0.59	0.70	0.00	0.81	0.88	0.00	0.16	0.41	***0.59***	***0.70***
I	*80471.7*	**1.85**	1.85	0.59	0.70	0.00	0.30	0.50	0.00	0.09	0.36	***0.59***	***0.70***
J	*40154.0*	**0.92**	0.92	0.59	0.70	0.00	0.30	0.50	0.00	0.09	0.36	***0.59***	***0.70***
J1	*35089.2*	**0.81**	0.81	0.90	0.96	0.00	0.30	0.50	0.00	0.09	0.36	***0.90***	***0.96***
K	*32957.7*	**0.76**	0.44	0.90	0.96	0.32	0.59	0.70	0.00	0.09	0.36	***0.77***	***0.85***
L	*43955.2*	**1.01**	1.01	0.59	0.70	0.00	0.30	0.50	0.00	0.09	0.36	***0.59***	***0.70***
M	*54027.0*	**1.24**	0.00	0.90	0.96	0.00	0.30	0.50	1.24	0.12	0.39	***0.12***	***0.39***
N	*20121.4*	**0.46**	0.00	0.90	0.96	0.00	0.30	0.50	0.46	0.09	0.36	***0.09***	***0.36***
O	*6998.7*	**0.16**	0.16	0.90	0.96	0.00	0.30	0.50	0.00	0.09	0.36	***0.90***	***0.96***
OS1*	*4013191.7*	**92.13**	0.00	0.90	0.96	0.00	0.59	0.70	92.13	0.09	0.36	***0.09***	***0.36***
OS2	*28121.0*	**0.65**	0.30	0.90	0.96	0.17	0.90	0.96	0.17	0.09	0.36	***0.68***	***0.80***
OS3	*196892.0*	**4.52**	4.52	0.73	0.81	0.00	0.16	0.41	0.00	0.09	0.36	***0.73***	***0.81***
OS4	*172934.0*	**3.97**	3.97	0.73	0.81	0.00	0.30	0.50	0.00	0.12	0.41	***0.73***	***0.81***
OS5	*1442324.0*	**33.11**	10.90	0.90	0.96	0.00	0.30	0.50	22.21	0.09	0.36	***0.36***	***0.56***
OS6	*43376.8*	**1.00**	0.24	0.90	0.96	0.00	0.30	0.50	0.76	0.09	0.36	***0.29***	***0.51***
OS7	*7962.0*	**0.18**	0.00	0.90	0.96	0.00	0.30	0.50	0.18	0.09	0.36	***0.09***	***0.36***

*from The Sands MDDP

Calculated by: DLM
Date: 11/4/2019
Checked by: VAS

SANDS INDUSTRIAL FILING NO. 1 MDDP
PROPOSED DRAINAGE CALCULATIONS
(Area Drainage Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*STREET / CHANNEL FLOW*				*Time of Travel (T_t)*		*INTENSITY **		*TOTAL FLOWS*	
BASIN	**AREA TOTAL**	**C_5**	**C_{100}**	**C_5**	**Length**	**Height**	**T_C**	**Length**	**Slope**	**Velocity**	**T_t**	**TOTAL**	**CHECK**	**I_5**	**I_{100}**	**Q_5**	**Q_{100}**
	(Acres)	*From DCM Table 5-1*			*(ft)*	*(ft)*	*(min)*	*(ft)*	*(%)*	*(fps)*	*(min)*	*(min)*	*(min)*	*(in/hr)*	*(in/hr)*	*(c.f.s.)*	*(c.f.s.)*
A	0.16	0.90	0.96	0.90	40	0.8	1.8	153	1.5%	2.4	1.0	2.9	11.1	5.2	8.7	***0.7***	***1.3***
B	0.27	0.64	0.76	0.64	12	4.0	0.9	460	0.5%	1.4	5.4	6.3	12.6	4.8	8.1	***0.8***	***1.7***
C	3.38	0.59	0.70	0.59	100	2.0	7.3	850	0.6%	1.5	9.2	16.6	15.3	3.5	5.9	***7.0***	***13.9***
D	0.53	0.59	0.70	0.59	66	2.0	5.2	180	2.0%	2.8	1.1	6.2	11.4	4.8	8.1	***1.5***	***3.0***
E	0.65	0.80	0.88	0.80	100	7.5	2.8	275	2.0%	2.8	1.6	4.4	12.1	5.2	8.7	***2.7***	***4.9***
F	0.92	0.59	0.70	0.59	50	1.0	5.2	240	1.3%	2.2	1.8	7.0	11.6	4.7	7.8	***2.5***	***5.0***
G	0.99	0.59	0.70	0.59	50	1.0	5.2	200	1.0%	2.0	1.7	6.8	11.4	4.7	7.9	***2.8***	***5.5***
H	0.99	0.59	0.70	0.59	50	1.0	5.2	250	1.0%	2.0	2.1	7.3	11.7	4.6	7.7	***2.7***	***5.4***
I	1.85	0.59	0.70	0.59	100	1.0	9.2	310	1.5%	2.4	2.1	11.4	12.3	3.9	6.6	***4.3***	***8.6***
J	0.92	0.59	0.70	0.59	50	1.0	5.2	250	1.0%	2.0	2.1	7.3	11.7	4.6	7.7	***2.5***	***5.0***
J1	0.81	0.90	0.96	0.90	40	0.8	1.8	760	1.4%	2.4	5.3	7.1	14.4	4.6	7.8	***3.4***	***6.0***
K	0.76	0.77	0.85	0.77	50	1.0	3.4	100	1.5%	2.4	0.7	4.0	10.8	5.2	8.7	***3.0***	***5.6***
L	1.01	0.59	0.70	0.59	50	1.0	5.2	250	1.6%	2.5	1.6	6.8	11.7	4.7	7.9	***2.8***	***5.6***
M	1.24	0.12	0.39	0.12	50	6.0	5.5	300	0.5%	1.4	3.5	9.0	11.9	4.3	7.2	***0.6***	***3.5***
N	0.46	0.09	0.36	0.09	25	2.0	4.6	400	1.0%	2.0	3.3	7.9	12.4	4.5	7.5	***0.2***	***1.3***
O	0.16	0.90	0.96	0.90	100	2.0	2.9	106	1.0%	2.0	0.9	3.8	11.1	5.2	8.7	***0.7***	***1.3***
OS1*	92.13	0.09	0.36	0.09	200	16.0	13.0	TC TAKEN	FROM	SANDS	MDDP	32.0		2.4	4.0	***19.8***	***132.7***
OS2	0.65	0.68	0.80	0.68	50	1.0	4.2	500	1.0%	0.7	11.9	16.1	13.1	3.7	6.3	***1.6***	***3.2***
OS3	4.52	0.73	0.81	0.73	100	2.0	5.3	680	1.7%	2.6	4.3	9.7	14.3	4.2	7.0	***13.8***	***25.7***
OS4	3.97	0.73	0.81	0.73	100	2.0	5.3	625	2.0%	2.8	3.7	9.0	14.0	4.3	7.2	***12.4***	***23.1***
OS5	33.11	0.36	0.56	0.36	150	3.0	13.1	2450	2.0%	1.4	28.9	41.9	24.4	2.8	4.7	***32.9***	***86.4***
OS6	1.00	0.29	0.51	0.29	50	1.0	8.3	830	1.4%	0.8	16.4	24.7	14.9	2.8	4.7	***0.8***	***2.3***
OS7	0.18	0.09	0.36	0.09	50	1.0	10.3	100	3.3%	3.6	0.5	10.7	10.8	4.0	6.8	***0.1***	***0.4***

* Intensity equations assume a minimum travel time of 5 minutes.

Calculated by: DLM
Date: 11/4/2019
Checked by: VAS

SANDS INDUSTRIAL FILING NO. 1 MDDP
PROPOSED DRAINAGE CALCULATIONS
(Basin Routing Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*PIPE / CHANNEL FLOW*				*Time of Travel (T_t)*	*INTENSITY **		*TOTAL FLOWS*		
DESIGN POINT	**CONTRIBUTING BASINS** *DPS AND/OR PIPES*	**CA_5**	**CA_{100}**	**C_5**	**Length** *(ft)*	**Height** *(ft)*	**T_C** *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	**T_t** *(min)*	**TOTAL** *(min)*	**I_5** *(in/hr)*	**I_{100}** *(in/hr)*	**Q_5** *(c.f.s.)*	**Q_{100}** *(c.f.s.)*	COMMENTS
1	**OS1**	8.29	33.17	See Area Drainage Sheet for Input								32.0	2.4	4.0	***19.8***	***132.7***	EX DUAL 42" CULVERTS
2	**OS2, A**	0.58	0.67	TAKEN FROM BASIN A (MIN Tc)								5.0	5.2	8.7	***3.0***	***5.8***	5'W CURB OPENING W/ RIPRAP RUNDOWN
3	**DP1, DP2**	8.88	33.84	TAKEN FROM BASIN DP1								32.0	2.4	4.0	***21.2***	***135.4***	EXIST EARTHEN SWALE
4	**DP3, B, OS3, OS4**	15.25	40.92	Initial			32.0	650	0.5%	1.4	7.7	39.7	2.1	3.5	***31.4***	***141.6***	PROP 8'W 2:1 SS CONC. SWALE
				Design Point 2 Tc Used													
5	**C**	1.99	2.36	See Area Drainage Sheet for Input								15.3	3.5	5.9	***7.0***	***13.9***	PROP 24" STORM
6	**D**	0.31	0.37	See Area Drainage Sheet for Input								6.2	4.8	8.1	***1.5***	***3.0***	PROP 18" STORM
7	**E**	0.52	0.57	See Area Drainage Sheet for Input (Min Tc)								5.0	5.2	8.7	***2.7***	***4.9***	PROP. 10' TYPE R SUMP INLET
8	**F**	0.54	0.64	See Area Drainage Sheet for Input								7.0	4.7	7.8	***2.5***	***5.0***	PROP CDOT TYPE 'C' INLET
9	**G**	0.59	0.69	See Area Drainage Sheet for Input								6.8	4.7	7.9	***2.8***	***5.5***	PROP 18" STORM
10	**H**	0.58	0.69	See Area Drainage Sheet for Input								7.3	4.6	7.7	***2.7***	***5.4***	PROP 18" STORM

Calculated by: DLM
Date: 11/4/2019
Checked by: VAS

SANDS INDUSTRIAL FILING NO. 1 MDDP
PROPOSED DRAINAGE CALCULATIONS
(Basin Routing Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*PIPE / CHANNEL FLOW*				*Time of Travel (T_t)*	*INTENSITY **		*TOTAL FLOWS*		
DESIGN POINT	**CONTRIBUTING BASINS** *DPS AND/OR PIPES*	**CA_5**	**CA_{100}**	**C_5**	**Length** *(ft)*	**Height** *(ft)*	**T_C** *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	**T_t** *(min)*	**TOTAL** *(min)*	**I_5** *(in/hr)*	**I_{100}** *(in/hr)*	**Q_5** *(c.f.s.)*	**Q_{100}** *(c.f.s.)*	COMMENTS
11	**I**	1.09	1.29	See Area Drainage Sheet for Input								11.4	3.9	6.6	***4.3***	***8.6***	PROP TYPE C INLET 18" STORM SEWER
12	**J**	0.54	0.65	See Area Drainage Sheet for Input								7.3	4.6	7.7	***2.5***	***5.0***	PROP 18" STORM
13	**J1**	0.72	0.77	See Area Drainage Sheet for Input								7.1	4.6	7.8	***3.4***	***6.0***	PROP 12' D-10R AT-GRADE INLET
14	**K**	0.58	0.64	See Area Drainage Sheet for Input (Min Tc)								5.0	5.2	8.7	***3.0***	***5.6***	PROP. 5' TYPE R SUMP INLET
15	**L**	0.60	0.71	See Area Drainage Sheet for Input								6.8	4.7	7.9	***2.8***	***5.6***	PROPOSED FSD POND 1 (SE Forebay)
16	**PR6, PR13 PR18, M**	8.22	9.87	TAKEN FROM BASIN PR13								11.4	3.9	6.6	***32.4***	***65.2***	PROPOSED FSD POND A
17	**O**	0.14	0.15	See Area Drainage Sheet for Input								5.0	5.2	8.7	***0.7***	***1.3***	EX SWALE
18	**OS5**	11.81	18.46	See Area Drainage Sheet for Input								24.4	2.8	4.7	***32.9***	***86.4***	EX 24" RCP CULVERT
19	**DP18, OS6**	12.10	18.97	TAKEN FROM BASIN DP18								24.4	2.8	4.7	***33.7***	***88.8***	EX ELLIPT. 48" CMP CULVERT
20	**N, OS7**	0.06	0.23	TAKEN FROM BASIN N								7.9	4.5	7.5	***0.3***	***1.7***	MOD TYPE D INLET BOX
21	**DP4, DP19, PR19**	27.41	61.36	TAKEN FROM BASIN DP4								39.7	2.1	3.5	***56.5***	***212.3***	TOTAL DISCHARGE NO ACCT FOR POND DET AFFECTS ON TC

Calculated by: DLM
Date: 11/4/2019
Checked by: VAS

SANDS INDUSTRIAL FILING NO. 1 MDDP
PROPOSED DRAINAGE CALCULATIONS
(Storm Sewer Routing Summary)

PIPE RUN	*Contributing Pipes/Design Points*	*Equivalent CA_5*	*Equivalent CA_{100}*	*Maximum T_C*	*Intensity**		*Flow*		*Pipe Size*
					I_5	*I_{100}*	*Q_5*	*Q_{100}*	
1	**DP5**	1.99	2.36	15.3	3.5	5.9	***7.0***	***13.9***	**PROP 24" PIPE**
2	**DP6**	0.31	0.37	6.2	4.8	8.1	***1.5***	***3.0***	**PROP 18" PIPE**
3	**PR 1, PR2**	2.30	2.73	15.4	3.5	5.8	***8.0***	***16.0***	**PROP 24" PIPE**
4	**PR3, DP7**	2.82	3.30	15.4	3.5	5.8	***9.8***	***19.3***	**PROP 24" PIPE**
5	**DP8**	0.54	0.64	7.0	4.7	7.8	***2.5***	***5.0***	**PROP 18" PIPE**
6	**PR4, PR5**	3.37	3.95	15.9	3.4	5.8	***11.5***	***22.7***	**PROP 30" PIPE**
7	**DP9**	0.59	0.69	6.8	4.7	7.9	***2.8***	***5.5***	**PROP 18" PIPE**
8	**DP10**	0.58	0.69	7.3	4.6	7.7	***2.7***	***5.4***	**PROP 18" PIPE**
9	**PR7, PR8**	1.17	1.39	7.3	4.6	7.7	***5.4***	***10.7***	**PROP 18" PIPE**
10	**DP11**	1.09	1.29	11.4	3.9	6.6	***4.3***	***8.6***	**PROP 18" PIPE**
11	**DP12**	0.54	0.65	7.3	4.6	7.7	***2.5***	***5.0***	**PROP 18" PIPE**
12	**NOT USED**	0.00	0.00	0.0	0.0	0.0	***0.0***	***0.0***	**PROP 18" PIPE**
13	**PR9, PR10, PR11**	2.80	3.33	11.4	3.9	6.6	***11.0***	***22.0***	**PROP 30" PIPE**
14	**INLET1**	0.72	0.76	7.1	4.6	7.8	***3.4***	***5.9***	**PROP 18" PIPE**
15	**DP14**	0.58	0.64	5.0	5.2	8.7	***3.0***	***5.6***	**PROP 18" PIPE**
16	**PR14, PR15**	1.31	1.40	7.1	4.6	7.8	***6.1***	***10.9***	**PROP 24" PIPE**
17	**DP15**	0.60	0.71	6.8	4.7	7.9	***2.8***	***5.6***	**PROP 18" PIPE**
18	**PR16, PR17**	1.90	2.11	7.1	4.6	7.8	***8.8***	***16.5***	**PROP 24" PIPE**
19	**POND 1 OUTLET (DP6)**		TAKEN FROM UD-DETENTION WORKSHEET				***4.2***	***100.0***	**PROP 18" PIPE**
20	**DP19**	12.10	18.97	24.4	2.8	4.7	***33.7***	***88.8***	**EX 48" CMP**
21	**PR20**	12.10	18.97	24.4	2.8	4.7	***33.7***	***88.8***	**PROP 48" RCP**
22	**PR21, DP20**	12.15	19.20	24.4	2.8	4.7	***33.9***	***89.8***	**EX DUAL 36" RCP**

* Intensity equations assume a minimum travel time of 5 minutes.

DP - Design Point
PR - Pipe Run
FB- Flow By from Design Point
INT- Intercepted Flow from Design Point

Calculated by: DLM
Date: 11/4/2019
Checked by: VAS

HYDRAULIC CALCULATIONS

Worksheet for Pipe 1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	24.0 in
Discharge	13.90 cfs

Results	
Normal Depth	17.3 in
Flow Area	2.4 ft²
Wetted Perimeter	4.1 ft
Hydraulic Radius	7.2 in
Top Width	1.79 ft
Critical Depth	16.1 in
Percent Full	72.1 %
Critical Slope	0.006 ft/ft
Velocity	5.73 ft/s
Velocity Head	0.51 ft
Specific Energy	1.95 ft
Froude Number	0.870
Maximum Discharge	17.21 cfs
Discharge Full	16.00 cfs
Slope Full	0.004 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	0.0 %
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	17.3 in
Critical Depth	16.1 in
Channel Slope	0.005 ft/ft
Critical Slope	0.006 ft/ft

Worksheet for Pipe 2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	18.0 in
Discharge	3.00 cfs

Results	
Normal Depth	8.0 in
Flow Area	0.8 ft²
Wetted Perimeter	2.2 ft
Hydraulic Radius	4.1 in
Top Width	1.49 ft
Critical Depth	7.9 in
Percent Full	44.2 %
Critical Slope	0.005 ft/ft
Velocity	3.98 ft/s
Velocity Head	0.25 ft
Specific Energy	0.91 ft
Froude Number	0.986
Maximum Discharge	7.99 cfs
Discharge Full	7.43 cfs
Slope Full	0.001 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	29.3 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	8.0 in
Critical Depth	7.9 in
Channel Slope	0.005 ft/ft
Critical Slope	0.005 ft/ft

Worksheet for Pipe 3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	24.0 in
Discharge	16.00 cfs

Results	
Normal Depth	19.7 in
Flow Area	2.8 ft²
Wetted Perimeter	4.5 ft
Hydraulic Radius	7.3 in
Top Width	1.54 ft
Critical Depth	17.3 in
Percent Full	82.0 %
Critical Slope	0.007 ft/ft
Velocity	5.80 ft/s
Velocity Head	0.52 ft
Specific Energy	2.16 ft
Froude Number	0.764
Maximum Discharge	17.21 cfs
Discharge Full	16.00 cfs
Slope Full	0.005 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	29.3 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	19.7 in
Critical Depth	17.3 in
Channel Slope	0.005 ft/ft
Critical Slope	0.007 ft/ft

Worksheet for Pipe 4

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	30.0 in
Discharge	19.30 cfs

Results	
Normal Depth	17.9 in
Flow Area	3.1 ft²
Wetted Perimeter	4.4 ft
Hydraulic Radius	8.3 in
Top Width	2.45 ft
Critical Depth	17.9 in
Percent Full	59.6 %
Critical Slope	0.005 ft/ft
Velocity	6.32 ft/s
Velocity Head	0.62 ft
Specific Energy	2.11 ft
Froude Number	0.999
Maximum Discharge	31.20 cfs
Discharge Full	29.00 cfs
Slope Full	0.002 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	51.5 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	17.9 in
Critical Depth	17.9 in
Channel Slope	0.005 ft/ft
Critical Slope	0.005 ft/ft

Worksheet for Pipe 5

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	18.0 in
Discharge	5.00 cfs

Results	
Normal Depth	10.8 in
Flow Area	1.1 ft²
Wetted Perimeter	2.7 ft
Hydraulic Radius	5.0 in
Top Width	1.47 ft
Critical Depth	10.3 in
Percent Full	60.1 %
Critical Slope	0.006 ft/ft
Velocity	4.51 ft/s
Velocity Head	0.32 ft
Specific Energy	1.22 ft
Froude Number	0.915
Maximum Discharge	7.99 cfs
Discharge Full	7.43 cfs
Slope Full	0.002 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	29.3 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	10.8 in
Critical Depth	10.3 in
Channel Slope	0.005 ft/ft
Critical Slope	0.006 ft/ft

Worksheet for Pipe 6

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	30.0 in
Discharge	22.70 cfs

Results	
Normal Depth	20.0 in
Flow Area	3.5 ft²
Wetted Perimeter	4.8 ft
Hydraulic Radius	8.7 in
Top Width	2.36 ft
Critical Depth	19.5 in
Percent Full	66.6 %
Critical Slope	0.005 ft/ft
Velocity	6.54 ft/s
Velocity Head	0.66 ft
Specific Energy	2.33 ft
Froude Number	0.950
Maximum Discharge	31.20 cfs
Discharge Full	29.00 cfs
Slope Full	0.003 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	29.3 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	20.0 in
Critical Depth	19.5 in
Channel Slope	0.005 ft/ft
Critical Slope	0.005 ft/ft

Worksheet for Pipe 7

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	18.0 in
Discharge	5.50 cfs

Results	
Normal Depth	11.5 in
Flow Area	1.2 ft²
Wetted Perimeter	2.8 ft
Hydraulic Radius	5.2 in
Top Width	1.44 ft
Critical Depth	10.9 in
Percent Full	64.0 %
Critical Slope	0.006 ft/ft
Velocity	4.60 ft/s
Velocity Head	0.33 ft
Specific Energy	1.29 ft
Froude Number	0.891
Maximum Discharge	7.99 cfs
Discharge Full	7.43 cfs
Slope Full	0.003 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	29.5 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	11.5 in
Critical Depth	10.9 in
Channel Slope	0.005 ft/ft
Critical Slope	0.006 ft/ft

Worksheet for Pipe 8

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	18.0 in
Discharge	5.40 cfs

Results	
Normal Depth	11.4 in
Flow Area	1.2 ft²
Wetted Perimeter	2.8 ft
Hydraulic Radius	5.1 in
Top Width	1.45 ft
Critical Depth	10.7 in
Percent Full	63.2 %
Critical Slope	0.006 ft/ft
Velocity	4.58 ft/s
Velocity Head	0.33 ft
Specific Energy	1.28 ft
Froude Number	0.896
Maximum Discharge	7.99 cfs
Discharge Full	7.43 cfs
Slope Full	0.003 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	29.5 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	11.4 in
Critical Depth	10.7 in
Channel Slope	0.005 ft/ft
Critical Slope	0.006 ft/ft

Worksheet for Pipe 9

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	18.0 in
Discharge	10.70 cfs

Results	
Normal Depth	11.4 in
Flow Area	1.2 ft²
Wetted Perimeter	2.8 ft
Hydraulic Radius	5.1 in
Top Width	1.45 ft
Critical Depth	10.7 in
Percent Full	63.2 %
Critical Slope	0.006 ft/ft
Velocity	4.58 ft/s
Velocity Head	0.33 ft
Specific Energy	1.28 ft
Froude Number	0.896
Maximum Discharge	7.99 cfs
Discharge Full	7.43 cfs
Slope Full	0.003 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	29.5 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	11.4 in
Critical Depth	10.7 in
Channel Slope	0.005 ft/ft
Critical Slope	0.006 ft/ft

Worksheet for Pipe 10

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	18.0 in
Discharge	8.60 cfs

Results	
Normal Depth	11.4 in
Flow Area	1.2 ft²
Wetted Perimeter	2.8 ft
Hydraulic Radius	5.1 in
Top Width	1.45 ft
Critical Depth	10.7 in
Percent Full	63.2 %
Critical Slope	0.006 ft/ft
Velocity	4.58 ft/s
Velocity Head	0.33 ft
Specific Energy	1.28 ft
Froude Number	0.896
Maximum Discharge	7.99 cfs
Discharge Full	7.43 cfs
Slope Full	0.003 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	29.5 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	11.4 in
Critical Depth	10.7 in
Channel Slope	0.005 ft/ft
Critical Slope	0.006 ft/ft

Worksheet for Pipe 11

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.007 ft/ft
Diameter	18.0 in
Discharge	5.00 cfs

Results	
Normal Depth	9.7 in
Flow Area	1.0 ft²
Wetted Perimeter	2.5 ft
Hydraulic Radius	4.7 in
Top Width	1.50 ft
Critical Depth	10.3 in
Percent Full	54.0 %
Critical Slope	0.006 ft/ft
Velocity	5.13 ft/s
Velocity Head	0.41 ft
Specific Energy	1.22 ft
Froude Number	1.121
Maximum Discharge	9.45 cfs
Discharge Full	8.79 cfs
Slope Full	0.002 ft/ft
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	54.0 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	9.7 in
Critical Depth	10.3 in
Channel Slope	0.007 ft/ft
Critical Slope	0.006 ft/ft

Worksheet for Pipe 13

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	30.0 in
Discharge	22.00 cfs

Results	
Normal Depth	19.5 in
Flow Area	3.4 ft²
Wetted Perimeter	4.7 ft
Hydraulic Radius	8.7 in
Top Width	2.38 ft
Critical Depth	19.1 in
Percent Full	65.1 %
Critical Slope	0.005 ft/ft
Velocity	6.50 ft/s
Velocity Head	0.66 ft
Specific Energy	2.28 ft
Froude Number	0.961
Maximum Discharge	31.20 cfs
Discharge Full	29.00 cfs
Slope Full	0.003 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	48.0 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	19.5 in
Critical Depth	19.1 in
Channel Slope	0.005 ft/ft
Critical Slope	0.005 ft/ft

Worksheet for Pipe 14

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	18.0 in
Discharge	5.90 cfs

Results	
Normal Depth	12.1 in
Flow Area	1.3 ft²
Wetted Perimeter	2.9 ft
Hydraulic Radius	5.3 in
Top Width	1.41 ft
Critical Depth	11.3 in
Percent Full	67.3 %
Critical Slope	0.006 ft/ft
Velocity	4.66 ft/s
Velocity Head	0.34 ft
Specific Energy	1.35 ft
Froude Number	0.867
Maximum Discharge	7.99 cfs
Discharge Full	7.43 cfs
Slope Full	0.003 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	34.2 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	12.1 in
Critical Depth	11.3 in
Channel Slope	0.005 ft/ft
Critical Slope	0.006 ft/ft

Worksheet for Pipe 15

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	18.0 in
Discharge	5.60 cfs

Results	
Normal Depth	11.7 in
Flow Area	1.2 ft²
Wetted Perimeter	2.8 ft
Hydraulic Radius	5.2 in
Top Width	1.43 ft
Critical Depth	11.0 in
Percent Full	64.9 %
Critical Slope	0.006 ft/ft
Velocity	4.62 ft/s
Velocity Head	0.33 ft
Specific Energy	1.30 ft
Froude Number	0.884
Maximum Discharge	7.99 cfs
Discharge Full	7.43 cfs
Slope Full	0.003 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	34.2 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	11.7 in
Critical Depth	11.0 in
Channel Slope	0.005 ft/ft
Critical Slope	0.006 ft/ft

Worksheet for Pipe 16

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	24.0 in
Discharge	10.90 cfs

Results	
Normal Depth	14.5 in
Flow Area	2.0 ft²
Wetted Perimeter	3.6 ft
Hydraulic Radius	6.7 in
Top Width	1.95 ft
Critical Depth	14.2 in
Percent Full	60.6 %
Critical Slope	0.005 ft/ft
Velocity	5.48 ft/s
Velocity Head	0.47 ft
Specific Energy	1.68 ft
Froude Number	0.957
Maximum Discharge	17.21 cfs
Discharge Full	16.00 cfs
Slope Full	0.002 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	34.2 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	14.5 in
Critical Depth	14.2 in
Channel Slope	0.005 ft/ft
Critical Slope	0.005 ft/ft

Worksheet for Pipe 17

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	18.0 in
Discharge	5.60 cfs

Results	
Normal Depth	11.7 in
Flow Area	1.2 ft²
Wetted Perimeter	2.8 ft
Hydraulic Radius	5.2 in
Top Width	1.43 ft
Critical Depth	11.0 in
Percent Full	64.9 %
Critical Slope	0.006 ft/ft
Velocity	4.62 ft/s
Velocity Head	0.33 ft
Specific Energy	1.30 ft
Froude Number	0.884
Maximum Discharge	7.99 cfs
Discharge Full	7.43 cfs
Slope Full	0.003 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	40.8 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	11.7 in
Critical Depth	11.0 in
Channel Slope	0.005 ft/ft
Critical Slope	0.006 ft/ft

Worksheet for Pipe 18

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	24.0 in
Discharge	16.50 cfs

Results	
Normal Depth	20.4 in
Flow Area	2.8 ft²
Wetted Perimeter	4.7 ft
Hydraulic Radius	7.3 in
Top Width	1.42 ft
Critical Depth	17.6 in
Percent Full	85.1 %
Critical Slope	0.007 ft/ft
Velocity	5.79 ft/s
Velocity Head	0.52 ft
Specific Energy	2.22 ft
Froude Number	0.721
Maximum Discharge	17.21 cfs
Discharge Full	16.00 cfs
Slope Full	0.005 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	40.8 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	20.4 in
Critical Depth	17.6 in
Channel Slope	0.005 ft/ft
Critical Slope	0.007 ft/ft

Worksheet for Pipe 21

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Diameter	48.0 in
Discharge	88.80 cfs

Results	
Normal Depth	34.8 in
Flow Area	9.7 ft²
Wetted Perimeter	8.1 ft
Hydraulic Radius	14.4 in
Top Width	3.58 ft
Critical Depth	34.3 in
Percent Full	72.4 %
Critical Slope	0.005 ft/ft
Velocity	9.11 ft/s
Velocity Head	1.29 ft
Specific Energy	4.19 ft
Froude Number	0.973
Maximum Discharge	109.25 cfs
Discharge Full	101.57 cfs
Slope Full	0.004 ft/ft
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Average End Depth Over Rise	0.0 %
Normal Depth Over Rise	35.9 %
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	34.8 in
Critical Depth	34.3 in
Channel Slope	0.005 ft/ft
Critical Slope	0.005 ft/ft

Conc Trap Swale 2:1ss - 151 cfs

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Left Side Slope	2.000 H:V
Right Side Slope	2.000 H:V
Bottom Width	8.00 ft
Discharge	151.00 cfs

Results	
Normal Depth	18.5 in
Flow Area	17.1 ft²
Wetted Perimeter	14.9 ft
Hydraulic Radius	13.8 in
Top Width	14.16 ft
Critical Depth	22.7 in
Critical Slope	0.002 ft/ft
Velocity	8.85 ft/s
Velocity Head	1.22 ft
Specific Energy	2.76 ft
Froude Number	1.421
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	18.5 in
Critical Depth	22.7 in
Channel Slope	0.005 ft/ft
Critical Slope	0.002 ft/ft

Worksheet for 5' Chase

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

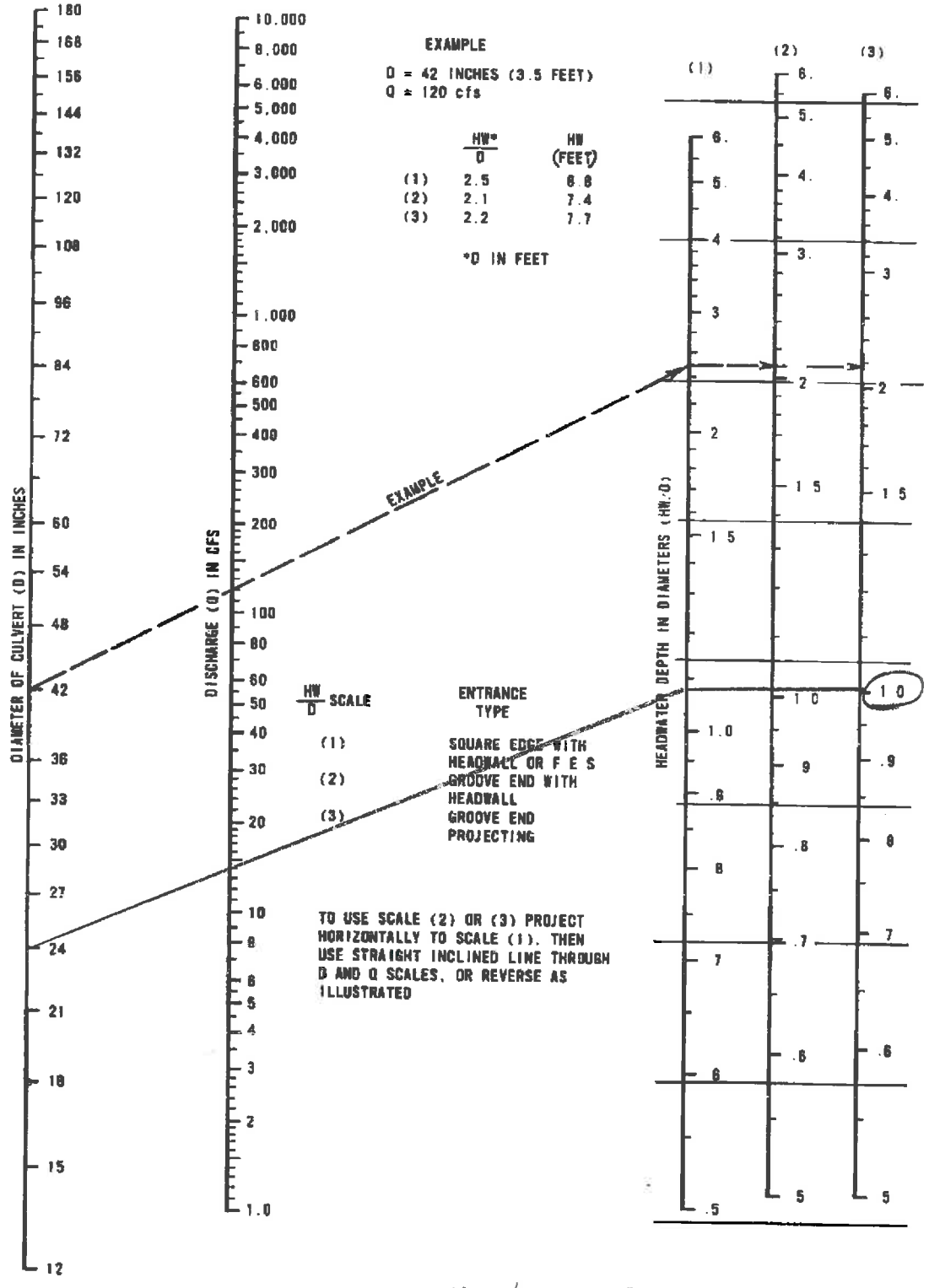
Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005 ft/ft
Bottom Width	5.00 ft
Discharge	5.80 cfs

Results	
Normal Depth	3.9 in
Flow Area	1.6 ft²
Wetted Perimeter	5.7 ft
Hydraulic Radius	3.5 in
Top Width	5.00 ft
Critical Depth	4.2 in
Critical Slope	0.004 ft/ft
Velocity	3.54 ft/s
Velocity Head	0.19 ft
Specific Energy	0.52 ft
Froude Number	1.090
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	3.9 in
Critical Depth	4.2 in
Channel Slope	0.005 ft/ft
Critical Slope	0.004 ft/ft

Inlet Control Nomograph for Concrete Pipe



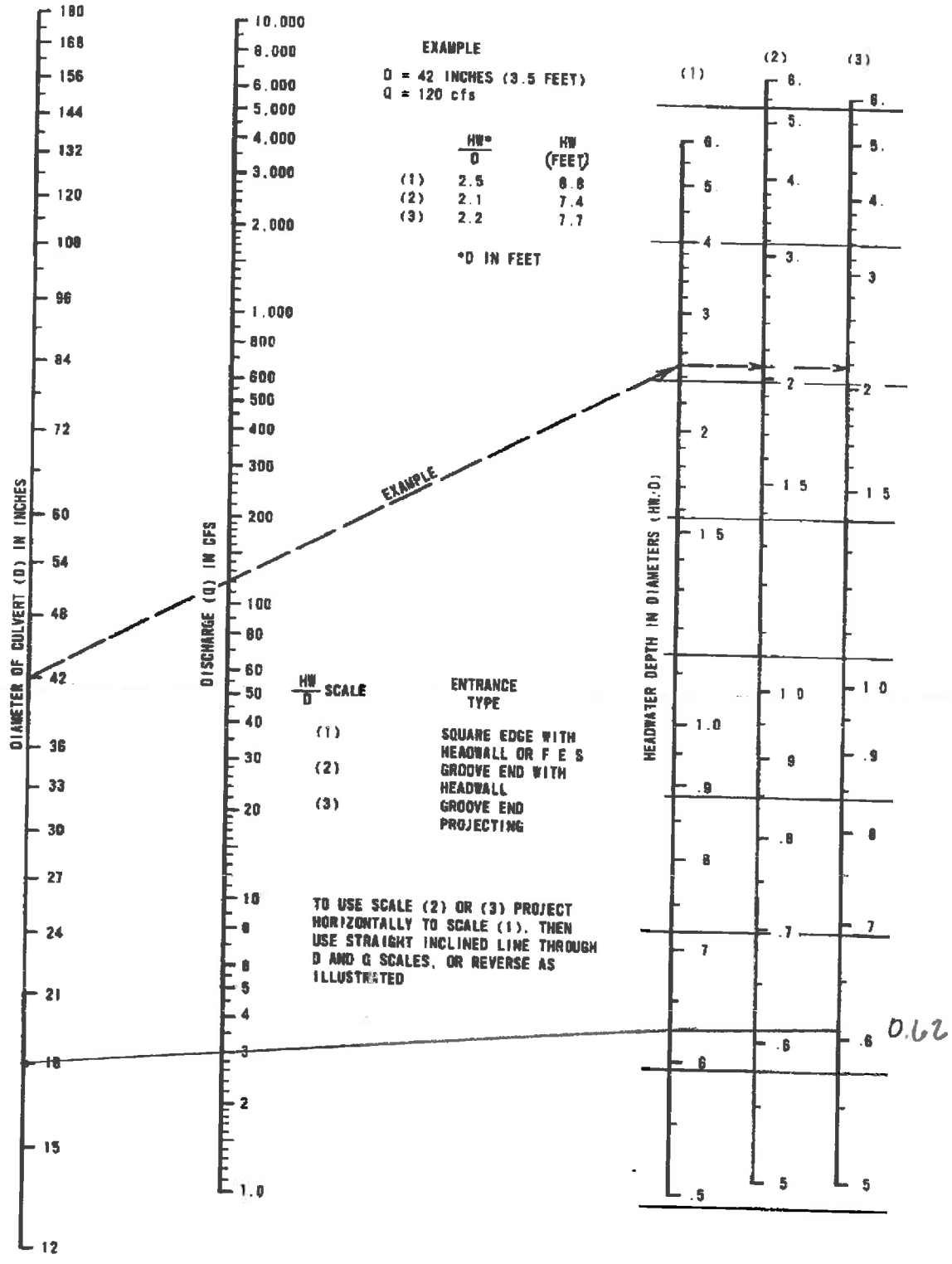
$Q_{100} = 13.9$ cfs

$HW/D = 1.0$

Min. $HW = 1.0 \times 2.0 = \underline{2.0}$

DP-5

Inlet Control Nomograph for Concrete Pipe



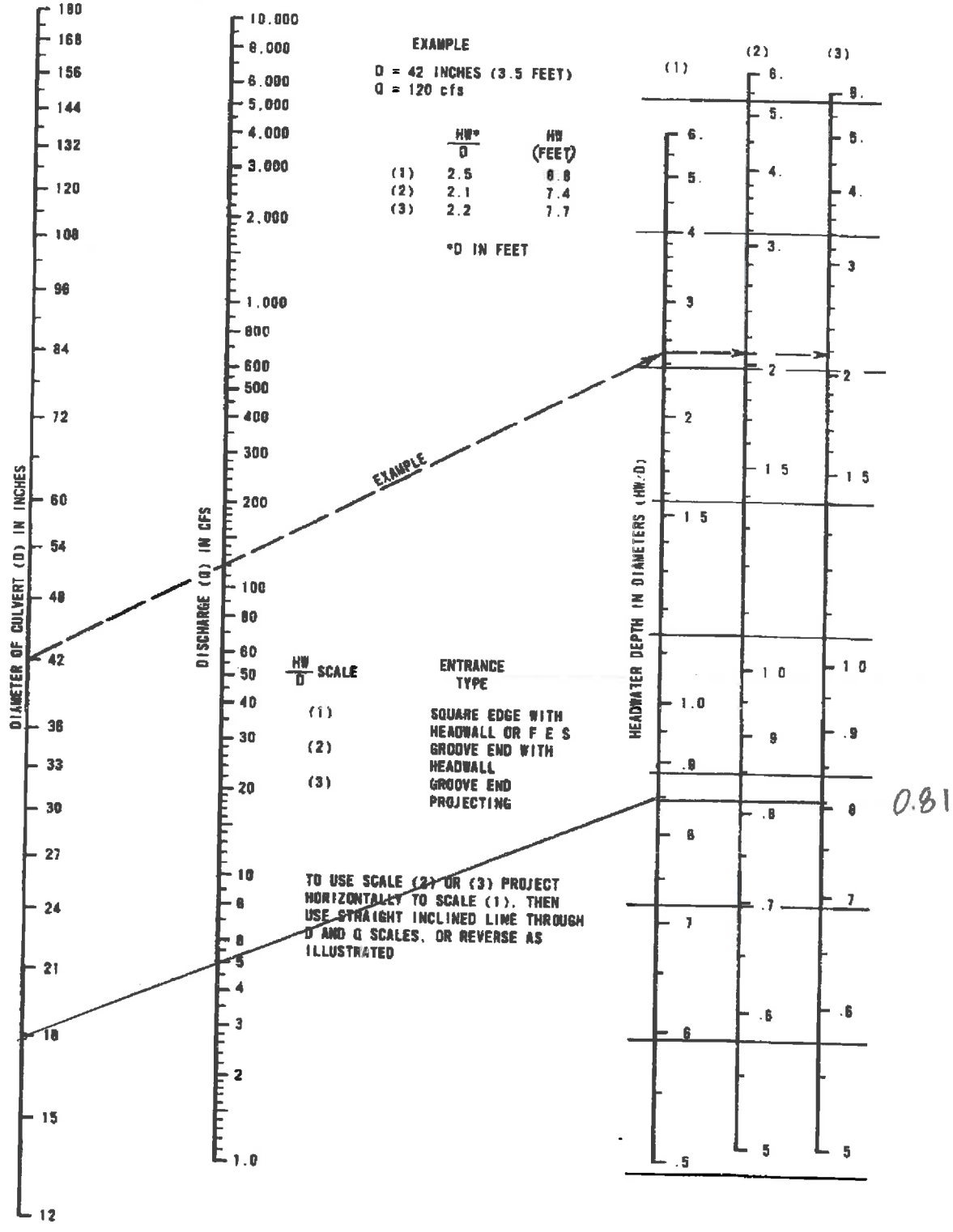
$HW/D = 0.62$

$Q_{100} = 3.0$

$\text{MIN } HW = 0.62 \times 1.5 = \underline{0.93'}$

DP-6

Inlet Control Nomograph for Concrete Pipe

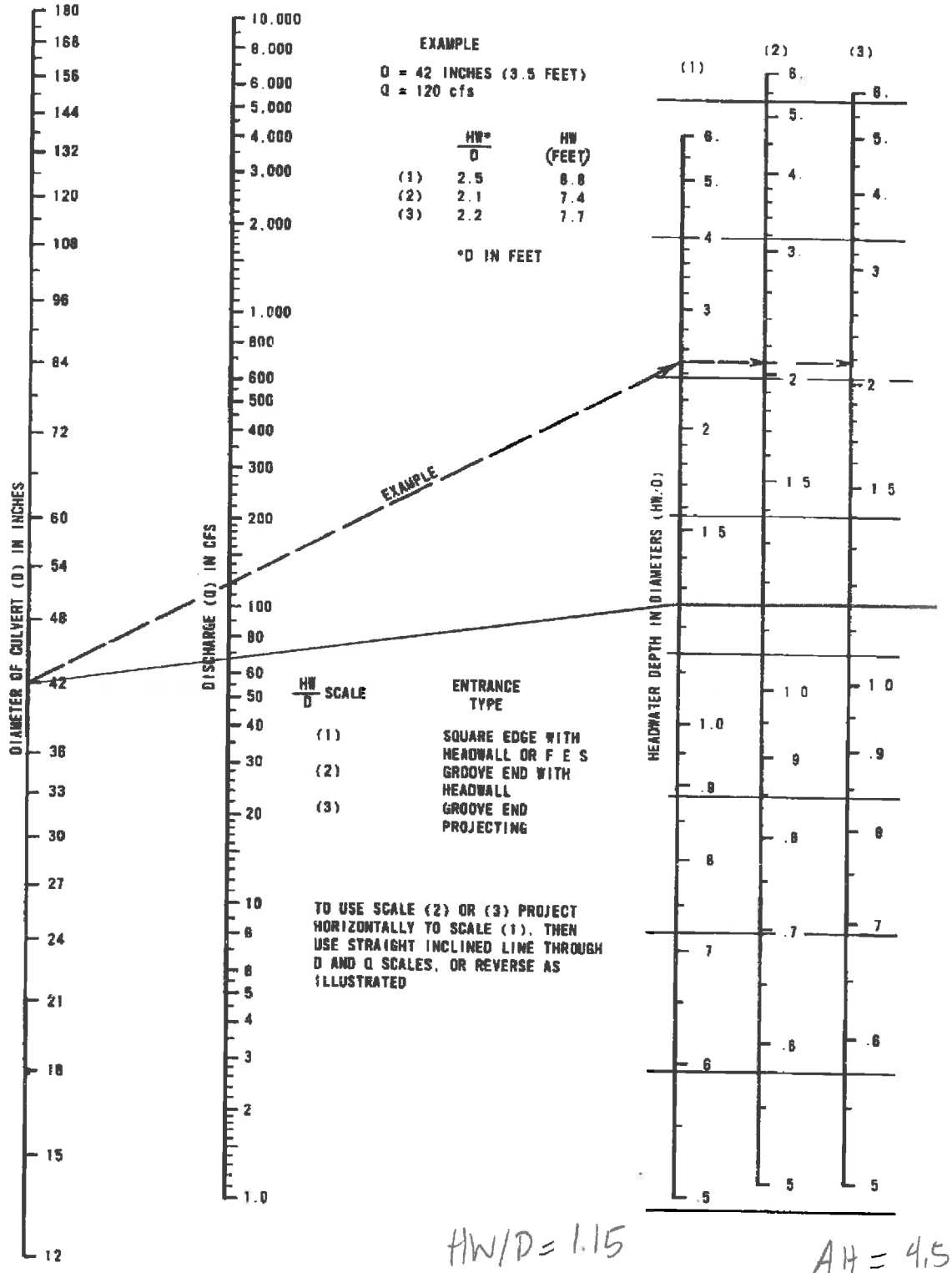


$Q_{100} = 5.0$

$HW/D = 0.81$

$\text{min } HW = 0.81 \times 1.5 = \underline{1.2'}$ DP - 12

Inlet Control Nomograph for Concrete Pipe



HW/D = 1.15

$D_{REQ'D} = 3.5 \times 1.15 = 4.02$

$\Delta H = 4.5'$ (field)

EXISTING 42" (Dum) ×

$Q_{100} = 135.7 / 2 \cong 68$ cfs per Culvert

DOESN'T WORK FOR HL THRU CULVERT

Sands Industrial - Area Inlet Calculation
Location: DP8
100 Year Event: 5.0 cfs

Width	2.917	ft	Area	8.51	sqft	open area x 70%		2.98
Length	2.917	ft	clogging factor	50%				
Perimeter	11.667	ft	blockage	4	ft	avail perm.		7.67

Elevation	Head (ft)					Orifice (cfs)	Weir (cfs)	
6502	0					0.00	0.00	
6502.125	0.125					5.07	1.05	
6502.25	0.25					7.17	2.97	
6502.375	0.375					8.78	5.46	
6502.5	0.5					10.14	8.40	
6502.625	0.625					11.33	11.74	
6502.75	0.75					12.42	15.44	
6502.875	0.875					13.41	19.45	
6503	1					14.34	23.77	
6503.125	1.125					15.21	28.36	
6503.25	1.25					16.03	33.22	
6503.375	1.375					16.81	38.32	
6503.5	1.5					17.56	43.66	
6503.625	1.625					18.28	49.23	
6503.75	1.75					18.97	55.02	
6503.875	1.875					19.63	61.02	
6504	2					20.27	67.22	
6504.125	2.125					20.90	73.62	
6504.25	2.25					21.50	80.21	
6504.375	2.375					22.09	86.99	
6504.5	2.5					22.67	93.95	

Sands Industrial - Area Inlet Calculation
Location: DP11
100 Year Event: 8.6 cfs

Width	2.917	ft	Area	8.51	sqft	open area x 70%		2.98
Length	2.917	ft	clogging factor	50%				
Perimeter	11.667	ft	blockage	4	ft	avail perm.		7.67

Elevation	Head (ft)					Orifice (cfs)	Weir (cfs)	
6502.5	0					0.00	0.00	
6502.625	0.125					5.07	1.05	
6502.75	0.25					7.17	2.97	
6502.875	0.375					8.78	5.46	
6503	0.5					10.14	8.40	
6503.125	0.625					11.33	11.74	
6503.25	0.75					12.42	15.44	
6503.375	0.875					13.41	19.45	
6503.5	1					14.34	23.77	
6503.625	1.125					15.21	28.36	
6503.75	1.25					16.03	33.22	
6503.875	1.375					16.81	38.32	
6504	1.5					17.56	43.66	
6504.125	1.625					18.28	49.23	
6504.25	1.75					18.97	55.02	
6504.375	1.875					19.63	61.02	
6504.5	2					20.27	67.22	
6504.625	2.125					20.90	73.62	
6504.75	2.25					21.50	80.21	
6504.875	2.375					22.09	86.99	
6505	2.5					22.67	93.95	

Sands Industrial - Area Inlet Calculation
Location: DP15
100 Year Event: 5.6 cfs

Width	2.917	ft	Area	8.51	sqft	open area x 70%		2.98
Length	2.917	ft	clogging factor	50%				
Perimeter	11.667	ft	blockage	4	ft	avail perm.		7.67

Elevation	Head (ft)					Orifice (cfs)	Weir (cfs)	
6502.75	0					0.00	0.00	
6502.875	0.125					5.07	1.05	
6503	0.25					7.17	2.97	
6503.125	0.375					8.78	5.46	
6503.25	0.5					10.14	8.40	
6503.375	0.625					11.33	11.74	
6503.5	0.75					12.42	15.44	
6503.625	0.875					13.41	19.45	
6503.75	1					14.34	23.77	
6503.875	1.125					15.21	28.36	
6504	1.25					16.03	33.22	
6504.125	1.375					16.81	38.32	
6504.25	1.5					17.56	43.66	
6504.375	1.625					18.28	49.23	
6504.5	1.75					18.97	55.02	
6504.625	1.875					19.63	61.02	
6504.75	2					20.27	67.22	
6504.875	2.125					20.90	73.62	
6505	2.25					21.50	80.21	
6505.125	2.375					22.09	86.99	
6505.25	2.5					22.67	93.95	

Sands Industrial - Area Inlet Calculation
Location: DP20
100 Year Event: 90 cfs (OVERFLOW CONDITION)

Width	2.917	ft	Area	35.00	sqft	open area x 70%		12.25
Length	12.000	ft	clogging factor	50%				
Perimeter	29.833	ft	blockage	4	ft	avail perm.		25.83

Elevation	Head (ft)					Orifice (cfs)	Weir (cfs)	
6497	0					0.00	0.00	
6497.125	0.125					20.85	3.54	
6497.25	0.25					29.49	10.01	
6497.375	0.375					36.12	18.39	
6497.5	0.5					41.71	28.31	
6497.625	0.625					46.63	39.57	
6497.75	0.75					51.08	52.02	
6497.875	0.875					55.17	65.55	
6498	1					58.98	80.08	
6498.125	1.125					62.56	95.56	
6498.25	1.25					65.95	111.92	
6498.375	1.375					69.16	129.12	
6498.5	1.5					72.24	147.12	
6498.625	1.625					75.19	165.89	
6498.75	1.75					78.03	185.40	
6498.875	1.875					80.77	205.61	
6499	2					83.42	226.51	
6499.125	2.125					85.98	248.07	
6499.25	2.25					88.48	270.28	
6499.375	2.375					90.90	293.11	
6499.5	2.5					93.26	316.56	

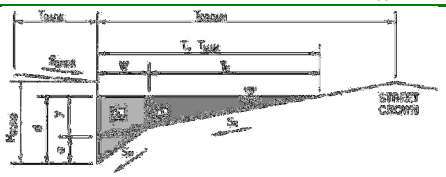
Version 4.05 Released March 2017

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

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

Project: SANDS INDUSTRIAL

Inlet ID: Inlet 1



Gutter Geometry (Enter data in the blue cells)

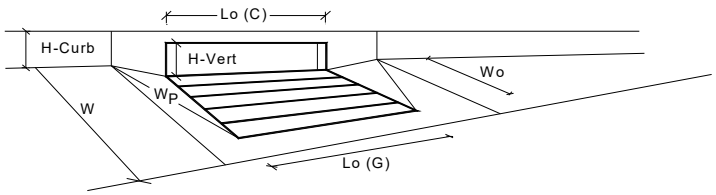
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	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} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.1	8.0	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.26	0.50	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.65	1.00	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**3.7**	**9.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	2.7	5.6	cfs

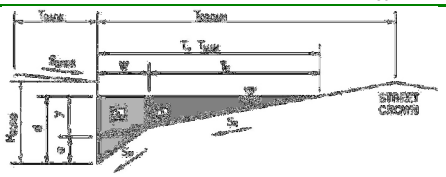
Version 4.05 Released March 2017

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

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

Project: SANDS INDUSTRIAL

Inlet ID: Inlet 4



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	8.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	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 =	0.011	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} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.1	7.8	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

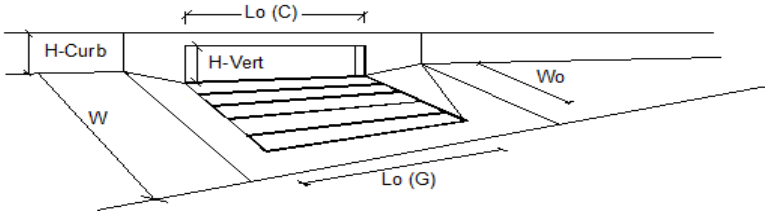
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**8.3**	**11.3**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)	Colorado Springs D-10-R		MINOR	MAJOR	
Type of Inlet		Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	4.0	4.0	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 =	12.00	12.00	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 =**	**3.4**	**5.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**98**	**%**

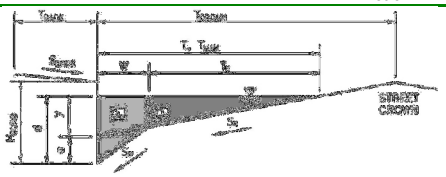
Version 4.05 Released March 2017

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

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

Project: SANDS INDUSTRIAL

Inlet ID: Inlet 5



Gutter Geometry (Enter data in the blue cells)

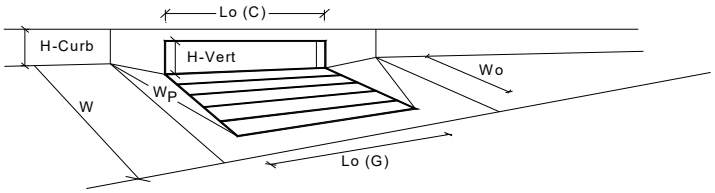
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	30.0	ft
Gutter Width	W =	1.00	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} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	30.0	30.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	6.0	inches
Grate Information			MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	1.00	1.00	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} =	0.42	0.42	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.77	0.77	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**5.9**	**5.9**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	3.0	5.6	cfs

POND CALCULATIONS

SANDS INDUSTRIAL MDDP (PROPOSED CONDITIONS)

(Weighted Percent Imperviousness of Proposed WQ Sand Filter Basin				
Contributing Basins	***Area (Acres)***	***C_5***	***Impervious % (I)***	***(Acres)*(I)***
C	3.38	0.59	80	270.10
D	0.53	0.59	80	42.30
E	0.65	0.80	94	61.01
F	0.92	0.59	80	73.59
G	0.99	0.59	80	79.41
H	0.99	0.59	80	79.13
I	1.85	0.59	80	147.79
J	0.92	0.59	80	73.74
J1	0.81	0.90	100	80.55
K	0.76	0.77	92	69.61
L	1.01	0.59	80	80.73
M	1.24	0.12	7	8.68
Totals	***14.04***			***1066.64***
Imperviousness % to FSD	***76.0***			

8.02	TYPE B	57%
6.02	TYPE A	43%

Sands Industrial MDDP
DRAINAGE REPORT DRAINAGE CALCULATIONS
(Pond Volume Calculation)

FSD POND A

	Elevation	SF	CF	Storage AF	Storage Sum
TMP/WQCV	6495.83	40.00	0.00	0.00	0.00
	6496.00	200.00	20.40	0.00	0.00
	6497.00	1,688.00	944.00	0.02	0.02
	6498.00	11,834.00	6,761.00	0.16	0.18
	6499.00	19,590.00	15,712.00	0.36	0.54
	6500.00	22,486.00	21,038.00	0.48	1.02
	6501.00	25,440.00	23,963.00	0.55	1.57
	6502.00	28,607.00	27,023.50	0.62	2.19
	6503.00	29,894.00	29,250.50	0.67	2.86

Total = 124,712 CF

Total = 2.9 Ac-ft

Calculated by: DLM

Date: 11/13/2019

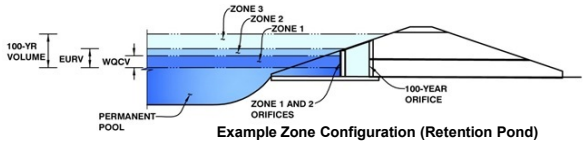
Checked by: VAS

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: The Sand Industrial MDDP

Basin ID: FSD Pond 1



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.73	0.357	Orifice Plate
Zone 2 (EURV)	4.64	0.910	Orifice Plate
Zone 3 (100-year)	5.71	0.625	Weir&Pipe (Restrict)
		1.892	Total

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 =	4.64	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	18.60	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	1.55	3.09					
Orifice Area (sq. inches)	1.68	1.68	8.00					

	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)

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

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.64	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	5.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.91	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 =	4.64	N/A	feet
Over Flow Weir Slope Length =	2.91	N/A	feet
Grate Open Area / 100-yr Orifice Area =	16.02	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	10.19	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.09	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 =	0.33	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 =	7.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.64	N/A	ft^2
Outlet Orifice Centroid =	0.34	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.35	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.60	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	20.00	feet
Spillway End Slopes =	10.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

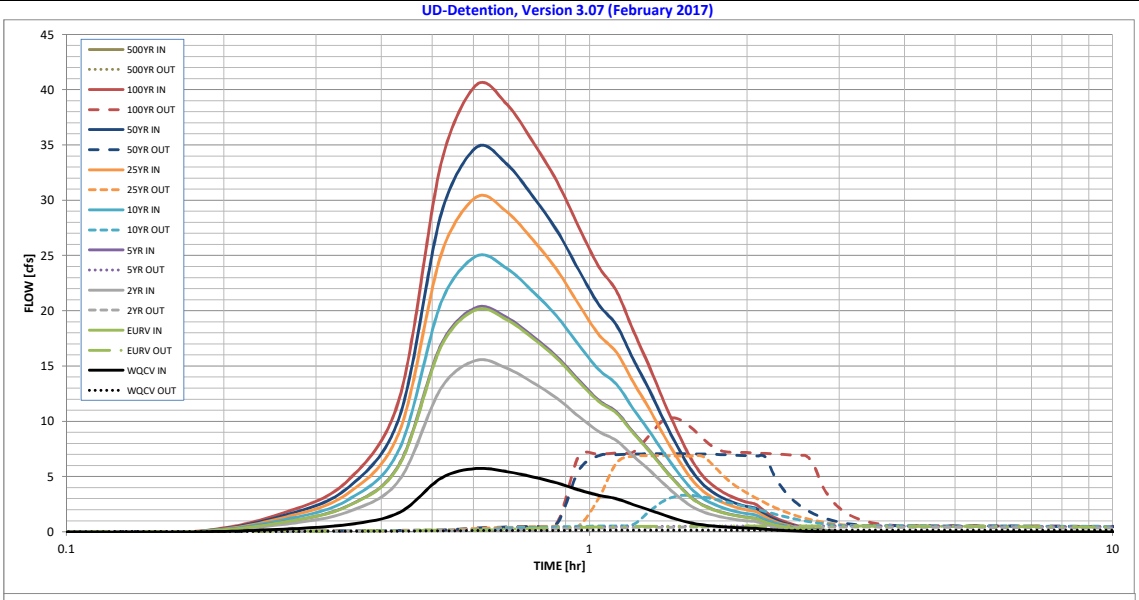
Spillway Design Flow Depth=	0.65	feet
Stage at Top of Freeboard =	7.25	feet
Basin Area at Top of Freeboard =	0.69	acres

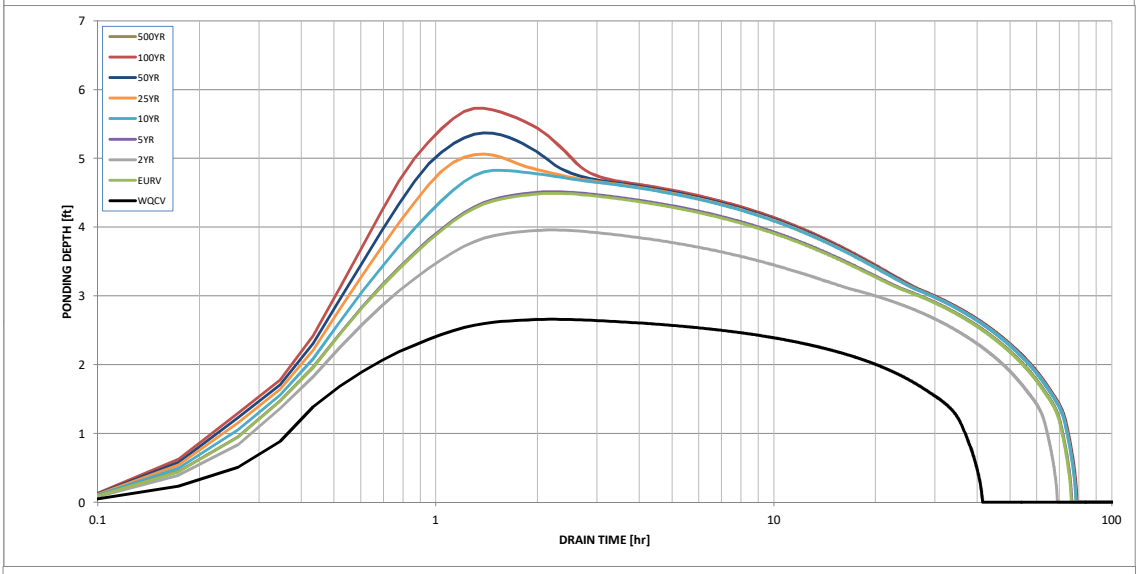
Routed Hydrograph Results

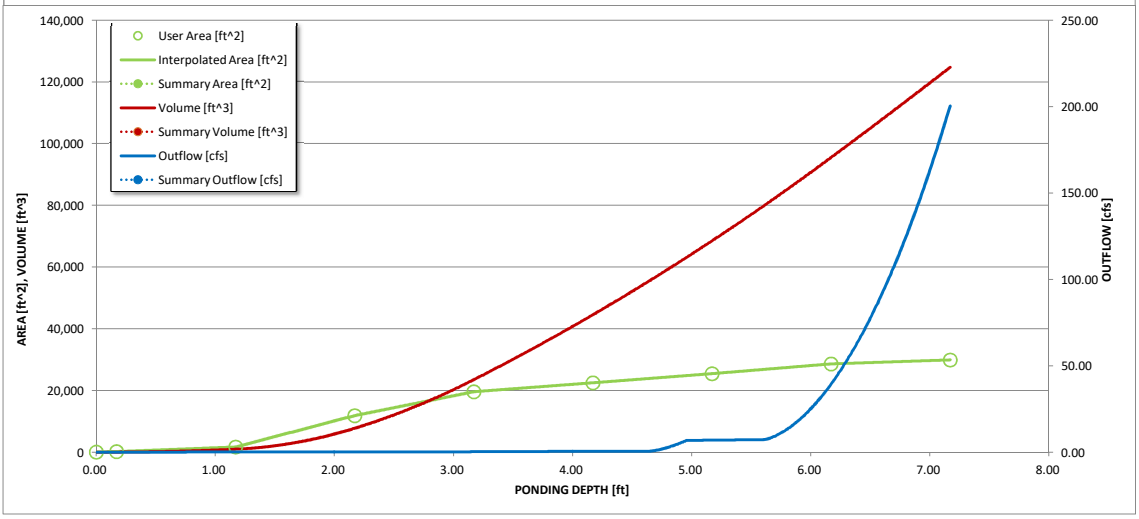
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.357	1.267	0.976	1.281	1.579	1.920	2.210	2.574	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.356	1.268	0.976	1.280	1.578	1.920	2.210	2.574	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.01	0.11	0.37	0.58	0.87	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.1	0.2	1.6	5.2	8.2	12.2	0.0
Peak Inflow Q (cfs) =	5.7	20.1	15.5	20.3	24.9	30.3	34.8	40.4	#N/A
Peak Outflow Q (cfs) =	0.2	0.5	0.4	0.5	3.3	6.9	7.1	10.2	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.8	2.1	1.3	0.9	0.8	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Spillway	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.3	0.6	0.6	0.7	#N/A
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	67	62	67	68	66	65	64	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	66	72	74	73	73	73	#N/A
Maximum Ponding Depth (ft) =	2.66	4.49	3.96	4.52	4.83	5.06	5.37	5.73	#N/A
Area at Maximum Ponding Depth (acres) =	0.36	0.54	0.50	0.54	0.56	0.58	0.60	0.62	#N/A
Maximum Volume Stored (acre-ft) =	0.328	1.190	0.909	1.200	1.371	1.507	1.689	1.903	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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

DRAINAGE MAPS

OFF-SITE EXISTING CONDITIONS
DRAINAGE MAP

BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5	Q_{100}
ONSITE BASINS			
OS1	92.13	21.0	135.7
OS2	4.52	13.8	25.7
OS3	3.97	12.4	23.1
OS4	33.11	32.9	86.4
OS5	1.00	0.8	2.3
EXA	15.27	3.6	24.5

DESIGN POINT SUMMARY				
DESIGN POINT	Q_5	Q_{100}	BASIN(S)/ DESIGN PT(S)	STRUCTURE
1	21.0	135.7	OS1	(2) EX. 42' CULVERTS
2	12.4	23.1	OS3	OVERLAND
3	28.8	150.4	DP1, OS2	OVERLAND
4	33.7	88.7	OS4, OS5	24&48 CULVERT/OVERLAND
5	59.6	229.4	EXA, DP3, DP4	EFSCST CHANNEL

1" = 400'

0 200 400 800

Scale in Feet

NOTES:

EFSCST = EAST FORK SAND CREEK SUB-TRIBUTARY
CONTOURS TAKEN FROM USGS SURFACE.

OFF-SITE DRAINAGE MAP
JOB NO. 43-129
DATE PREPARED: 11/13/2019

M&S CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

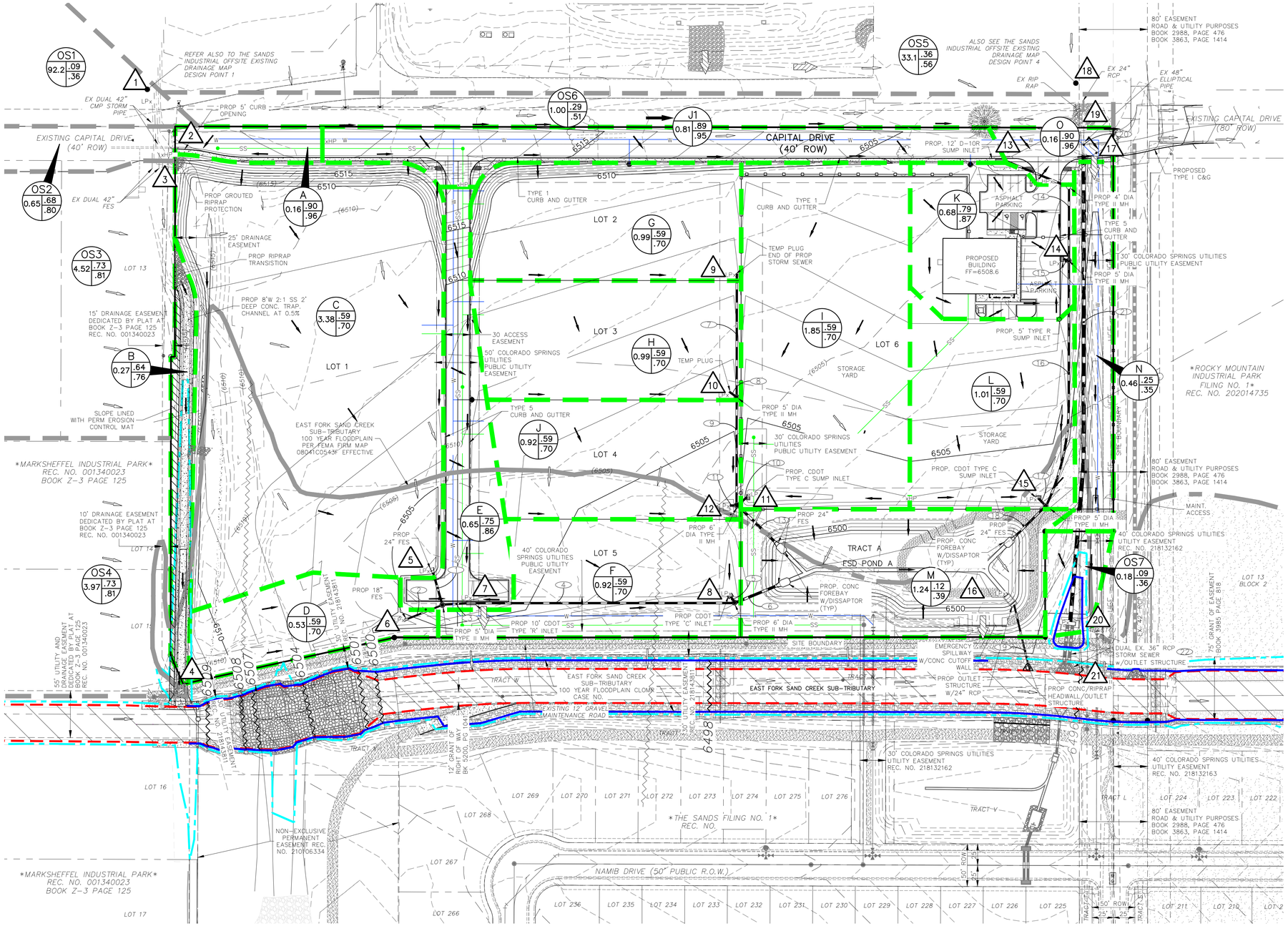
File: O:\43129A-Sands Industrial\Sands Industrial\dwg\Eng Exhibits\43-129-DM-Offsite.dwg Plotstamp: 11/13/2019 8:22 PM

THE SANDS INDUSTRIAL PARK FILING NO.1

COUNTY OF EL PASO, STATE OF COLORADO

PROPOSED DRAINAGE MAP

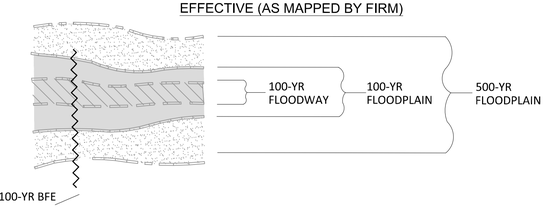
NOVEMBER 2019



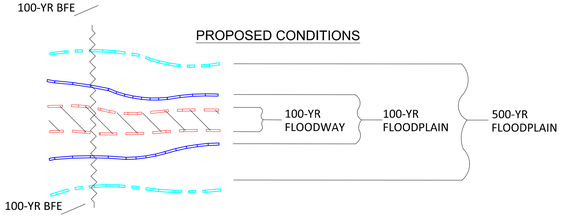
LEGEND

- BASIN DESIGNATION (Z / 25 / .25 / .35 / C5 / C100 / ACRES)
- BASIN BOUNDARY
- (6920) EXISTING INDEX CONTOUR (5')
- 6920 PROP INDEX CONTOUR (5')
- PROPERTY BOUNDARY
- PROPOSED STORM SEWER PIPE
- EXISTING STORM SEWER PIPE
- W PROPOSED WATERLINE
- S PROPOSED SAN. SEWER
- UGE UNDERGROUND ELECTRICAL
- GAS EXISTING GAS LINE
- 4 PIPE RUN REFERENCE LABEL
- 6 SURFACE DESIGN POINT
- CROSSPAN
- INLET
- EXISTING FLOW DIRECTION ARROW
- EXISTING FLOW DIRECTION ARROW
- PROPOSED FLOW DIRECTION ARROW
- FLARED END SECTION
- HPx HIGH POINT
- LPx LOW POINT

EFFECTIVE (AS MAPPED BY FIRM)



PROPOSED CONDITIONS



BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5	Q_{100}
ONSITE BASINS			
A	0.16	0.7	1.3
B	0.27	0.8	1.7
C	3.38	7.0	13.9
D	0.53	1.5	3.0
E	0.65	2.7	4.9
F	0.92	2.5	5.0
G	0.99	2.8	5.5
H	0.99	2.7	5.4
I	1.85	4.3	8.6
J	0.92	2.5	5.0

BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5	Q_{100}
ONSITE BASINS			
J1	0.81	3.4	6.0
K	0.76	3.0	5.6
L	1.01	2.8	5.6
M	1.24	0.6	3.5
N	0.46	0.2	1.3
O	0.16	0.7	1.3
OS1	92.92	19.8	132.7
OS2	0.65	1.6	3.2
OS3	4.52	13.8	25.7
OS4	3.97	12.4	23.1

BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5	Q_{100}
ONSITE BASINS			
OS5	33.11	32.9	86.4
OS6	1.00	0.8	2.3
OS7	0.18	0.1	0.4

DESIGN POINT SUMMARY				
DESIGN POINT	Q_5	Q_{100}	BASIN(S)/ DESIGN PT(S)	STRUCTURE
1	19.8	132.7	OS1	(2) EX. 42" CULVERTS
2	3.0	5.8	OS2, A	CURB OPENING W/RIPRAP
3	21.2	135.4	DP1, DP2	EX. SWALE
4	33.2	149.4	DP3, B, OS3, OS4	8'W CONC. SWALE
5	7.0	13.9	C	PROP. 24" STORM
6	1.5	3.0	D	PROP. 18" STORM
7	2.7	4.9	E	PROP. 10' TYPE R INLET
8	2.5	5.0	F	PROP. CDOT TYPE C INLET
9	2.8	5.5	G	PROP. 18" STORM
10	2.7	5.4	H	PROP. 18" STORM
11	4.3	8.6	I	PROP. CDOT TYPE C INLET
12	2.5	5.0	J	PROP 18" STORM
13	3.4	6.0	J1	PROP 10' TYPE R INLET
14	3.0	5.6	K	PROP 5' TYPE R INLET
15	2.8	5.6	L	PROP CDOT TYPE C INLET
16	32.4	65.2	PR6, PR13, PR18, M	PROP FSD POND A
17	0.7	1.3	O	EX SWALE
18	32.9	86.4	OS5	EX 24" RCP
19	33.7	88.8	DP18, OS6	EX. ELL 48" CMP
20	0.3	1.7	N, OS7	MOD TYPE D INLET BOX
21	56.5	212.3	DP4, DP19, PR19	EST OF TOTAL DISCHARGE

1" = 60'

0 30 60 120

Scale in Feet

STORM SEWER SUMMARY				
PIPE RUN	Q_5	Q_{100}	PIPE SIZE	CONTRIBUTING PIPES/DESIGN POINTS
1	7.0	13.9	24" PP	DP5
2	1.5	3.0	18" PP	DP6
3	8.0	16.0	24" PP	PR1, PR2
4	9.8	19.3	30" PP	PR3, DP7
5	2.5	5.0	18" PP	DP8

STORM SEWER SUMMARY				
PIPE RUN	Q_5	Q_{100}	PIPE SIZE	CONTRIBUTING PIPES/DESIGN POINTS
6	11.5	22.7	30" PP	DP12
7	2.8	5.5	18" PP	DP9
8	2.7	5.4	18" PP	DP10
9	5.4	10.7	24" PP	PR7, PR8
10	4.3	8.6	18" PP	DP11

PP = POLYPROPOLENE (ADS N-12 OR APPROVED EQUAL)

STORM SEWER SUMMARY				
PIPE RUN	Q_5	Q_{100}	PIPE SIZE	CONTRIBUTING PIPES/DESIGN POINTS
11	2.5	5.0	18" PP	DP12
12		NOT	USED	
13	11.0	22.0	30" PP	PR9, PR10, PR11
14	3.4	5.9	18" PP	INLET 1
15	3.0	5.6	18" PP	DP14
16	6.1	10.9	24" PP	PR14, PR15

STORM SEWER SUMMARY				
PIPE RUN	Q_5	Q_{100}	PIPE SIZE	CONTRIBUTING PIPES/DESIGN POINTS
17	2.8	5.6	18" PP	DP15
18	8.8	16.5	24" PP	PR16, PR17
19	0.5	10.2	18" RCP	POND 1
20	33.7	88.8	48" CMP	DP19
21	33.7	88.8	48" PP	PR20
22	33.9	89.8	36"RCPs	PR21, DP20

FULL SPECTRUM DETENTION POND A (PRIVATE)	
WQ VOLUME	0.328 AC-FT
EURV VOLUME	1.190 AC-FT
100 YR STORAGE VOLUME	1.903 AC-FT
100 YR WATER SURFACE EL	6501.54
SPILLWAY CREST EL	6501.54
TOP OF EMBANKMENT EL	6503.30
SPILLWAY DESIGN FLOW DEPTH	0.65 FT

FOR LOCATING & MARKING GAS, ELECTRIC, WATER & TELEPHONE LINES

FOR BURIED UTILITY INFORMATION 48 HRS BEFORE YOU DIG CALL 1-800-922-1987

M&S CIVIL CONSULTANTS, INC.

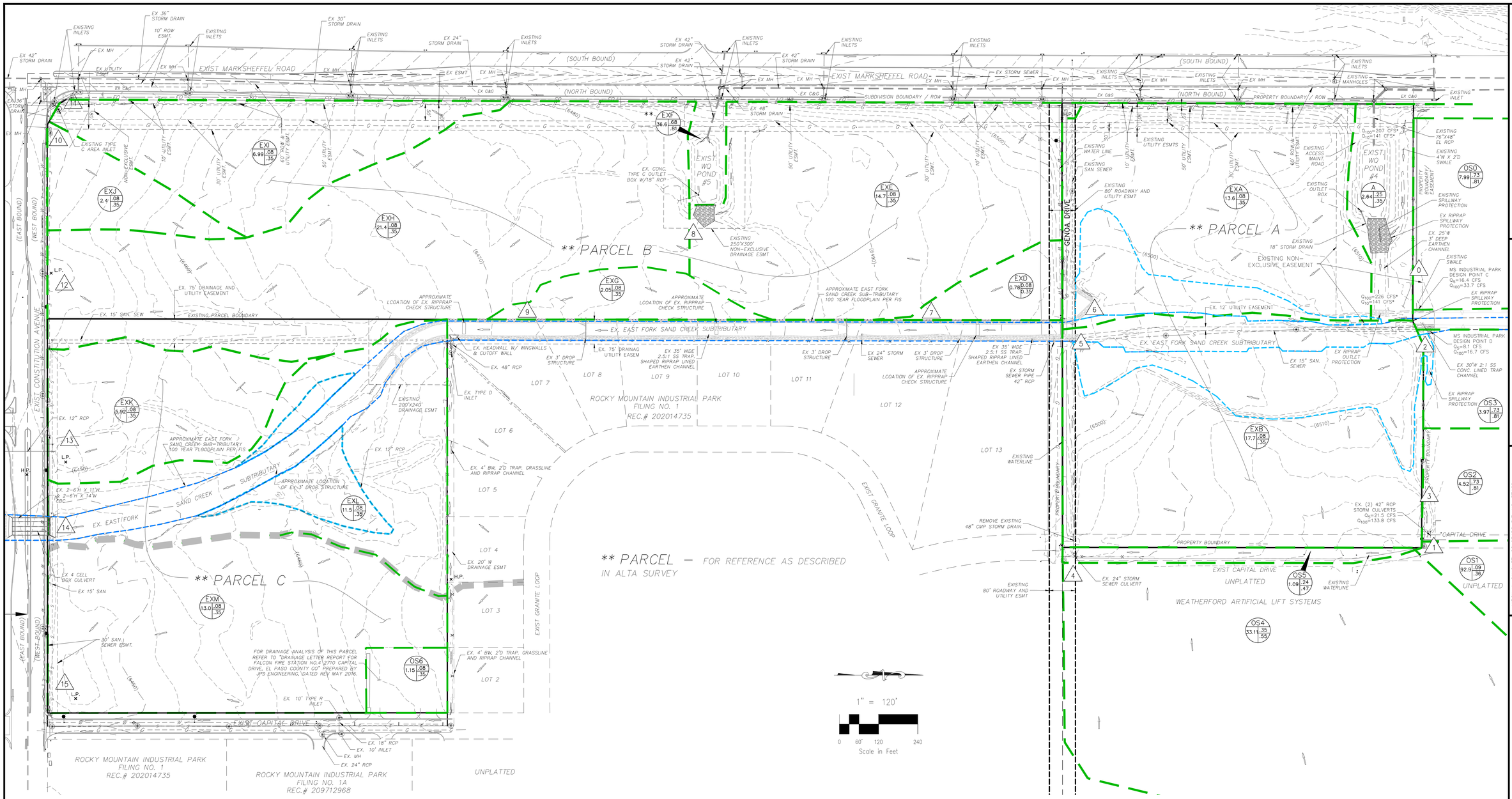
102 E. PIKE PEAK AVE, SUITE 500
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

THE SANDS INDUSTRIAL PARK FIL NO. 1

PROPOSED DRAINAGE MAP

PROJECT NO. 43-129	SCALE: HORIZONTAL: 1"=60' VERTICAL: N/A	DATE: 11/13/19	
DESIGNED BY: DLM		SHEET 1 OF 1	PDM01
DRAWN BY: ELY			
CHECKED BY: VAS			

File: Q:\43129A-Sands Industrial\Sands Industrial (dwg)\Eng Exhibits\43-129 PDM01.dwg Plotstamp: 11/13/2019 4:08 PM



BASIN SUMMARY			
BASIN	AREA (ACRES)	Q5	Q100
OS0	7.99	19.9	37.1
OS1	92.92	21.5	133.8
OS2	4.52	13.7	25.4
OS3	3.97	12.3	22.9
OS4	33.11	32.6	85.4
OS5	1.09	0.8	2.5
EXA	13.61	3.2	23.4
EXB	17.68	4.1	30.0
EXD	0.78	0.2	1.6
EXE	14.72	3.9	27.1
**EXF	36.59	81.3	159.9
EXG	2.05	0.5	3.4
EXH	21.40	4.6	33.5
EXI	6.99	1.6	11.5
EXJ	2.40	0.6	4.5
EXK	5.92	1.3	9.7
EXL	11.49	2.6	19.1
EXM	12.99	2.9	21.6
***EXN	1.15	0.4	2.6

DESIGN POINT SUMMARY			
DESIGN POINT	Q5	Q100	BASIN
DP0	19.9	37.1	OS0
DP1	21.5	133.8	OS1
DP2	12.3	22.9	OS3
DP3	29.9	148.4	DP1, OS2
DP4	33.3	87.8	OS4, OS5
DP5	72.3	304.8	EXB, DP3, DP4
DP6	3.2	23.4	EXA
DP7	0.2	1.6	EXD
DP8	79.9	167.8	EXE, **EXF WQ #5
DP9	0.5	3.4	EXG
DP10	0.6	4.5	EXJ
DP11	2.1	15.5	EXL, DP10
DP12	68.6	176.2	EXH, DP8
DP13	1.3	9.7	EXK
DP14	77.1	341.2	EXL,DP5,DP6,DP7,DP9
DP15	2.9	21.6	EXM

**EXF WQ POND #5 EXISTING C VALUES AND INTENSITY'S AS STUDIED IN THE "FINAL DRAINAGE REPORT FOR MARKSHEFFEL RD. FROM CONSTITUTION AVE. TO DUBLIN RD." PREPARED BY CHSM HILL, DATED 2008

***REFER TO "DRAINAGE LETTER REPORT FOR FALCON FIRE STATION NO.4 2710 CAPITAL DRIVE, EL PASO COUNTY CO" PREPARED BY JPS ENGINEERING, DATED REV MAY 2016.

LEGEND

BASIN DESIGNATION: Z / 25 (ACRES) / .25 .35 (C5 / C100)

- EXISTING FLOW DIRECTION ARROW
- EMERGENCY OVERFLOW DIRECTION
- FLARED END SECTION
- PERIMETER SWALE
- FILING LINE
- 2.5% STREET GRADE W/DIRECTION
- H.P. HIGH POINT
- L.P. LOW POINT
- 2A SURFACE DESIGN POINT
- BASIN BOUNDARY
- 100 YEAR FLOODPLAIN
- 5 YEAR FLOODPLAIN
- 6920 EXISTING CONTOUR
- STORM SEWER PIPE
- INLET

FOR REFERENCE ONLY
FROM THE SANDS FILING 1
MDDP

THE SANDS
PREDEVELOPED CONDITIONS DRAINAGE MAP
PROJECT NO. 43-089 | DESIGNED BY: DLM | DRAWN BY: JWP | CHECKED BY: VAS
SCALE: HORIZONTAL: 1"=120' VERTICAL: NA
DATE: 12-14-17
SHEET 1 OF 1
ECDM-1

20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF CIVIL CONSULTANTS, INC.
VIRGIL A. SANCHEZ, COLORADO P.E. NO. 37760

REVISIONS: NO. | DATE: | BY | DESCRIPTION:

THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE OR LIABLE FOR UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE PREPARER OF THESE PLANS.

CAUTION

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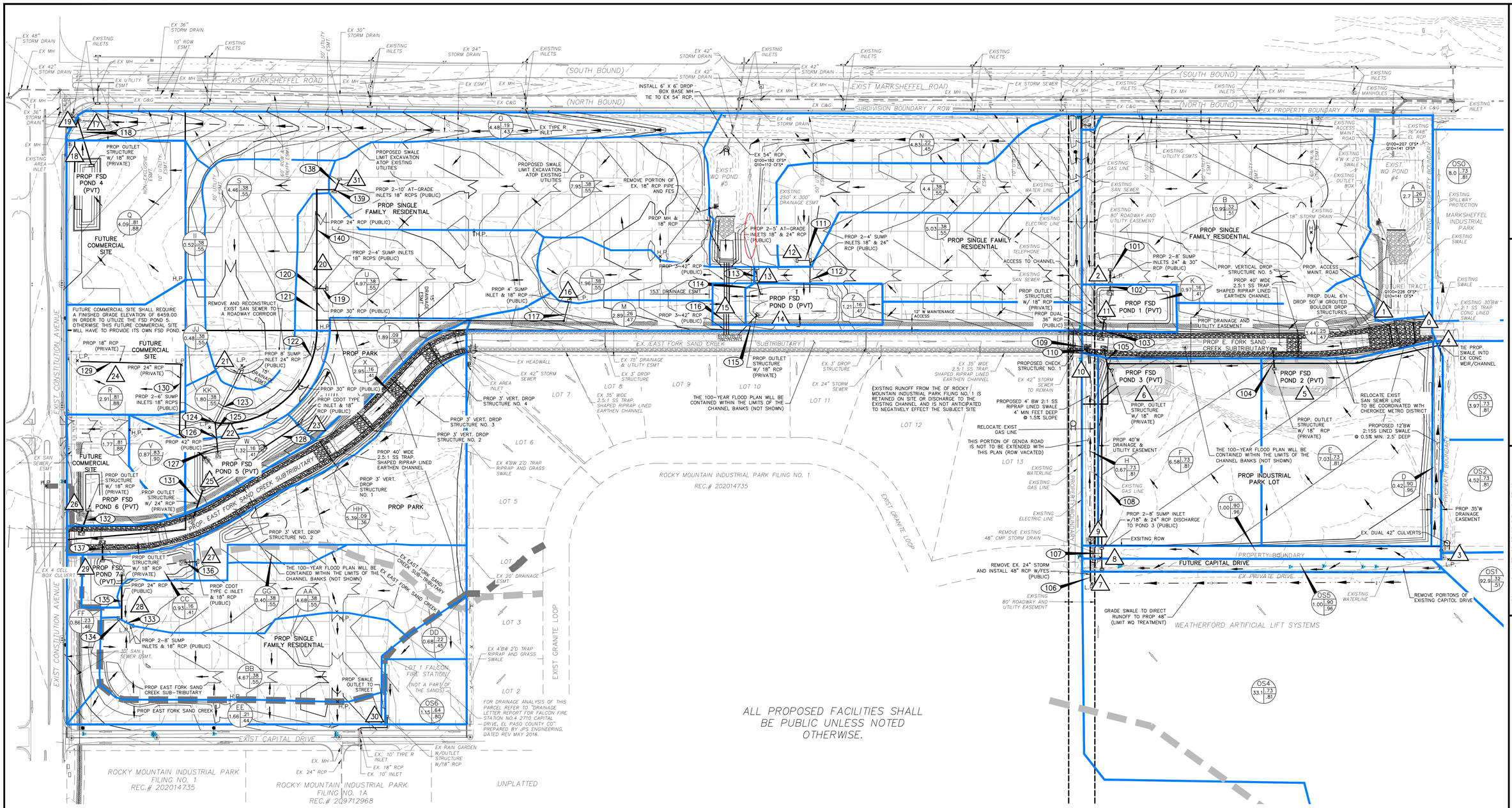

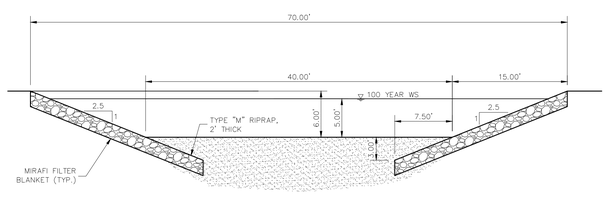

TYPICAL SECTION EAST FORK SAND CREEK SUB-TRIBUTARY

SCALE: 1/8" = 1'

LEGEND

- SB — SEDIMENT BASIN
- 200 — PIPE RUN REFERENCE LABEL
- 2A — SURFACE DESIGN POINT
- BASIN BOUNDARY
- (6920) — EXISTING CONTOUR
- 6920 — PROPOSED CONTOUR
- STORM SEWER PIPE
- CROSSPAN
- INLET
- DEVELOPED CONDITION MAJOR BASIN BOUNDARY
- EX CONDITION MAJOR BASIN BOUNDARY

BASIN DESIGNATION: Z / 25 / .25 / .35 / C5 / C100 / ACRES

- EXISTING FLOW DIRECTION ARROW
- EMERGENCY OVERFLOW DIRECTION
- PROPOSED FLOW DIRECTION
- FLARED END SECTION
- PERIMETER SWALE
- FILING LINE
- 11 — LOT NUMBER
- 2.5% — STREET GRADE W/DIRECTION
- H.P. — HIGH POINT
- L.P. — LOW POINT

BASIN SUMMARY			
BASIN	AREA (ACRES)	Q5	Q100
A	38.50	141.0	226.0
B	10.99	11.6	31.1
C	3.44	4.0	12.5
D	0.42	2.0	3.5
E	7.03	21.4	39.8
F	6.58	20.0	37.2
G	1.00	3.8	6.7
H	0.67	2.5	4.7
I	5.03	6.6	15.9
J	4.40	5.8	14.1
K	0.97	0.7	2.8
L	1.96	2.8	6.8
EXF	36.59	90.2	180.3
M	2.89	3.0	9.3
N	4.83	3.6	12.1
O	4.48	2.6	9.9
P	7.95	9.8	23.8
Q	4.09	16.3	29.8
R	2.91	8.9	16.2
S	4.46	6.0	14.5
T	1.89	0.6	4.2

BASIN SUMMARY			
BASIN	AREA (ACRES)	Q5	Q100
U	4.97	6.8	16.6
V	0.87	3.7	6.8
W	1.32	0.8	3.5
X	2.95	1.5	6.6
Y	1.77	7.3	13.3
Z	1.21	0.7	3.2
AA	4.68	6.1	14.8
BB	4.67	6.1	14.9
CC	0.93	0.6	2.7
DD	0.68	0.6	2.1
EE	1.66	1.4	5.0
FF	0.86	0.8	2.7
GG	0.40	0.6	1.6
HH	5.39	1.7	11.2
II	0.52	0.9	2.2
JJ	0.48	0.8	2.0
KK	1.80	2.7	6.6
OS0	7.99	19.9	37.1
OS1	92.92	77.2	206.5
OS2	4.52	13.6	25.4
OS3	3.97	12.3	22.9
OS4	33.11	67.4	125.5
OS5	1.00	3.8	6.7
OS6	1.15	3.8	8.0

DESIGN POINT SUMMARY		
DESIGN POINT	Q5	Q100
0	19.9	37.1
1	141.0	226.0
2	11.6	31.1
3	77.2	206.5
4	80.7	203.9
5	21.4	39.8
6	27.5	50.6
7	67.4	125.5
8	7.5	13.5
9	67.4	125.4
10	62.6	116.7
11	12.1	33.3
12	5.8	14.1
13	6.6	15.9
14	13.0	32.8
15	88.5	181.9

DESIGN POINT SUMMARY		
DESIGN POINT	Q5	Q100
16	2.8	6.8
17	2.6	9.9
18	16.1	30.0
19	3.0	13.8
20	6.8	16.6
21	6.0	14.5
22	9.4	21.3
23	0.6	4.2
24	9.5	17.8
25	41.8	99.2
26	7.3	13.3
27	2.2	12.5
28	12.2	29.5
29	14.8	44.1
30	0.6	2.1
31	9.8	23.8

STORM SEWER SUMMARY			
PIPE RUN	Q5	Q100	PIPE SIZE
101	6.0	16.0	24" RCP
102	11.9	32.0	30" RCP
103	0.2	13.8	18" RCP
104	1.0	4.9	18" RCP
105	1.2	6.0	18" RCP
106	67.4	125.5	48" RCP
107	3.8	6.7	18" RCP
108	7.5	13.5	24" RCP
109	31.3	58.3	36" RCP
110	31.3	58.3	36" RCP
111	2.9	7.1	18" RCP
112	5.8	14.1	24" RCP
113	3.3	8.0	18" RCP
114	6.6	15.9	24" RCP
115	0.3	10.5	18" RCP
116	88.5	181.9	3-42" RCP
117	2.8	6.8	18" RCP
118	0.7	3.2	18" RCP
119	3.4	8.3	18" RCP

STORM SEWER SUMMARY			
PIPE RUN	Q5	Q100	PIPE SIZE
120	3.4	8.3	18" RCP
121	15.9	38.7	30" RCP
122	18.4	44.6	30" RCP
123	6.0	14.5	24" RCP
124	4.7	10.7	18" RCP
125	28.1	67.6	42" RCP
126	4.7	10.7	18" RCP
127	32.4	77.2	42" RCP
128	0.6	4.2	18" RCP
129	4.4	8.1	18" RCP
130	9.5	17.8	24" RCP
131	0.7	38.6	24" RCP
132	7.3	13.3	18" RCP
133	6.1	14.8	18" RCP
134	6.1	14.8	18" RCP
135	12.2	29.5	24" RCP
136	2.2	12.5	18" RCP
137	0.4	16.2	18" RCP
138	4.9	11.9	18" RCP
139	4.9	11.9	18" RCP
140	9.8	23.8	24" RCP

FOR REFERENCE ONLY
FROM THE SANDS FILING 1
MDDP

1" = 120'

0 60 120 240

Scale in Feet

THE SANDS

PROPOSED CONDITIONS DRAINAGE MAP

DATE: 12-15-17

SHEET 1 OF 1

PCDM-1

SCALE: HORIZONTAL: 1"=120' VERTICAL: N/A

PROJECT NO. 43-089

DESIGNED BY: DLM

DRAWN BY: JMP

CHECKED BY: VAS

20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF CIVIL CONSULTANTS, INC.

VIRGIL A. SANCHEZ, COLORADO P.E. NO. 37160

REVISIONS:

NO.	DATE:	BY:	DESCRIPTION:

APPD./D. BY: DATE:

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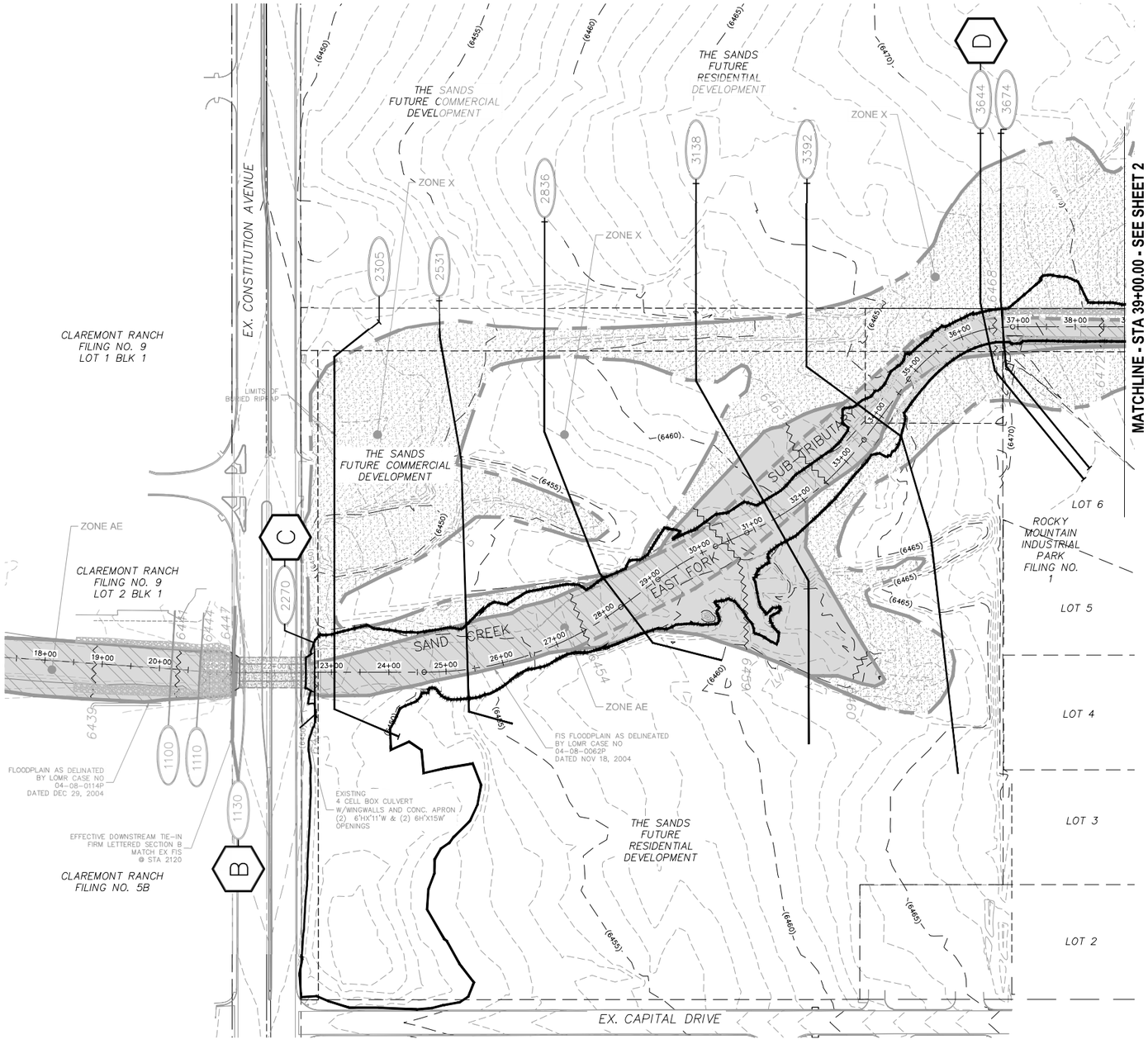
BACKGROUND INFORMATION



1" = 100'

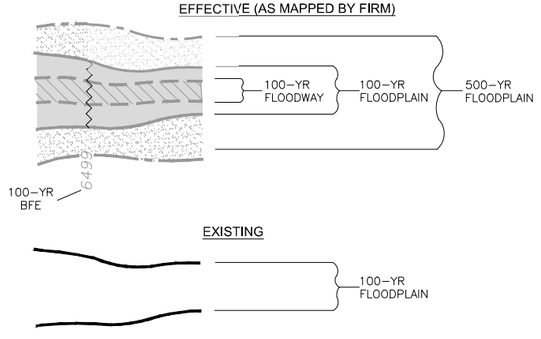
0 50 100 200

Scale in Feet

LEGEND

- 2.850 — HEC-2 CROSS-SECTION
- 2.850 — HEC-2 CROSS-SECTION (PREVIOUS STUDY)
- 114 — HEC-2 CROSS-SECTION (PREVIOUS STUDY)
- C — EFFECTIVE CROSS SECTION ID

EFFECTIVE (AS MAPPED BY FIRM)



EXISTING

NOTES :

1. CROSS-SECTIONS ORIENTED LEFT-TO-RIGHT FACING DOWNSTREAM.

2. TOPOGRAPHY COMPILED USING DATA FROM FIELD SURVEY PERFORMED IN MAY OF 2015 & AUGUST OF 2017. ELEVATIONS BASED ON THE NGVD OF 1929.

FROM REFERENCE ONLY
TAKEN FROM CLOMR SUBMITTAL
FEMA CASE NO. 18-08-0610R

THE SANDS SUBDIVISION CLOMR

EFSCST EXISTING CONDITIONS MAP

PROJECT NO. 43-089 | DESIGNED BY: N/A | DRAWN BY: DLM | CHECKED BY: VAS | SCALE: HORIZONTAL: 1"=100' VERTICAL: | DATE: 7/11/2018 | SHEET 1 OF 3 | EC1

20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF MJAS CIVIL CONSULTANTS, INC.

DARIN L. MOFFETT, COLORADO P.E. NO. 38923

REVISIONS: NO. | DATE: | BY: | DESCRIPTION:

APPVD. BY: | DATE:

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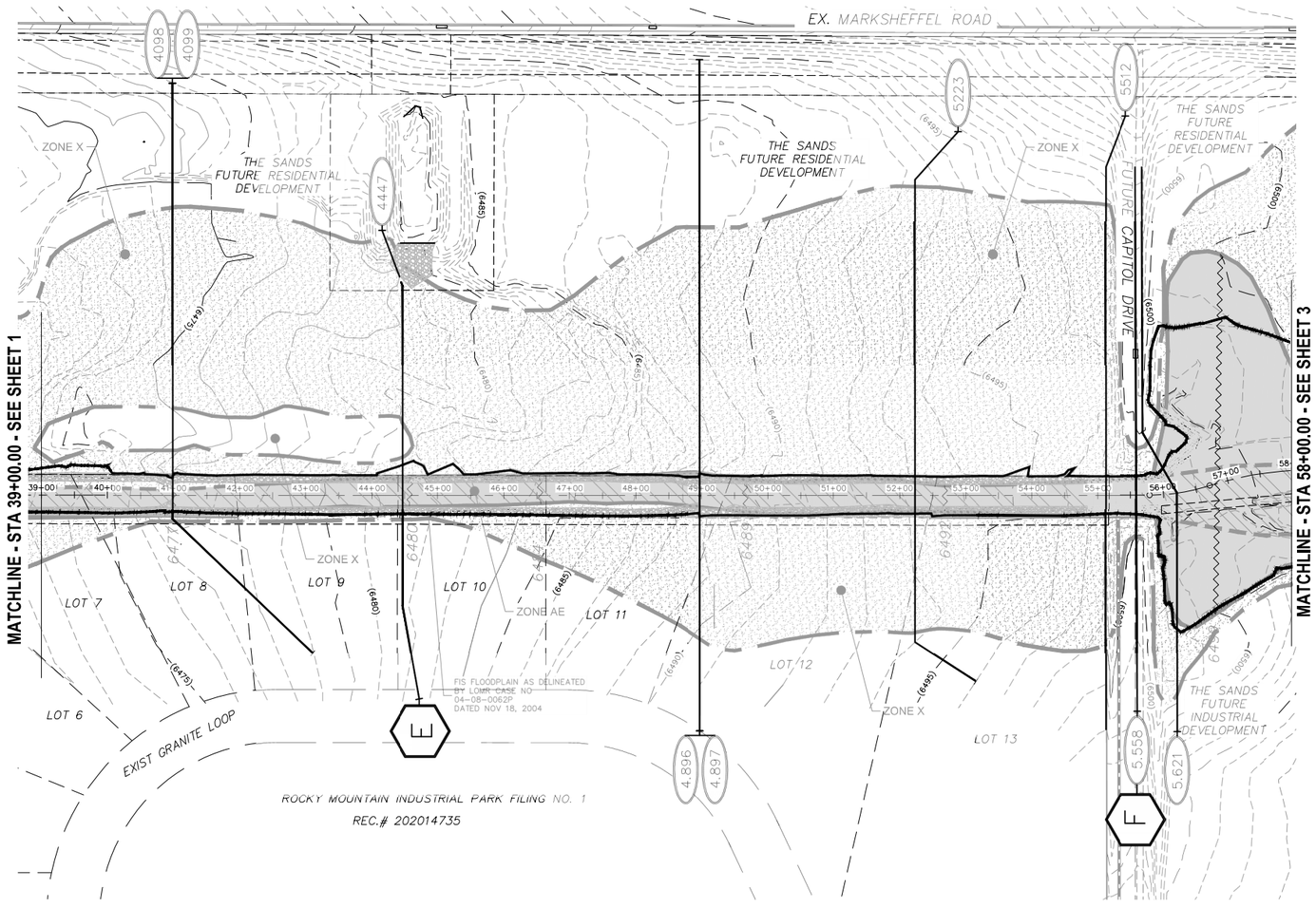


1" = 100'

0 50 100 200

Scale in Feet

LEGEND

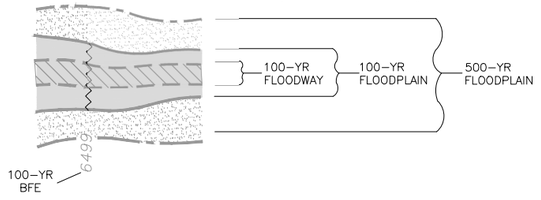
2.850 — HEC-2 CROSS-SECTION

2.850 — HEC-2 CROSS-SECTION (PREVIOUS STUDY)

114 — HEC-2 CROSS-SECTION (PREVIOUS STUDY)

C — EFFECTIVE CROSS SECTION ID

EFFECTIVE (AS MAPPED BY FIRM)



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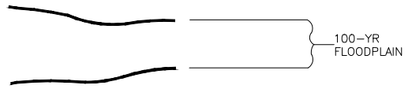


NOTES :

1. CROSS-SECTIONS ORIENTED LEFT-TO-RIGHT FACING DOWNSTREAM.

2. TOPOGRAPHY COMPILED USING DATA FROM FIELD SURVEY PERFORMED IN MAY OF 2015 & AUGUST OF 2017. ELEVATIONS BASED ON THE NGVD OF 1929.

FOR REFERENCE ONLY
FROM CLOMR SUBMITTAL
FEMA CASE NO. 18-08-0610R

THE SANDS SUBDIVISION CLOMR

EFSCST EXISTING CONDITIONS MAP

PROJECT NO. 43-089
DESIGNED BY: N/A
DRAWN BY: DLM
CHECKED BY: VAS
SCALE: HORIZONTAL: 1"=100' VERTICAL:
DATE: 7/11/2018
SHEET 2 OF 3
EC2

20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
CIVIL CONSULTANTS, INC.

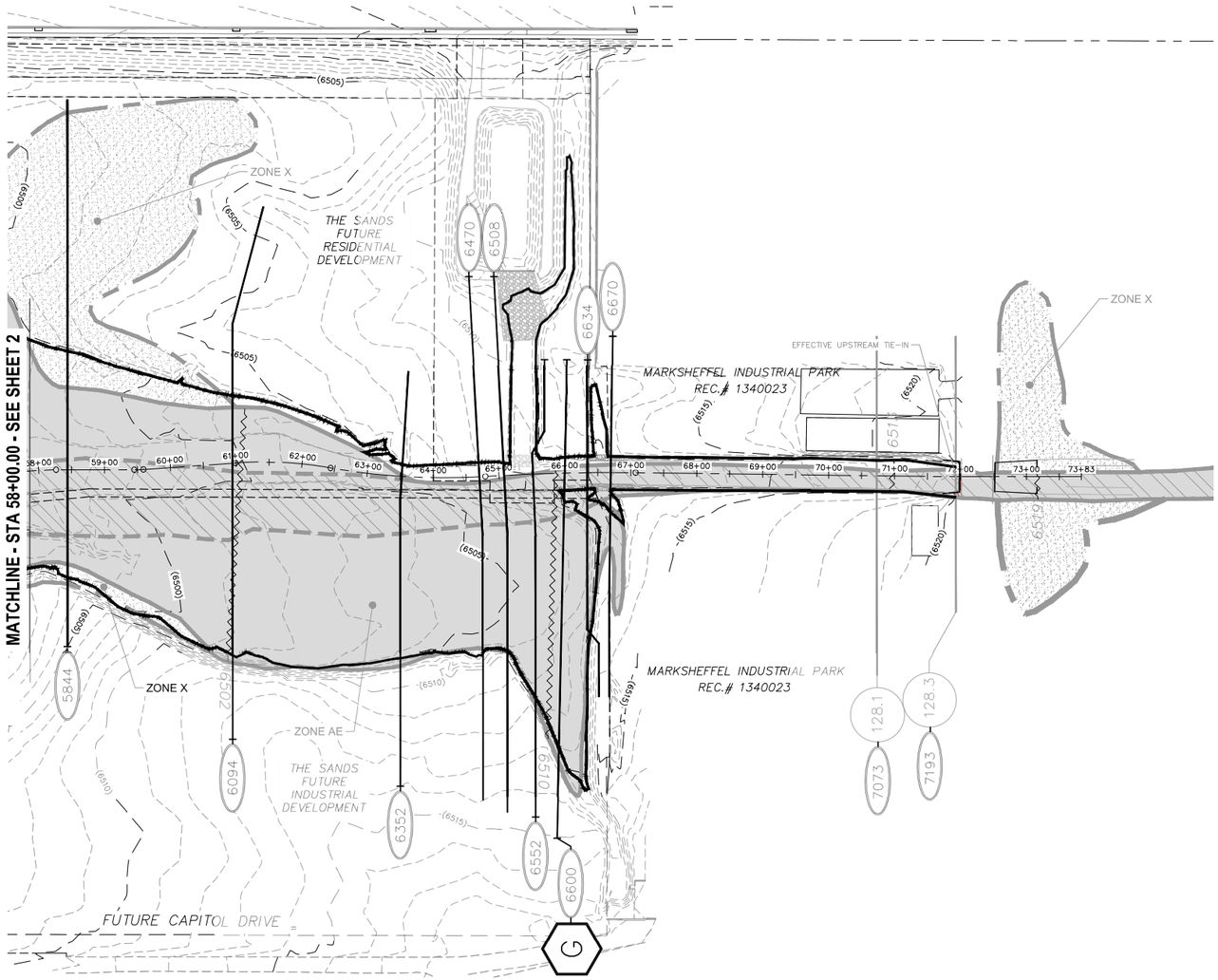
FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.

DARIN L. MOFFETT, COLORADO P.E. NO. 38923

REVISIONS:
NO. | DATE: | BY: | DESCRIPTION:

APPD. BY: | DATE:

Plot: C:\43089A\MS Rds-Const Ave\dwg\Eng Exhibits\EFTSC ExistMapMap-7-25-2018.dwg Plotstamp: 8/8/2018 9:08 PM



1" = 100'

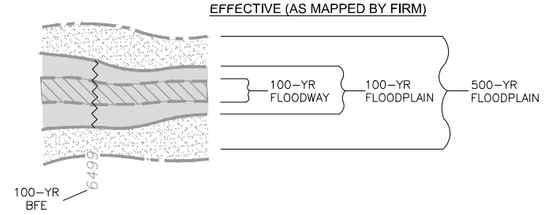
0 50 100 200

Scale in Feet

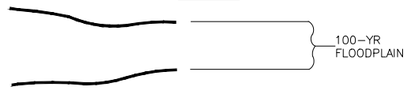
LEGEND

- 2.850 — HEC-2 CROSS-SECTION
- 2.850 — HEC-2 CROSS-SECTION (PREVIOUS STUDY)
- 114 — HEC-2 CROSS-SECTION (PREVIOUS STUDY)
- C — EFFECTIVE CROSS SECTION ID

EFFECTIVE (AS MAPPED BY FIRM)



EXISTING



NOTES :

1. CROSS-SECTIONS ORIENTED LEFT-TO-RIGHT FACING DOWNSTREAM.

2. TOPOGRAPHY COMPILED USING DATA FROM FIELD SURVEY PERFORMED IN MAY OF 2015 & AUGUST OF 2017. ELEVATIONS BASED ON THE NGVD OF 1929.

FOR REFERENCE ONLY
FROM CLOMR SUBMITTAL
FEMA CASE NO. 18-08-0610R

THE SANDS SUBDIVISION CLOMR

EFSCST EXISTING CONDITIONS MAP

PROJECT NO. 43-089 | SCALE: HORIZONTAL: 1"=100' VERTICAL: | DATE: 7/11/2018 | SHEET 3 OF 3 | EC3

DESIGNED BY: N/A
DRAWN BY: DLM
CHECKED BY: VAS

20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.

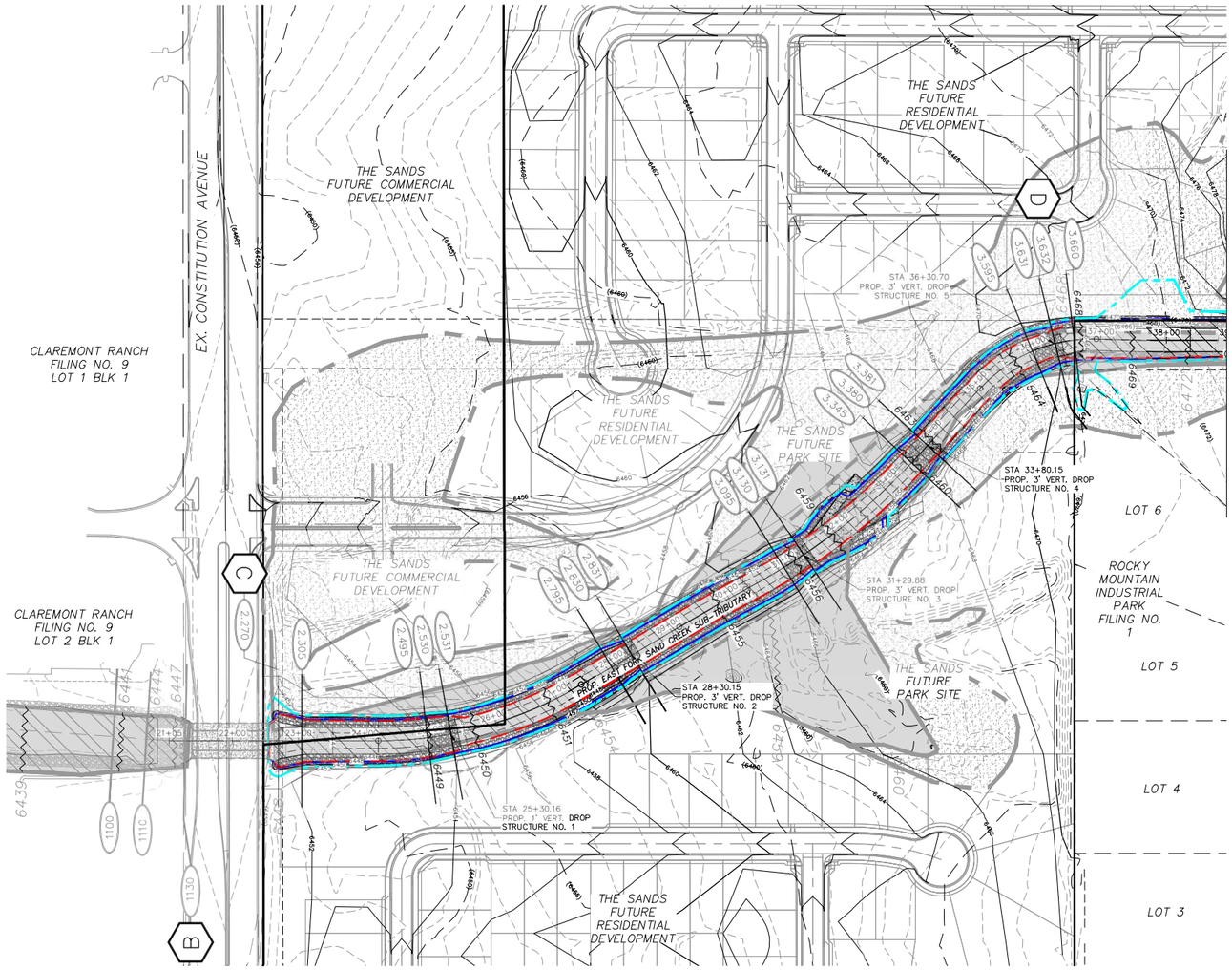
DARIN L. MOFFETT, COLORADO P.E. NO. 38923

REVISIONS:

NO.	DATE:	BY:	DESCRIPTION:	APPVD. BY:	DATE:

THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE, OR LIABLE FOR, UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE PREPARER OF THESE PLANS.

CAUTION



1" = 100'

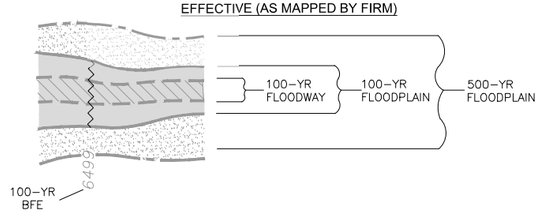
0 50 100 200

Scale in Feet

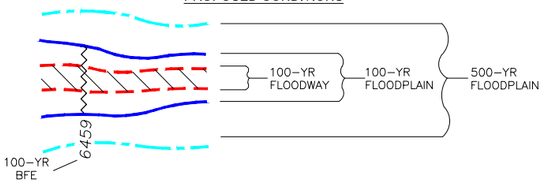
LEGEND

- PROPOSED CONDITION HEC-RAS CROSS-SECTION
- HEC RAS OR HEC-2 CROSS-SECTION (PREVIOUS STUDY)
- HEC-2 CROSS-SECTION (PREVIOUS STUDY)
- EFFECTIVE CROSS SECTION ID

EFFECTIVE (AS MAPPED BY FIRM)



PROPOSED CONDITIONS



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LEGEND

- 500-YEAR FLOOD
- 100-YEAR FLOOD
- 50-YEAR FLOOD
- 10-YEAR FLOOD
- INVERT

FOR REFERENCE ONLY
FROM CLOMR SUBMITTAL
FEMA CASE NO. 18-08-0610R

THE SANDS SUBDIVISION CLOMR

EFSCST PROPOSED CONDITIONS MAP

PROJECT NO. 43-089 | SCALE: HORIZONTAL: 1"=100' VERTICAL: 1"=10' | DATE: 7/11/2018 | SHEET 1 OF 3 | PC1

DESIGNED BY: N/A
DRAWN BY: DLM
CHECKED BY: VAS

20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.

DARIN L. MOFFETT, COLORADO P.E. NO. 38923

REVISIONS: NO. | DATE | BY | DESCRIPTION:

APPR'D. BY: | DATE:

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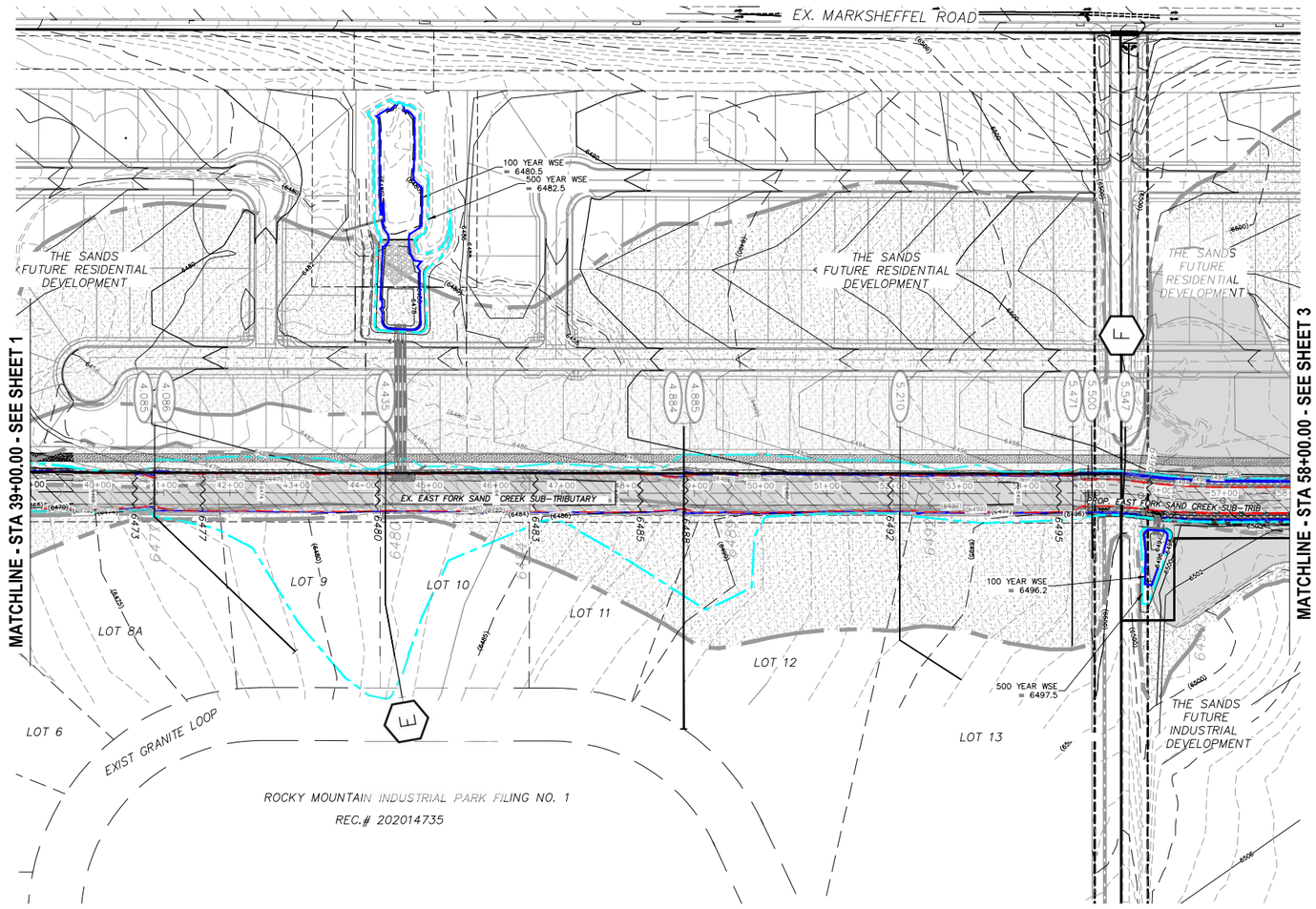

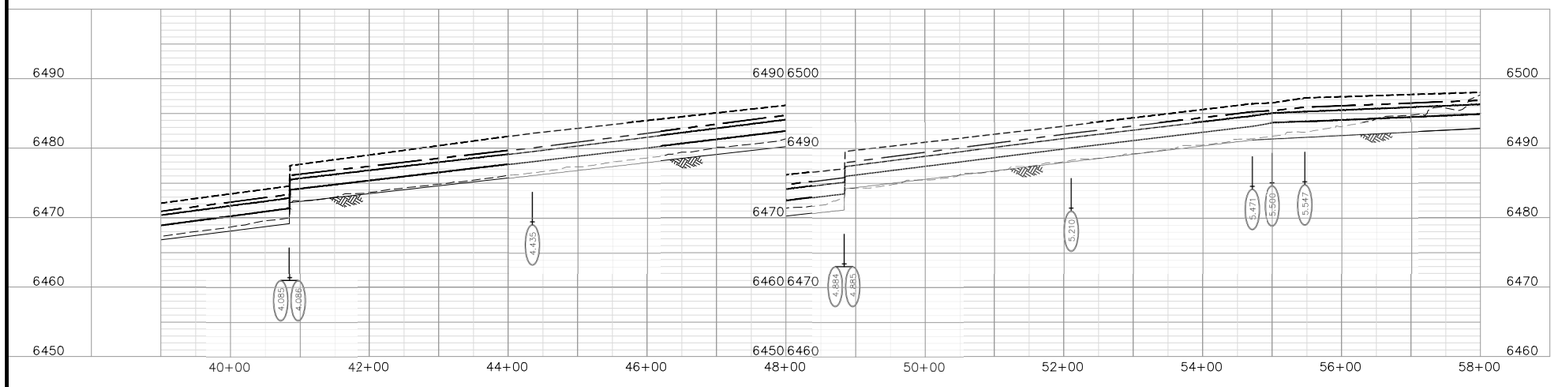

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Scale in Feet

LEGEND

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- 2.850 — HEC RAS OR HEC-2 CROSS-SECTION (PREVIOUS STUDY)
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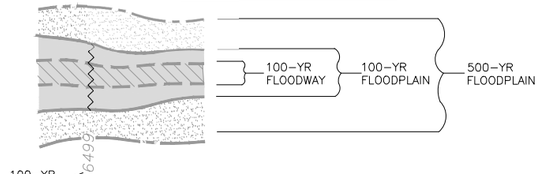
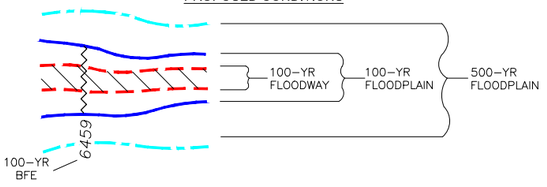


PROPOSED CONDITIONS



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- 100-YEAR FLOOD
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- 10-YEAR FLOOD
- INVERT

FOR REFERENCE ONLY
FROM CLOMR SUBMITTAL
FEMA CASE NO. 18-08-0610R

THE SANDS SUBDIVISION CLOMR

EFSCST PROPOSED CONDITIONS MAP

PROJECT NO. 43-089 | SCALE: HORIZONTAL: 1"=100' VERTICAL: 1"=10' | DATE: 7/11/2018 | SHEET 2 OF 3 | PC2

DESIGNED BY: N/A
DRAWN BY: DLM
CHECKED BY: VAS

20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.

DARIN L. MOFFETT, COLORADO P.E. NO. 38923

REVISIONS:

NO.	DATE:	BY:	DESCRIPTION:

APPVD. BY: DATE:

File: Q:\43089A\MS Rd-Const Ave\dwg\Eng Exhibits\PropWkMap-7-25-2018.dwg Plotstamp: 8/14/2018 11:06 AM

THE SANDS FILING NO. 1

CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO

CHANNEL IMPROVEMENT PLANS

DECEMBER 2018

AGENCIES

OWNER/DEVELOPER:	LANDHUIS COMPANY 212 N. WAHSATCH AVE, SUITE 301 COLORADO SPRINGS, CO 80903 JEFF MARK (719) 635-3200
CIVIL ENGINEER:	M & S CIVIL CONSULTANTS, INC. 20 BOULDER CRESCENT, SUITE 110 COLORADO SPRINGS, CO 80903 VIRGIL A. SANCHEZ P.E. (719) 955-5485
ENGINEERING DIVISION:	CITY OF COLORADO SPRINGS 30 S. NEVADA AVE., SUITE 401 COLORADO SPRINGS, CO 80903 ERIN POWERS, P.E. (719) 385-5852
TRAFFIC ENGINEERING:	CITY OF COLORADO SPRINGS 30 S. NEVADA AVE., SUITE 401 COLORADO SPRINGS, CO 80903 KATHLEEN KRAGER, P.E. (719) 385-7628
DEVELOPMENT SERVICES:	COLORADO SPRINGS UTILITIES 1521 HANCOCK EXPRESSWAY COLORADO SPRINGS, CO 80903 MIKE GACKLE, P.E. (719) 668-8262
CSU GAS DEPARTMENT:	COLORADO SPRINGS UTILITIES 7710 DURANT DR. COLORADO SPRINGS, CO 80947 TIM WENDT (719) 668-3556
CSU ELECTRIC DEPARTMENT:	COLORADO SPRINGS UTILITIES 7710 DURANT DR. COLORADO SPRINGS, CO 80920 SARAH LABARRE (719) 668-4933
ELECTRIC DEPARTMENT:	MOUNTAIN VIEW ELECTRIC 11140 E. WOODMEN ROAD FALCON, CO 80831 (719) 495-2283
CHEROKEE WATER & WASTEWATER:	CHEROKEE METROPOLITAN DISTRICT 6250 PALMER PARK BOULEVARD COLORADO SPRINGS, CO 80915 (719) 597-5080
FIRE DISTRICT:	FALCON FIRE PROTECTION DISTRICT 2710 CAPITAL DRIVE COLORADO SPRINGS, CO 80939 CHIEF T. HARWIG (719) 495-4050
COMMUNICATIONS:	CENTURY LINK COMMUNICATIONS (U.N.C.C LOCATORS) (800) 922-1987 AT&T (LOCATORS) (719) 635-3674

TIMING: THE SANDS FILING NO. 1 – CHANNEL IMPROVEMENTS

FEBRUARY 2019
ANTICIPATED STARTING AND COMPLETION TIME PERIOD OF SITE GRADING:

DECEMBER 2020
EXPECTED DATE ON WHICH THE FINAL STABILIZATION WILL BE COMPLETED:

AREAS: THE SANDS FILING NO. 1 – CHANNEL IMPROVEMENTS

ALL DISTURBANCE AREAS ASSOCIATED WITH CHANNEL IMPROVEMENTS ACCOUNTED FOR ON THE SANDS FILING NO.1 AMENDED EARLY GRADING, EROSION AND STORMWATER QUALITY PLANS BY M&S CIVIL, APPROVED 12-18-2018
TOTAL AREA OF THE SITE TO BE CLEARED, EXCAVATED OR GRADED:

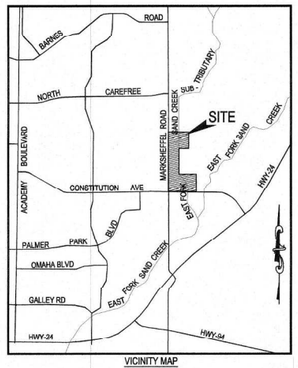
SOIL TYPES:

BLAKELAND LOAMY SAND (6), BLENDON SANDY LOAM (10), AND ELLICOTT LOAMY COURSE SAND (28). HYDROLOGIC SOIL TYPES "A" & "B"

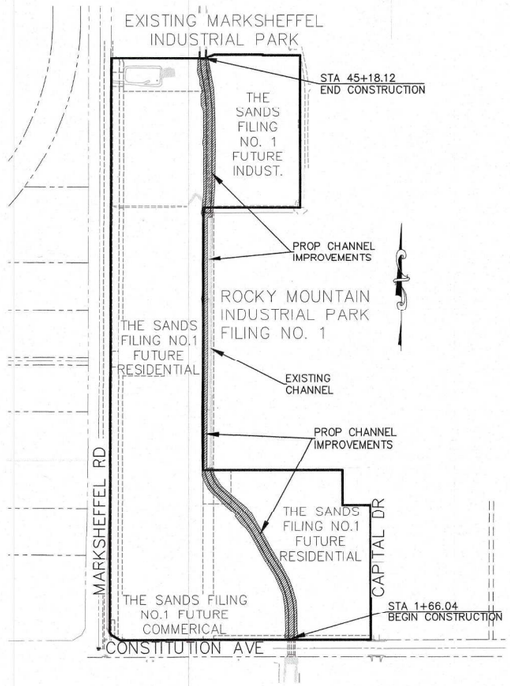
RECEIVING WATERS: SAND CREEK VIA EAST FORK SAND CREEK SUBTRIBUTARY

SHEET INDEX

SHEET 1 TITLE SHEET
SHEET 2 GENERAL NOTES AND DETAILS
SHEET 3 SURVEY CONTROL DIAGRAM
SHEET 4 DEMOLITION PLAN
SHEET 5 GEOTECHNICAL BORING LOG
SHEET 6 GEOTECHNICAL BORING LOC
SHEET 7 PLAN & PROFILE STA 1+66.04 TO STA 15+50.00
SHEET 8 PLAN & PROFILE STA 15+50.00 TO STA 25+00.00
SHEET 9 PLAN & PROFILE STA 25+00.00 TO STA 33+00.00
SHEET 10 PLAN & PROFILE STA 33+00.00 TO STA 45+15.92
SHEET 11 LOWER SEGMENT CHANNEL TRANSITION
SHEET 12 UPPER SEGMENT CHANNEL TRANSITION & POND #5 OUTFALL
SHEET 13 UPPER SEGMENT CHANNEL TRANSITION & GSB DROP STRUCTURE
SHEET 14 TYPICAL CHANNEL CROSS SECTION DETAILS
SHEET 15 CHECK STRUCTURE DETAILS
SHEET 16 DROP STRUCTURE DETAILS
SHEET 17 EXISTING 42" RCP OUTFALL DETAIL
SHEET 18 DUAL AND TRIPLE 36" RCP OUTFALL DETAILS
SHEET 19 GROUTED BOULDER DROP STRUCTURE DETAILS
SHEET 20 CONCRETE TO RIPRAP TRANSITIONS DETAILS
SHEET 21 CHANNEL CROSS SECTIONS
SHEET 22 CHANNEL CROSS SECTIONS



VICINITY MAP
N.T.S.



SITE MAP
N.T.S.

PROJECT DATUM

VERTICAL – NATIONAL GEODETIC VERTICAL DATUM 1929 (NGVD29)
HORIZONTAL – NORTH AMERICAN DATUM 1983 (NAD83) (TRUNCATED)
CONTROL – COLORADO STATE PLANE CENTRAL ZONE

BENCHMARK:

1. FIMS MONUMENT BLT104, THE TOP OF A 2" ALUMINUM CAP IN NORTHEAST TOP OF HEADWALL OF BOX CULVERT AT FIRST CREEK CROSSING UNDER CONSTITUTION AVENUE EAST OF MARKSHEFFEL ROAD.
   ELEVATION = 6452.43'
2. A NUMBER 5 REBAR AT THE NORTHWEST CORNER OF THE SUBJECT PROPERTY.
   ELEVATION = 6519.48'

LEGEND

PROPOSED SANITARY SEWER
CENTERLINE
FENCE
EXISTING SANITARY SEWER
EXISTING GAS
EXISTING ELECTRIC (UG OR OH)
EXISTING TELEPHONE
EXISTING TELEVISION
EXISTING FIBER OPTIC
EXISTING WATER
RIGHT-OF-WAY
PROPERTY LINE
FIRE HYDRANT (EXISTING)

EXISTING STORM DRAIN
STORM DRAIN
EXISTING RIPRAP
PROPOSED CONCRETE
PROPOSED MAINTENANCE/ACCESS TRAIL
PROPOSED SOIL RIPRAP
PROPOSED GROUTED BOULDERS
PROPOSED GROUTED RIPRAP

APPROVALS:

ENGINEER'S STATEMENT:

DETAILED DRAINAGE CONSTRUCTION PLANS AND SPECIFICATIONS ENGINEER'S STATEMENT:
THESE DETAILED PLANS AND SPECIFICATIONS WERE PREPARED UNDER MY DIRECTION AND SUPERVISION. SAID DETAILED PLANS AND SPECIFICATIONS HAVE BEEN PREPARED ACCORDING TO THE ESTABLISHED CRITERIA FOR DETAILED DRAINAGE PLANS AND SPECIFICATIONS, AND SAID DETAILED PLANS AND SPECIFICATIONS ARE IN CONFORMITY WITH THE MASTER PLAN OF THE DRAINAGE BASIN. SAID DETAILED DRAINAGE PLANS AND SPECIFICATIONS MEET THE PURPOSES FOR WHICH THE PARTICULAR DRAINAGE FACILITY(S) IS DESIGNED. I ACCEPT RESPONSIBILITY FOR ANY LIABILITY CAUSED BY ANY NEGLIGENT ACTS, ERRORS OR OMISSIONS ON MY PART IN PREPARATION OF THE DETAILED DRAINAGE PLANS AND SPECIFICATIONS.

COLORADO REGISTERED VIRGIL A. SANCHEZ 37160 PROFESSIONAL ENGINEER

VIRGIL A SANCHEZ, COLORADO P.E. NO. 37160
FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.

2/12/19
DATE

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

FOR THE CITY ENGINEER

2/13/19
DATE

CONDITIONS: APPROVAL ONLY APPLIES TO WORK PROPOSED WITHIN THE CITY LIMITS.

OWNER/DEVELOPER STATEMENT:

THE OWNER/DEVELOPER WILL COMPLY WITH THE REQUIREMENTS OF THE EROSION CONTROL AND STORMWATER QUALITY CONTROL PLAN INCLUDING TEMPORARY BMP INSPECTION REQUIREMENTS AND FINAL STABILIZATION REQUIREMENTS. I ACKNOWLEDGE THE RESPONSIBILITY TO DETERMINE WHETHER THE CONSTRUCTION ACTIVITIES ON THESE PLANS REQUIRE COLORADO DISCHARGE PERMIT SYSTEM (CDPS) PERMITTING FOR STORMWATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITIES.

S. Alan Vanel

~~JEFF MARK,~~ LANDHUIS COMPANY S. Alan Vanel
~~PRESIDENT~~ Secretary, Treasurer

2-12-2019
DATE

EL PASO COUNTY:

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 AND ENGINEERING CRITERIA MANUAL AS AMENDED.

JENNIFER IRVINE, P.E.
COUNTY ENGINEER/ECM ADMINISTRATOR

DATE

CONDITIONS: APPROVAL ONLY APPLIES TO WORK PROPOSED WITHIN EL PASO COUNTY LIMITS.

FOR REFERENCE ONLY
(UNDER CONSTRUCTION)
COMPLETION DATE MID NOV-2019

FOR LOCATING & MARKING GAS, ELECTRIC, WATER & TELEPHONE LINES
FOR BURIED UTILITY INFORMATION
48 HRS BEFORE YOU DIG
CALL 1-800-922-1987

THE SANDS FILING NO. 1
CHANNEL IMPROVEMENT PLANS
DATE: 11/19/2018
SHEET 1 OF 22
CH01
PROJECT NO. 43-089
SCALE: HORIZONTAL: N/A VERTICAL: N/A
DESIGNED BY: DLM
DRAWN BY: DLM
CHECKED BY: VAS

20 BOULDER CRESCENT SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.
VIRGIL A. SANCHEZ, COLORADO P.E. NO. 37160
COLORADO REGISTERED VIRGIL A. SANCHEZ 37160 PROFESSIONAL ENGINEER

REVISIONS:

NO.	DATE:	BY:	DESCRIPTION:	APPRV'D. BY:	DATE:

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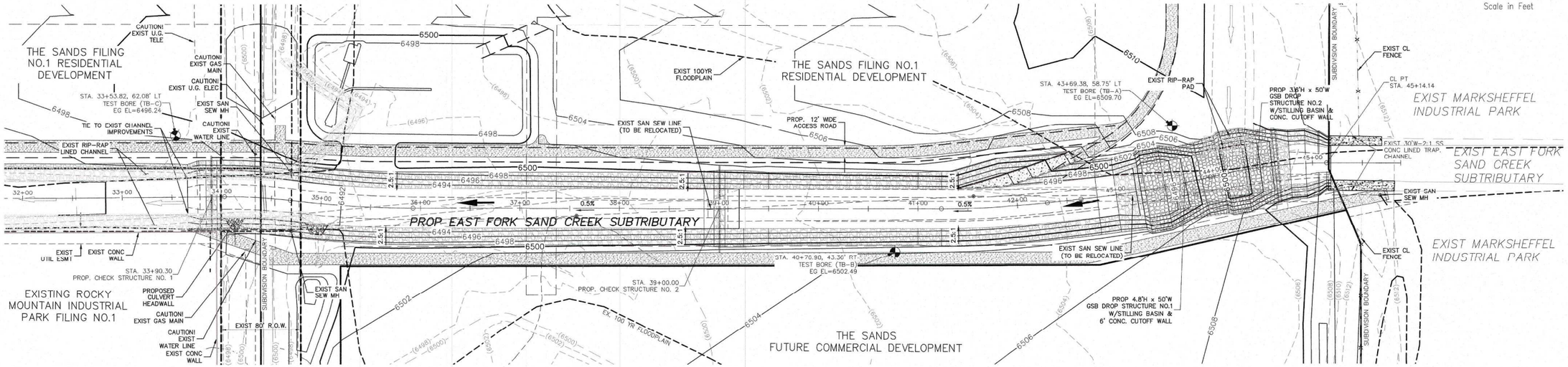
CAUTION

File: O:\430893\MS Rd-Const Awd\dwg\Const Dwg\Channel\CH01.dwg Plotstamp: 2/11/2019 10:45 AM



GEOTECHNICAL BORING LOGS - EAST FORK SUBTRIBUTARY CHANNEL
STA 33+00.00 TO STA 46+00.00

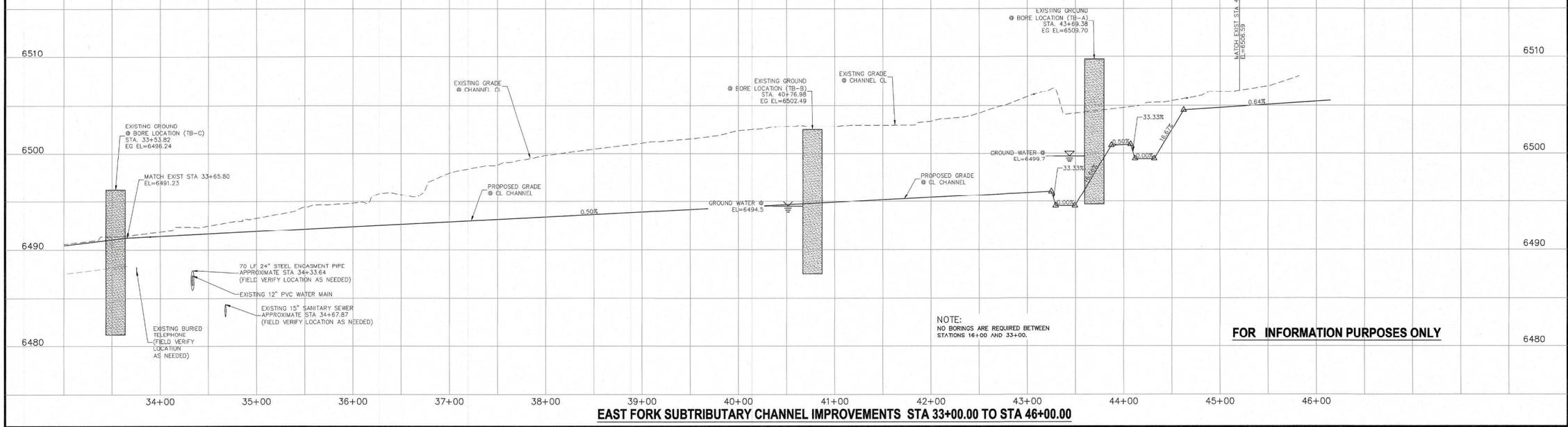
TEST BORE (TB) LOCATION
EXISTING GROUND ELEVATION (EG EL)

SAND (SP-SC, SC, SC-GC)

SAND, SILTY (SW-SM, SM)

SHALE BEDROCK

CLAYSTONE



NOTE:
NO BORINGS ARE REQUIRED BETWEEN STATIONS 16+00 AND 33+00.

FOR INFORMATION PURPOSES ONLY

EAST FORK SUBTRIBUTARY CHANNEL IMPROVEMENTS STA 33+00.00 TO STA 46+00.00

STATEMENT:

THE CITY OF COLORADO SPRINGS RECOGNIZES THE DESIGN ENGINEER AS HAVING RESPONSIBILITY FOR THE DESIGN; THE CITY HAS LIMITED ITS SCOPE OF REVIEW ACCORDINGLY. RESUBMITTAL REQUIRED IF CONSTRUCTION HAS NOT COMMENCED WITHIN 180 DAYS AFTER APPROVAL DATE.

FOR LOCATING & MARKING GAS, ELECTRIC, WATER & TELEPHONE LINES
FOR BURIED UTILITY INFORMATION
48 HRS BEFORE YOU DIG
CALL 1-800-922-1987

FOR REFERENCE ONLY
(UNDER CONSTRUCTION)
COMPLETION DATE MID NOV-2019

DRAINAGE DESIGN:

FILED IN ACCORDANCE WITH SECTION 7-7-906 (DRAINAGE ORDINANCE) OF THE CODE OF THE CITY OF COLORADO SPRINGS 2001, AS AMENDED.

FOR THE CITY ENGINEER:

DRAINAGE REVIEW: _____ DATE: 2/13/19

THE SANDS FILING NO. 1
GEOTECHNICAL BORING LOGS

PROJECT NO. 43-089
DESIGNED BY: DLM
DRAWN BY: DLM
CHECKED BY: VAS
SCALE: HORIZONTAL: 1"=50' VERTICAL: 1"=5
DATE: 11/19/2018
SHEET 6 OF 22
CH06

20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.
VIRGIL A. SANCHEZ, COLORADO P.E. NO. 37160

REVISIONS:
NO. | DATE: | BY: | DESCRIPTION: | APPR'D BY | DATE:

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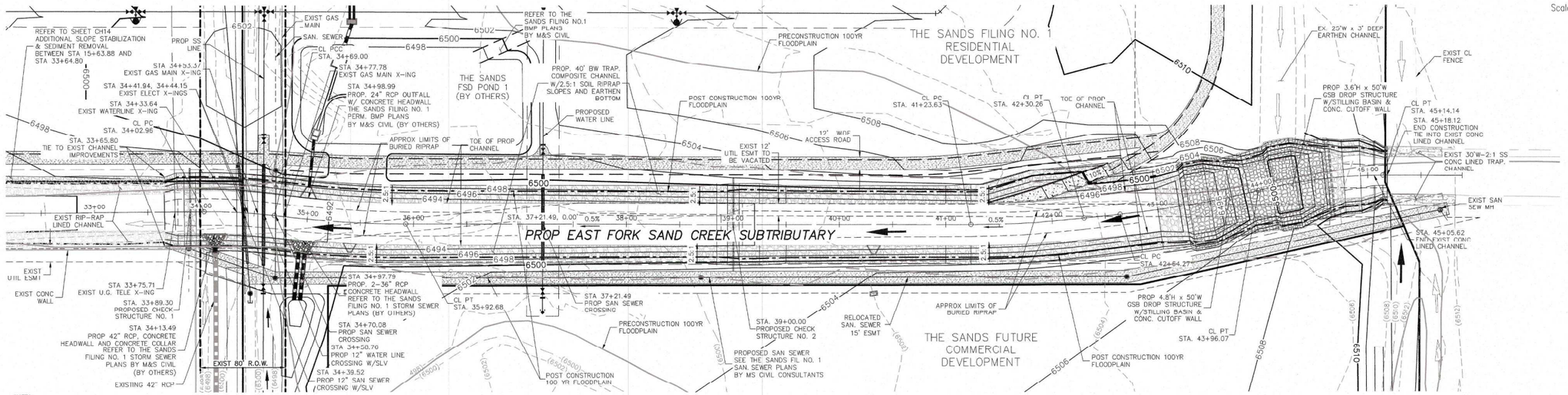
CAUTION

File: C:\43089A\MS Rd-Corat Ave\dwg\Const Dwg\Channel\CH06.dwg Plotstamp: 2/8/2019 9:47 AM



NOTES:
REFER TO SHEET CH14 FOR TYPICAL CHANNEL CROSS SECTION

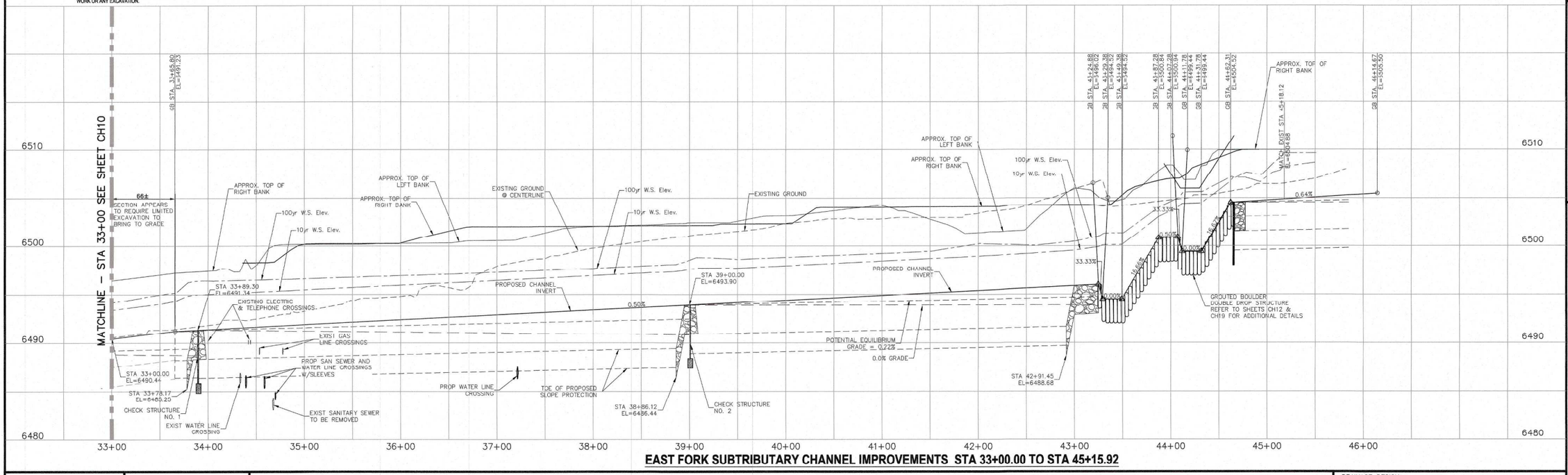
PROPOSED GRADING SHOWN ON PLANS PERFORMED AS PART OF THE SANDS FILING NO.1 AMENDED EARLY GRADING, EROSION AND STORMWATER QUALITY CONTROL PLANS BY M&S CIVIL, APPROVED 12-18-18

REFER TO SHEET CH14 FOR TYPICAL RIPRAP SECTION. SEE SHEET CH15 FOR CHECK STRUCTURE DETAILS AND SHEET CH13 FOR GROUTED BOULDER DROP STRUCTURE DETAILS

UTILITY LOCATIONS PROVIDED ON THE PLAN ARE APPROXIMATE AND ARE BASED UPON THE BEST AVAILABLE INFORMATION , IT IS THE CONTRACTORS RESPONSIBILITY TO LOCATE ALL UTILITIES PRIOR TO STARTING THE WORK OR ANY EXCAVATION.

NOTE:
SPECIAL CARE SHOULD BE TAKEN WHEN EXCAVATING AND PLACING MATERIALS ADJACENT TO PROPOSED 12" SANITARY SEWER LINE AND 12" WATERLINES AND OTHER EXISTING UTILITIES LOCATED NEAR THE GENOA RD. CORRIDOR. REFER TO THE SANDS FILING NO.1 , SANITARY SEWER PLANS, CHEROKEE 12" SANITARY SEWER RELOCATION PLANS, AND THE SANDS FILING NO. 1 - 8" 12" AND 24" WATER PLANS, BY M&S CIVIL.

EAST FORK SUBTRIBUTARY CHANNEL IMPROVEMENTS
STA 33+00.00 TO STA 45+18.12



EAST FORK SUBTRIBUTARY CHANNEL IMPROVEMENTS STA 33+00.00 TO STA 45+15.92

STATEMENT:
THE CITY OF COLORADO SPRINGS RECOGNIZES THE DESIGN ENGINEER AS HAVING RESPONSIBILITY FOR THE DESIGN. THE CITY HAS LIMITED ITS SCOPE OF REVIEW ACCORDINGLY. RESUBMITTAL REQUIRED IF CONSTRUCTION HAS NOT COMMENCED WITHIN 180 DAYS AFTER APPROVAL DATE.

FOR LOCATING & MARKING GAS, ELECTRIC, WATER & TELEPHONE LINES
FOR BURIED UTILITY INFORMATION
48 HRS BEFORE YOU DIG
CALL 1-800-922-1987

FOR REFERENCE ONLY
(UNDER CONSTRUCTION)
COMPLETION DATE MID NOV-2019

DRAINAGE DESIGN:
FILED IN ACCORDANCE WITH SECTION 7-7-906 (DRAINAGE ORDINANCE) OF THE CODE OF THE CITY OF COLORADO SPRINGS 2001, AS AMENDED.

FOR THE CITY ENGINEER:

DRAINAGE REVIEW: _____ DATE: 7/13/19

REVISIONS:

NO.	DATE:	BY:	DESCRIPTION:	APPVD. BY:	DATE:

THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE, OR LIABLE FOR, UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE PREPARER OF THESE PLANS.

CAUTION

THE SANDS FILING NO. 1
CHANNEL PLAN & PROFILE

PROJECT NO. 43-089	DATE: 11/19/2018
DESIGNED BY: DLM	SCALE: HORIZONTAL: 1"=50'
DRAWN BY: DLM	VERTICAL: 1"=5'
CHECKED BY: VAS	SHEET 10 OF 22
	CH10

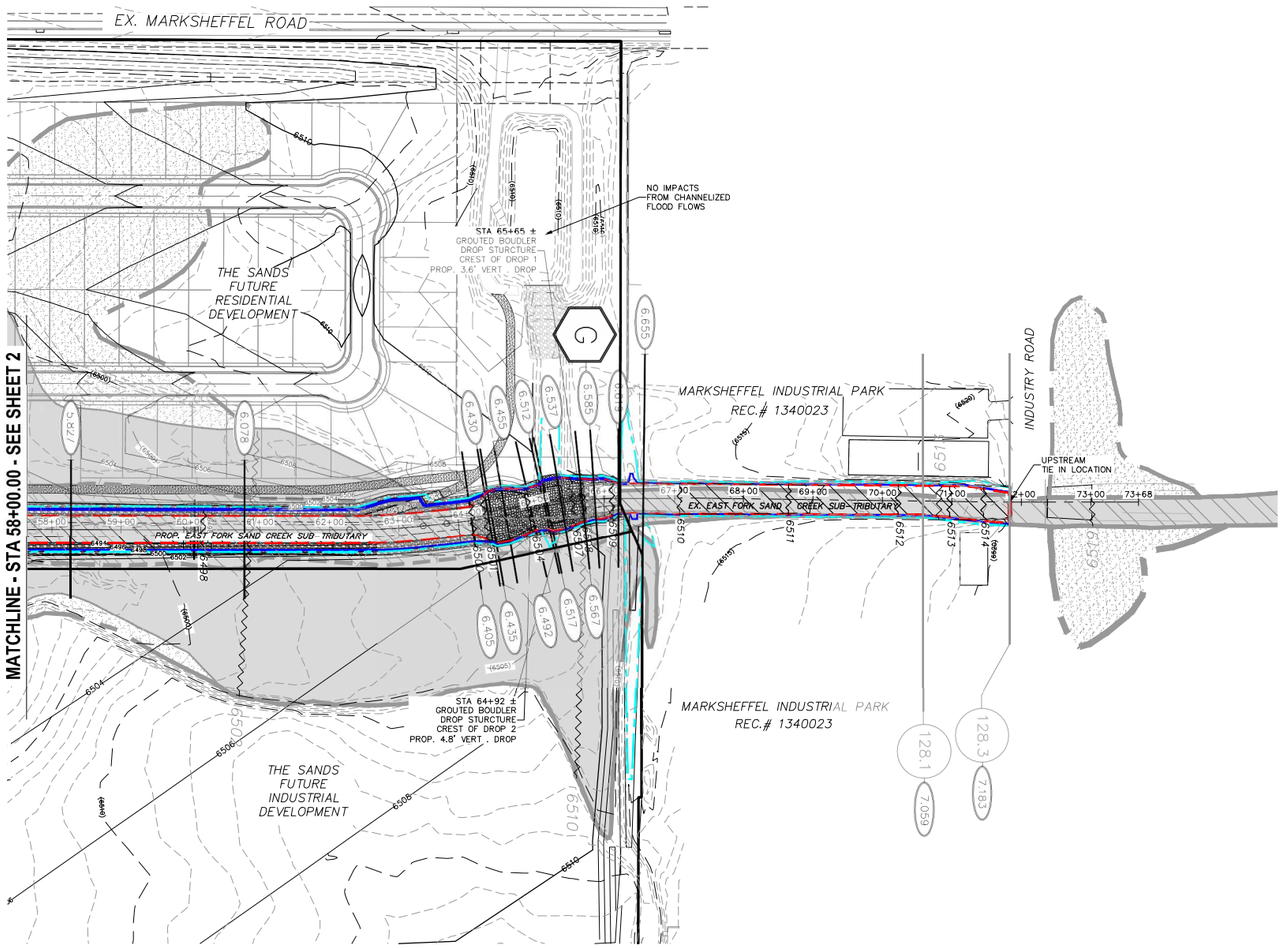
20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
CIVIL CONSULTANTS, INC.

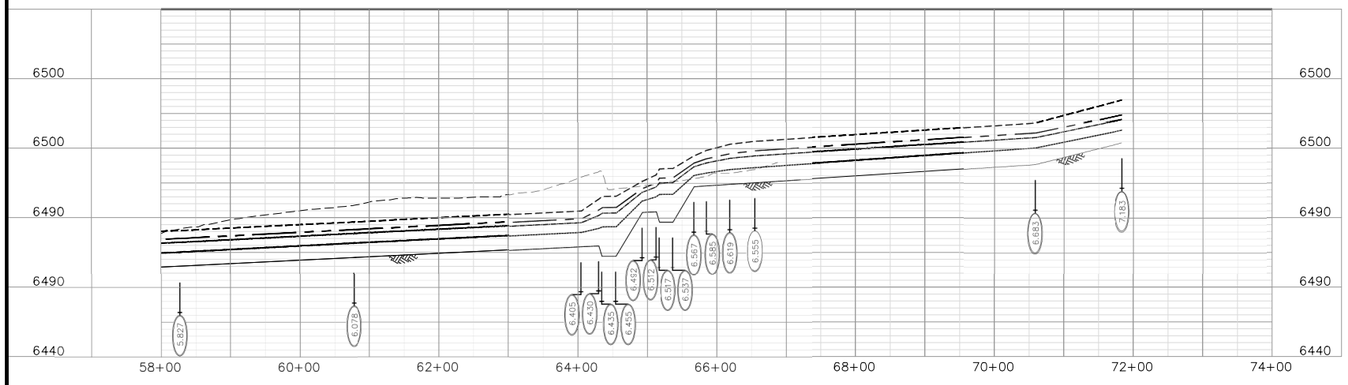
FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.

VIRGIL A. SANCHEZ, COLORADO P.E. NO. 37160

REGISTERED PROFESSIONAL ENGINEER VIRGIL A. SANCHEZ 37160 STATE OF COLORADO

File: O:\43089A\MS Rd-Const Ave\Eng\Const Dwg\Channel\CH10A.dwg Plotstamp: 2/8/2019 10:31 AM





1" = 100'

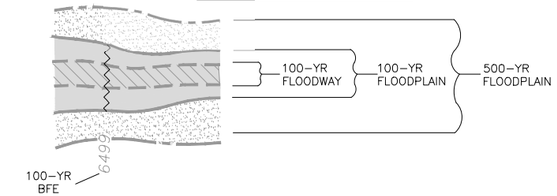
0 50 100 200

Scale in Feet

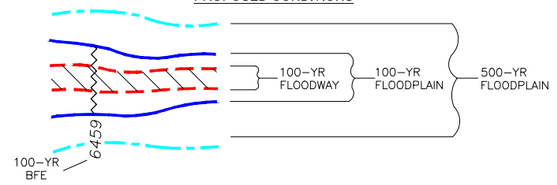
LEGEND

- 2.850 — PROPOSED CONDITION HEC-RAS CROSS-SECTION
- 2.850 — HEC RAS OR HEC-2 CROSS-SECTION (PREVIOUS STUDY)
- 114 — HEC-2 CROSS-SECTION (PREVIOUS STUDY)
- C — EFFECTIVE CROSS SECTION ID

EFFECTIVE (AS MAPPED BY FIRM)



PROPOSED CONDITIONS



NOTES :

1. CROSS-SECTIONS ORIENTED LEFT-TO-RIGHT FACING DOWNSTREAM.

2. TOPOGRAPHY COMPILED USING DATA FROM FIELD SURVEY PERFORMED IN MAY OF 2015 & AUGUST OF 2017. ELEVATIONS BASED ON THE NGVD OF 1929.

LEGEND

- 500-YEAR FLOOD
- 100-YEAR FLOOD
- 50-YEAR FLOOD
- 10-YEAR FLOOD
- INVERT

FOR REFERENCE ONLY
FROM CLOMR SUBMITTAL
FEMA CASE NO. 18-08-0610R

THE SANDS SUBDIVISION CLOMR

EFSCST PROPOSED CONDITIONS MAP

PROJECT NO. 43-089 | DESIGNED BY: N/A | DRAWN BY: DLM | CHECKED BY: VAS | SCALE: HORIZONTAL: 1"=100' VERTICAL: 1"=10' | DATE: 7/11/2018 | SHEET 3 OF 3 | PC3

20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.

DARYN L. MOFFETT, COLORADO P.E. NO. 38923

REVISIONS:

NO.:	DATE:	BY:	DESCRIPTION:	APPR'D. BY:	DATE:

THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE, OR LIABLE FOR, UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE PREPARER OF THESE PLANS.

CAUTION

File: O:\43089A\MS Rd-Const Ave\dwg\Eng Exhibits\ProjWkMap-7-25-2018.dwg Plotstamp: 8/14/2018 11:09 AM

MARKSHEFFEL INDUSTRIAL PARK

CHANNEL / CROSSING IMPROVEMENTS

GENERAL NOTES

1. There will be a pre-construction meeting with El Paso County Department of Transportation personnel prior to commencement of any work.

2. Start & end lengths are approximate and are intended for bid purposes.

3. A minimum of 12 inches of cover will be required over all storm sewer pipe.

4. Storm sewer pipe over 18 inches in diameter will have cover in accordance with manufacturer's specifications or with AASHTO specifications.

5. Additional drainage structure may be required at time of construction.

6. Additional ditch checks may be required to protect pipe end from siltation and scour and ditches. Shall be reviewed.

7. The location of existing utilities has been plotted from available information. It is the contractors responsibility to field verify the location of all utilities prior to the start of any construction.

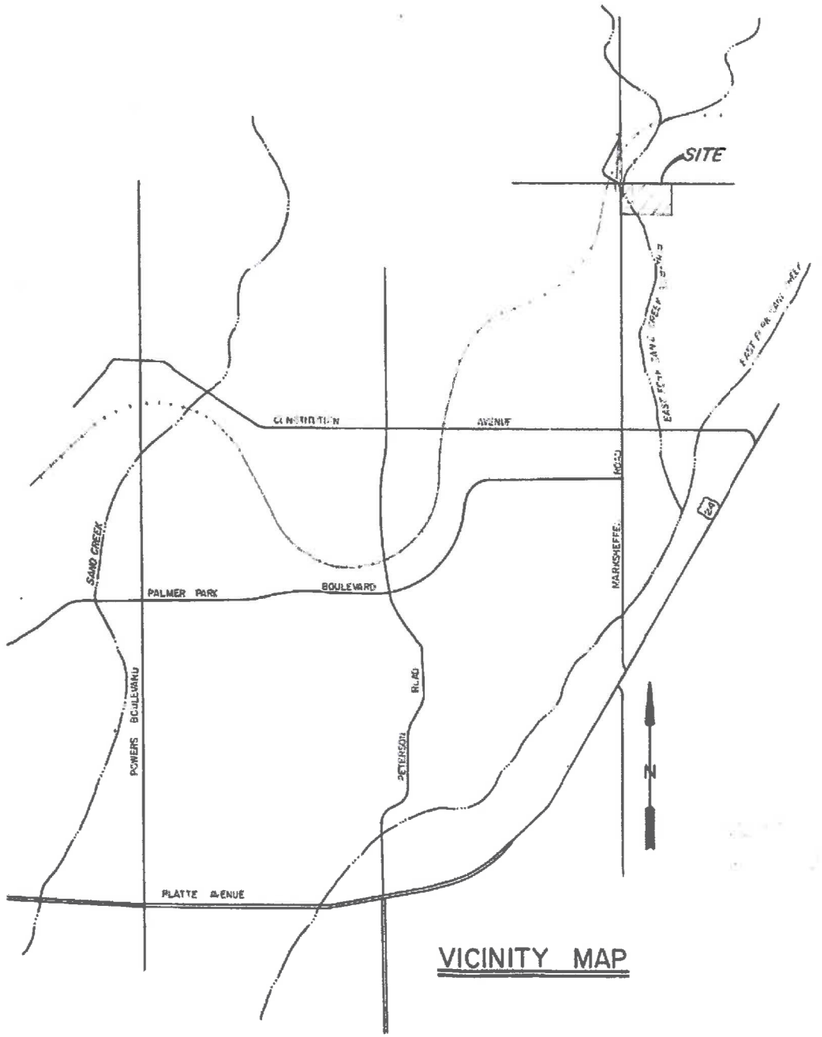
8. All construction shall conform to the standards and specifications of El Paso County Department of Transportation.

9. The contractor shall grade a channel from the Chicago Rock Island and Pacific Railroad Bridge to the Northerly Property line at Marksheffel Industrial Park - The channel shall be as straight as possible with a constant grade (~1.7%). Provide grade control structures as noted on the detail in these plans and the ratio of all horizontal curves shall be a minimum of 3:1.

10. The contractor shall continue the channel grading downstream of Marksheffel Industrial Park as shown on the following drawings.

PREPARED FOR

JAG DEVELOPMENT INC
2460 WAYNOKA ROAD
COLORADO SPRINGS,
COLORADO 80915



VICINITY MAP

INDEX OF SHEETS

Sheet No.	Description
1.)	COVER SHEET : VICINITY MAP & INDEX OF SHEETS
2.)	PLAN & PROFILE : DOWNSTREAM SECTION
3.)	PLAN & PROFILE : MAIN CHANNEL
4.)	PLAN & PROFILE: UPSTREAM SECTION
5.)	CHANNEL DETAILS
6.)	BOX CULVERT TRANSITION DETAILS
7.)	UPSTREAM TRANSITION DETAILS
8.)	WINGWALLS FOR PIPE OR BOX CULVERT
9.)	TRIPLE CONCRETE BOX CULVERT

APPROVED BY:

EL PASO COUNTY D.O.T.

PREPARED BY:

Richard N. Wray
Colo. P.E. No. 19310

sla Simons, Li & Associates, Inc.
Colorado Springs, CO

finn & associates, ltd.
Architects
Colorado Springs

SLA PROJ. NO. P-CO-FA-06

MARCH, 1986

DESIGN POINT A
Q_5 = 14.5
Q_{100} = 24.5

DESIGN POINT 1
Q_5 = 11.9
Q_{100} = 24.5

2-4' D-10-R INLETS - SOUTH
Q_5 = 32.4 cfs
Q_{100} = 66.5 cfs

8" CURB & GUTTER TYPE I ALONG LOTS 3 & 4

9
1.00 AC.

10
1.00 AC.

11
1.00 AC.

12
1.00 AC.

13
1.00 AC.

2-13' & 1-16' CONCRETE BOX CULVERTS
SEE REPORT FOR DETAILS

50' CHANNEL ESMT.

15 14 17 16

1.825 AC. 2.664 AC. 2.664 AC. 1.825 AC.

0.6%

320.75'

132.5'

DESIGN POINT C
Q_5 = 16.4 cfs
Q_{100} = 33.7 cfs

DESIGN POINT D
CHANNEL SECTION E
Q_5 = 8.1 cfs
Q_{100} = 16.7 cfs

CHANNEL SECTION D

1438.42'

PAVED PARKING AREA

NOTE: RE-SEED ALL DISTURBED AREAS

SUB-BASIN BOUNDARY

SUBJECT SITE

SMARTT CONST. CO.
6055 LEHMAN DR.

PREPARED BY:
SIMONS, LI & ASSOCIATES
118 N. TEJON STREET
COLORADO SPRINGS, CO
80903

LEGAL DESCRIPTION:

That portion of the West half of Section 33, Township 13 South, Range 65 West of the 6th P.M., [illegible]

Beginning at the Northwest [illegible] on the West [illegible] 1438.42 [illegible] to a point on the North line [illegible] West, along said North line, [illegible] Point of Beginning, El Paso County, Colorado.

48" FLARED END SECTION

CHANNEL "D"

DUMPED RIPRAP
D_{50} = 18", DEPTH = 3'

4:1 4:1
14.8' 8' 14.8'

CULVERT "B" OUTLET DET.
SCALE: 1" = 20'

24' MAT

40' R.O.W. ESMT.

40' R.O.W. TO BE DEDICATED BY AXELSON INC.

80' R.O.W.

Q_5 = 89.6 cfs
Q_{100} = 194.5 cfs

CULVERT B
2-48" R.C.P. @ 1.0%
W/FLARED END SECTIONS

PROVIDE 18" D_{50} RIP-RAP @ OUTLET OF CHANNEL

EXHIBIT I

SLA PROJ. NO. P-CO-FA-06

OCTOBER

finn & ARCHITECTS
611 N. Nevada Ave. S

JOB NO: 05116
FILE NO: 250
DATE: 3/05
SCALE: 1" = 100'

MARKSHEFFEL INDUSTRIAL PARK
JAH DEVELOPMENT, INC.
2460 WATHOKA RD. - JERRY GOETSCH
COLO. SPGS., CO 80915

1/1

DRAINAGE PLAN

NOTE: FOR TYPICAL SECTIONS & DETAILS, SEE SHEETS 5 – 9

EXISTING DISCHARGE

SUBJECT SITE

FOR SIDE CHANNEL DETAIL, SEE SHEET 5, & SEE GRADING / DRAINAGE PLAN

FOR DOWNSTREAM CHANNEL & TRANSITION, SEE DETAIL SHEET 2

STA 9+52.64 SOUTH PROPERTY LINE
SEE SHEET 2 ... S89°49'03"E

2-6'STATE TYPE R C.O INLETS, N SIDE
2-4'STATE TYPE R C.O INLETS, S SIDE
SEE SHEETS 6 & 9

FOR GUARD RAILS, SEE INDUSTRY ROAD STREET PLANS, SHEET BY FINN & ASSOC.

STA 15+12.22 SOUTH ROAD ROW

STA 15+42.92 ℄ INDUSTRY ROAD

STA 15+72.22 NORTH ROAD ROW

TRIPLE BOX CULVERT
2 - 8'x 13'
1 - 9'x 16'
SEE DETAIL SHEET 9

FOR BOTH BOX CULVERT TRANSITIONS, SEE SHEET 6

10.05 typ

NATURAL BOTTOM

N0°40'52"E 35' 22.05'

30' BOTTOM WIDTH

50' TOP WIDTH

℄ CO-ORDINATE CONTROL LINE

55' ROW

STA 19+80 START OF 4' DROP STRUCTURE
SEE SHEET 7

STA 20+05.08 END OF 4' DROP STRUCTURE

FOR UPSTREAM CHANNEL SECTION & TRANSITION DETAIL, SEE SHEET 4 & 7

FOR SIDE CHANNEL DETAIL SEE SHEET 5, & GRADING/ DRAINAGE PLAN

STA 20+80.14

STA 10+33.79 ℄ TURNAROUND
SEE SHEET 5

STA 14+66.22 START OF DROP STRUCTURE

STA 14+69.22 ℄ ACCESS STEPS
SEE SHEET 6

STA 14+90.22 START OF TRANSITION WALLS, & END OF DROP STRUCTURE, SEE SHEETS 6 & 9

STA 15+12.22 START OF BOX CULVERT
SEE SHEETS 6 & 9

STA 15+61.92 END OF BOX CULVERT

STA 15+72.22 START OF TRANSITION DROP

STA 16+33.22 END OF TRANSITION DROP

STA 16+38.22 ℄ ACCESS STEPS
SEE SHEET 6

STA 18+68.20 ℄ TURN-AROUND
SEE SHEET 5

N

SCALE 1" = 50'
C.I. = 2'

COORDINATES

POINT	42	N	9510.8111,	E	10747.1656
POINT	43	N	9459.8114,	E	10746.9745
POINT	56	N	10360.1308,	E	10748.7242
POINT	57	N	9950.6068,	E	10745.3828
POINT	58	N	10040.1308,	E	10748.8516

SOUTH PROPERTY LINE

STA 9+52.64 TOW EL = 6511.56
STA 9+52.64 START OF WEST SIDE CHANNEL, TOW EL = 6511.56
STA 9+93.64 ℄ WEST SIDE CHANNEL, TOW EL = 6511.56
STA 9+93.64 START OF EAST SIDE CHANNEL, TOW EL = 6511.56
STA 9+93.64 ℄ EAST SIDE CHANNEL, TOW EL = 6511.56
STA 9+93.64 END OF EAST SIDE CHANNEL, TOW EL = 6511.56
STA 9+93.64 END OF WEST SIDE CHANNEL, TOW EL = 6511.56

TOP OF CONCRETE CHANNEL

EXISTING GROUND ℄

100-YR WATER SURFACE

FLOWLINE

0.64%

TOE DOWN

℄ EL = 6504.66

STA 9+52.64

6' CUT-OFF WALL

STA 14+66.22 START OF DROP STRUCTURE, ℄ EL = 6508.13
TOW EL = 6514.85 SEE SHEET 6

STA 14+90.22 START OF TRANSITION WALLS, & END OF DROP
℄ EL (TOE) = 6506.39, ℄ EL (TOP) = 6516.06,
TOW EL = 6516.35, SEE SHEETS 6 & 9

STA 15+15.22 START OF BOX CULVERT, ℄ EL = 6510.91,
TOP OF CHANNEL WALL = 6520.43, SEE SHEETS 6 & 9

STA 15+42.92 ℄ INDUSTRY ROAD, ℄ EL = 6521.82

STA 15+69.22 END OF BOX CULVERT, ℄ EL = 6511.45
TOP OF CHANNEL WALL = 6520.77

STA 15+72.22 START OF DROP STRUCTURE, ℄ EL = 6511.55
SEE SHEET 6

STA 16+33.22 END OF DROP STRUCTURE, TOW EL = 6521.18
℄ EL (TOE) = 6512.09, ℄ EL (TOP) = 6514.48

STA 18+68.20 ℄ ACCESS STEPS
SEE SHEET 6

STA 19+80 GRADE BREAK, TOW EL = 6523.40

STA 19+80 START OF DROP STRUCTURE
℄ EL = 6516.70, 4 W-8 CUT-OFF WALL
STA 20+05.00 EL 6520.87
℄ EL (TOE) = 6516.87

STA 20+39.9 S.W. SIDE CHANNEL, ℄ EL = 6520.00

STA 20+44.3 ℄ E. SIDE CHANNEL, ℄ EL 6521.20

STA 20+59.14 END OF E. & W. SIDE CHANNELS
TOW EL = 6527.91

STA 20+59.14 END OF CHANNEL, ℄ EL = 6521.21
TOW EL = 6527.91, & START OF TRANSITION, SEE SHEET 7

STA 20+80.14, NORTH PROPERTY LINE, ℄ EL = 6521.14
SEE SHEET 4

HGL

0.64%

6530
6525
6520
6515
6510
6505

9+00 10+00 11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00 19+00 20+00

Finn and Associates Ltd.
611 N. Nevada Ave. Suite 1
Colorado Springs, CO 80903
(303) 578-0031
Architects Engineers Planners

SIA Simons, Li & Associates, Inc.
118 North Tejon Street, Colorado Springs, CO. 80903

MARKSHEFFEL INDUSTRIAL PARK

PLAN & PROFILE: STA. 9+52.64 TO STA. 20+80.14

Project No.	P-CC-FA 2.5
Date:	3/86
Design:	JRL
Drawn:	EAK
Check:	RMW
Revisions:	

3