MASTER DEVELOPMENT DRAINAGE PLAN for THE SANDS and PRELIMINARY DRAINAGE REPORT

March 2018

Prepared for:

The Landhuis Company
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Project #43-089

22655-51

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DRAINAGE PLAN STATEMENTS

Engineer's Statement

This report and plan for the drainage design of The Sands was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said 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.

COLORADO REGISTERED PROFESSIONAL ENGINEER VIRGIL A. SANCHEZ 37160

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 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, guarantee that final drainage design review will absolve the Landuis Company, and/or their successors and/or assigns future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

The Landuis Company

BY: ______________________ DATE: 3/16/18
Mr. Jeff Mark

TITLE: Owner & Manager

ADDRESS: The Landuis Company
212 N. Wahsatch Ave, Suite 301
Colorado Springs, CO 80903

City of Colorado Springs Statement:

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

BY: ______________________ DATE: 3/26/2018
For The City Engineer

CONDITIONS:

Permanent BMP drain times must be updated in Final Drainage Reports where necessary.

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<u>APPENDIX</u>

MASTER DEVELOPMENT DRAINAGE PLAN for THE SANDS and PRELIMINARY DRAINAGE REPORT

PURPOSE

The purpose of this Master Development Drainage Plan and Preliminary Drainage Report will identify and analyze on and offsite drainage patterns, analyze and determine the adequacy of existing facilities, and as necessary recommend drainage improvements to route developed storm water to conceptual down-gradient facilities. The drainage improvements proposed in this report are preliminary in nature and will be further detailed with subsequent analysis, reports and construction plans. This report briefly discusses the concept channel improvements recommended for the East Fork Sand Creek Subtributary Channel which falls within a portion of the subject site. The proposed Sands development is currently in the annexation process which will alter its location from Unincorporated El Paso County to the City of Colorado Springs.

GENERAL SITE LOCATION AND DESCRIPTION

The Sands site is approximately 114.30 acres in size and is located in Section 33, Township 13 South, Range 65 West of the 6th P.M. in El Paso County, Colorado. The site currently exists as three separate parcels zoned I-3 (heavy industrial). The site is bound to the west by Marksheffel Road and to the south by Constitution Avenue. It is bound on the north by Marksheffel Industrial Park, to the east by undeveloped land, Rocky Mountain Industrial Park Filings No.1 & 1A and Capital Drive. The East Fork Sand Creek Sub-tributary drainage way bisects the upper and lower parcels of the property, and lies adjacent to the middle segment of property. A vicinity map showing the general location of the site and a copy of the existing conditions survey (American Land Title Association, ALTA) has been provided in the appendix of the report to show the three parcels as they exist, prior to development and annexation.

The Sands property is planned for multi-use development consisting of; open space, single family residential, industrial and commercial development areas. The proposed site improvements will include the construction of paved roadways and parking lots, trails, maintenance access roadways, utilities such as sanitary sewer, water, and storm sewer. Detention and water quality ponds (Full Spectrum Detention) and channel stabilization improvements are also planned.

SOILS

The National Resources Conservation Service, Web Soil Survey was utilized to investigate the existing general soil types within and tributary to the site. The soils underlying this site are identified as (8) Blakeland Loamy Sand (1 to 9 percent slopes), (10) Blendon Sandy Loam (0-3 percent slopes), and (28) Ellicott loamy coarse sand (0 to 5 percent slopes). The NRCS has assigned a Hydrologic Soil Group rating for the three soils types as either "A" or "B". Group A soils are defined as having a high infiltration rate (low runoff potential) when thoroughly wet and are typically well drained to excessively drained sands or gravelly sands and have a high rate of water transmission. Group B soils are defined as having a moderate infiltration rate when thoroughly wet. These soils consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. Group B soils typically possess a moderate rate of water transmission. A soils map showing the soil management unit, soil rating, and soil type has been provided in the appendix of this report.

HYDROLOGIC CALCULATIONS

Where required hydrologic calculations were performed using the City of Colorado Springs Storm Drainage Criteria Manual. The Rational Method was used to estimate storm water runoff anticipated from design storms with 5-year and 100-year recurrence intervals.

HYDRAULIC CALCULATIONS

Hydraulic calculations were estimated using the Manning's Formula and the methods described in the City of Colorado Springs Storm Drainage Criteria Manual the pertinent data sheets are included in the appendix of this report. Hydraulic grade line (HGL) analysis of the various storm sewer systems will be submitted within forthcoming drainage reports after the various developments and the internal infrastructure has been finalized.

FLOODPLAIN STATEMENT

Review of the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel Nos. 08041C0543F and 08041C0756F, with effective dates of March 17, 1997 and revised to reflect Letter of Map Revisions (LOMRs), dated November 18, 2004 and December 29 2004, indicate that portions of the proposed Sands development are currently impacted by a Special Flood Hazard Area (SFHA) Zone "AE". A zone "AE" is an area that is likely to be inundated by flows that occur during a 100-year event, for which a detailed study has been performed and for which Base Flood Elevations have been established.

A floodplain exhibit showing the Digital Flood Insurance Rate Map (DFIRM) Panel maps numbers, the approximate site boundary, and the existing floodplain zones atop an aerial background has been included in the appendix. The 100-year and 500-year floodplains as defined by the most recent LOMRs (see appendix A) have been shown on The Sands Existing Condition Drainage Map, which is provided in the appendix of this report.

Channel Improvements, along the lines of those recommended by the Sand Creek Drainage Basin Planning Study (SCDBPS), will be required with the development of the subject site and upon construction will alter the existing floodplain. A FEMA Conditional Letter of Map Revision (CLOMR) and Letter of Map Revision (LOMR) process will need to be conducted with development of the subject site to adequately map and record the revised floodplain impact zones.

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 analysis of drainage basins possessing less than 100 acres.

EXISTING SITE DRAINAGE CONDITIONS

General Description

The following is general overview of the existing conditions for the subject site, detailed existing conditions analysis and a description of the condition of the existing channel will follow.

An ALTA survey conducted in 2016, divided the subject site into 3 parcels; Parcel A (33.97) acres, Parcel B (47.61 acres) and Parcel C (33.87 acres) totaling ~114.30 acres. These parcel references have been added to the Existing Conditions Map, to aid the reader in interpreting the physical location of the various existing improvements and existing site conditions. A copy of the map is located within one of the pockets at the back of this report.

Currently about 89% or 101.3 acres of the subject site falls within the EFSCST of the Sand Creek Watershed. This includes all of parcels A and B and approximately 58% of parcel C. The remaining 12% of the subject site drains easterly into the Sand Creek East Fork (not to be confused with the EFSCST). These two major drainage basin boundaries are separated by a light gray dashed line on the enclosed map. Ultimately all flows are tributary to Sand Creek.

Parcel A (33.87 acres) is located at the north end of the site, south of the Marksheffel Industrial Park, between existing Marksheffel Road and future Capital Drive. This parcel remains primarily undeveloped with the exception of drainage improvements consistent with the construction of a water quality pond and a formalized grass lined swale, which is located within a non-exclusive drainage easement in the northwest corner of the parcel. The existing WQ pond functions to treat runoff from a portion of existing Marksheffel Road as well as being sized for a series of planned parcels located adjacent to the Marksheffel Road corridor, while the improved swale conveys runoff to the channel a portion of the Marksheffel Industrial Park that was in place prior the roadway improvements. A unimproved swale directs offsite flows from a portion of the Marksheffel Industrial park and a large offsite basin (refer to offsite map) located to the north and east of the subject site, thru the east half of the parcel. The segment of the EFSCST channel, that runs through parcel A is relatively unimproved and retains its historical 250’-400’ floodplain width.

The land within Parcel A generally possess fair ground cover (mostly native grasses), with slopes typically ranging from 2-15% with areas as steep as 2 to 1 and 4 to 1 along portions of the Marksheffel Road and Genoa Drive roadway embankments and along some portions of the outer channel banks of the unimproved EFSCST. A handful of trees and shrubs are present, mostly spotting the outer limits of the existing channel banks.

Runoff produced within the east and west halves of parcel A, generally drains toward the southward. A elevated embankment which runs east west aids in consolidating flows into the downstream section of the improved EFSCST (adjacent to Parcel B). The embankment, which currently covers buried utilities such as sanitary, sewer, water, and gas was previously set aside as a utility and roadway corridor for planned Genoa Drive. A sanitary sewer line and easement also runs from the north to south along the east side of the existing channel, through Parcel A.

Parcel B consists of 47.61 acres, which is located between a portion of Constitution Avenue and the Genoa Drive corridors. The parcel is bound to the west by Marksheffel Road and to the east by Rocky Mountain Industrial Park and a 75’ existing utility and drainage easement. Similar to Parcel A, this parcel remains primarily undeveloped with the exception of a water quality pond, which is located within a non-exclusive drainage easement in the middle of the parcel. The existing WQ pond treats runoff for a portion of existing Marksheffel Road and has been sized for additional planned parcels located to the west of the Marksheffel Road corridor. The remaining EFSCST drainage way lies outside of the parcel B boundary falling primarily within the El Paso County Rocky Mountain Industrial Park Filing No.1 property or within Parcel C.

Parcel B possesses fair ground cover (mostly native grasses), with slopes typically ranging from 2-15% with areas as steep as 2 to 1 along portions of the existing Marksheffel Road outer historical banks of the EFSCST, prior to its consolidation with the adjacent development. Runoff produced within this parcel generally drains southward toward Constitution Avenue and to Parcel C. A small strip of Parcel B is collected by an existing drainage inlet located at the northwest corner of Marksheffel Road and Constitution Avenue which was constructed with the Marksheffel roadway improvements. With the exception of the flows directed to the WQ pond, offsite flows don’t appear to impact this parcel.

Parcel C consists of 32.72 acres, located to the north of existing Constitution Avenue, between the 75’ wide utility and drainage easement and Capital Drive. This parcel remains entirely vacant from development, with the exception the sanitary sewer line and easement which runs along the west and south sides of the parcel and a limited amount of riprap channel protection that extends just to the south of the Rocky Mountain Industrial Park (Filing No. 1) boundary.

The EFSCST drainageway serpentines across Parcel C, beginning at the northwest corner and ending at the the center of the parcel at Constitution Avenue. As previously mentioned a small segment of the upper portion of the channel has some bank stabilization consistent with the improved section located adjacent to Parcel B, while the remainder of the channel remains generally unimproved.

Parcel C possesses fair ground cover (mostly native grasses), with slopes typically ranging from 2-15% with areas as steep as 2 to 1 along the historical outer banks of the EFSCST.

Runoff produced onsite generally drains southward toward Constitution Avenue and Capital Drive and with the exception of the onsite flows entering from Parcel B, offsite runoff appears to be prohibited from reaching this portion of the site.

An existing 4 cell concrete box culvert constructed with (2)-6'H x11'W and (2)-6'H x 14'W openings traverses underneath Constitution Boulevard allows for the runoff collected by the EFSCST to discharge to downstream facilities.

It should be noted that since the initial draft of this report a fire station was constructed at the northeast corner of Parcel C, which reduced the overall acreage from 115.45 acres (as shown on the ALTA) to the now reported 114.30 acres. The site is not significantly impacted by the construction of the facility, as the majority of the developed drainage discharges to Capital Drive.

Detailed Existing Conditions Drainage Basin Description

The following is a detailed summary of the existing condition drainage analysis for the 114.30 acre Sands development site and the offsite areas which impact it. It should be noted when two asterisks comes before a basin callout, it is to denote that the basin has been previously studied in the "Final Drainage Report for Marksheffel Road from Constitution Avenue to Dublin Road,” prepared by CH2M Hill, dated 2008.

It should be noted that limited historical drainage analysis documentation and contour mapping for many of the undeveloped and developed parcels located to both the north and east of the subject site, (MS Industrial

Park Development) was not readily available at that the time of this writing of this report and thus some assumptions have been made regarding the offsite watersheds (OS-0 thru OS-5). Where applicable United States Geological Survey (USGS) contour mapping, aerial imagery and onsite inspection were utilized to make good engineering assumptions for the purposes of the hydrologic and hydraulic calculation provided in this report.

Further more, it is important to note that the design points provided on the existing and proposed conditions map only total the flows produced by the onsite and contributing offsite areas and do not attempt to calculate the total runoff conveyed within the East Fork Sand Creek Subtributary along the subject reach. The primary reason for this is due to a few factors. First and foremost the developed channel segments upstream, adjacent to, and downstream of the subject site have been designed to convey the 100-year runoff proposed by the DBPS for this segment of the East Fork Sand Creek Sub tributary of 1720 cfs. Although one may recognize that this flow rate was based upon the construction of large regional detention facilities constructed within the up-gradient Banning Lewis Ranches, the nearest being located upstream of the railroad embankment less than a ¼ mile from the subject site. In reality the flow rates within the EFSCST may never reach this rate, or the calculated existing conditions DPBS flow rate of 1400cfs, even without the full build out of regional facilities, due in part to the implementation of Full Spectrum Detention ponds in both the upstream Banning Lewis development and within the subject site which function to limit discharge to less than existing. There by making the use of the approved FEMA flow rate conservative and the need to calculate point discharge rates along the channel unnecessary. A copy of the Sands Proposed Conditions Map is included in the map pocket at the end of this report.

Basin OS0 is located to the north of the subject site and consists of approximately 7.99 acres, which is currently developed and utilized by Centurylink as center for installation and maintenance. Runoff produced by the basin has been estimated to be 19.9 cfs for the minor storm event (5-Year) and 37.1 cfs for the major storm event (100-Year). Currently runoff from this basin is not anticipated to reach the subject site due to concrete and earthen swales located on site. Runoff collected by the swales are directed eastward to a trapezoidal shaped cutout in a portion of the existing partially concrete lined portion of the EFSCST at **Design Point 0**. This calculated runoff rate is generally in line with the values shown on existing drainage map provided by El Paso County for Lot 16 of Marksheffel Industrial Park of 16.4 and 33.7 cfs. Should the existing channel in **Basin OSO** become blocked or become sediment laden, runoff could overflow onsite into Sub-basin A and discharge to the channel via an existing 3' deep earthen channel.

Basin A consists of approximately 2.7 acres of land located in northwest corner of the site. The basin houses an existing water quality treatment facility, a small earthen swale, a large earthen channel, a riprap spillway and spot placement of riprap slope protection on the western bank of the EFSCST. Based upon review of the available drainage report and bid documents, provided by Wilson & Company, regarding the planning and construction of the expanded Marksheffel Road, the following summary has been prepared by M&S Civil regarding the design of the existing facilities;

> The 2.7 acre **Basin A** represents only the onsite area of a larger 15.8 acre watershed which was previously analyzed within the Wilson/CH2MHill drainage report (Basin OSP4A). According to the report, offsite area was estimated to produce developed runoff of approximately 11 cfs in the 10-year event and 20 cfs in the 100-year event. A 4' BW 4:1 SS minimum 2' deep earthen swale was constructed to bypass offsite runoff around the north embankment of the WQ pond to the base of the existing riprap spillway.

The existing WQ pond, (#4) was designed to treat only the WQ event runoff from approximately 15.8 acres of Marksheffel Road, requiring a design volume of slightly over a half acre foot. The facility was to be constructed approximately 6' deep (bottom to the pond crest) which included a 2' deep spillway. The 100-year outflow from the pond was listed to be 206 cfs and was estimated to flow 1.6' above the spillway crest. A 25' wide 4:1 SS, 3' minimum deep earthen trapezoidal channel was to be graded at ~ 0.5% to direct the combined 10-year (141 cfs) and 100-year runoff (226 cfs) to the EFSCST.

Based upon site topography and onsite inspection the existing facility appears to be built in relative compliance with the construction drawings and thus is anticipated to function as intended.

Using USGS contour data **Basin OS1** was estimated to consist of approximately 92.92 acres. At the time of writing of this report the offsite watershed, which is located to the north and east of the subject site is currently undeveloped. The existing flow rates for the 5-year and 100-year events were estimated to be 21.5 and 133.8 cfs. Currently two existing 42" culverts are located at **Design Point 1** to aid in conveying 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 13.7 cfs for the minor storm event (5-Year) and 25.4 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 29.9 cfs for the minor storm event (5-Year) and 148.4 cfs for the major storm event (100-Year). The runoff discharges into **Basin EX B** 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 12.3 cfs in the minor storm event (5-Year) and 22.9 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 area, limited information was obtained regarding how the Weatherford development in its entirety is to function, (how offsite areas where dealt with, and what the total flow discharged from the site it current condition is) thus assumptions were required to be made to complete this analysis and likely will need to be further investigated with subsequent final drainage reports.

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 the Weatherford drainage report data. Runoff produced by the basin in the existing condition has been estimated to be 32.6 cfs for the minor storm event (5-Year) and 85.4 cfs for the major storm event (100-Year). The runoff has been routed to the southwest corner of the basin to **Design Point 4**.

Basin OS5 consists of approximately 1.09 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 2.5 cfs for the major storm event (100-Year). For the purposed of the existing conditions analysis it is assumed that the runoff reaches the southwest corner of the basin, **Design Point 4** (33.3cfs / 87.8cfs). Currently, a 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 and **DP5** at the EFSCST.

Basin EXA consists of approximately 13.61 acres, which is currently undeveloped and is located in the northwest portion of the site. Runoff produced by the basin is estimated to be 3.2 cfs for the minor storm event (5-Year) and 23.4 cfs for the major storm event (100-Year). The runoff from this basin discharges directly into the EFSCST at or upstream of **Design Point 6.**

Basin EXB consists of approximately 17.68 acres, which is currently undeveloped and is located in the northeast portion of the site. Runoff produced by this basin is estimated to be 4.1 cfs for the minor storm event (5-Year) and 30.0 cfs for the major storm event (100-Year). The cumulative flows at **Design Point 5** (EXB+DP3+DP4), are estimated to be 72.3 cfs for the minor storm event (5-Year) and 304.8 cfs for the major storm event (100-Year). The runoff from this basin will outfall into the EFSCST**.**

Basin EXD consists of approximately 0.78 acres, which is currently undeveloped and is located in the central-west portion of the site. Runoff produced by the basin, is estimated to be 0.2 cfs for the minor storm event (5-Year) and 1.6 cfs for the major storm event (100-Year). All runoff from this basin will currently outfalls into an existing improved segment of the EFSCST at or upstream of **Design Point 7.**

Basin EXE consists of approximately 14.72 acres, which is currently undeveloped and is located in the central-west portion of the site. Runoff produced by the basin, is estimated to be 3.9 cfs for the minor storm event (5-Year) and 27.1 cfs for the major storm event (100-Year). The runoff from this basin will outfall to **Design Point 8**.

Basin **EXF and Existing WQ Pond #5 are located along the central-west portion of the site. The cumulative flows at **Design Point 8** (EXE+EXF), are estimated to be 79.9 cfs for the minor storm event (5-Year) and 167.8 cfs for the major storm event (100-Year). The runoff from this basin will outfall into an existing swale and be routed to **Design Point 12**. Since the WQ Pond is existing, the "C" values and intensities provided in the CH2MHill and those shown on the Wilson & Company storm sewer plans shall be used. Per the Wilson & Company Report the WQ Pond is designed to treat 6.48 acres with design volume of

0.27 ac-ft. Similarly to Pond#4, existing Pond #5appears to be built in relative compliance with the construction drawings and likely functions as planned.

Basin EXG consists of approximately 2.05 acres, which is currently undeveloped and is located in the central-west portion of the site. Runoff produced by the basin is estimated to be 0.5 cfs for the minor storm event (5-Year) and 3.4 cfs for the major storm event (100-Year). The runoff from this basin will outfall into the EFSCST at or upstream of **Design Point 9.**

Basin EXH consists of approximately 21.40 acres, which is currently undeveloped and is located in the southwest portion of the site. Runoff produced by the basin, is estimated to be 4.6 cfs for the minor storm event (5-Year) and 33.5 cfs for the major storm event (100-Year). The cumulative flows at **Design Point 12** (EXH+DP8) are 68.6 cfs for the minor storm event (5-Year) and 176.2 cfs for the major storm event (100-Year). The runoff has been routed to a low point on the southern edge of the property boundary. The runoff from this basin, and those reaching **DP12**, likely permeates the soil and overflows onto the existing Constitution Avenue.

Basin EXJ consists of approximately 2.40 acres, which is currently undeveloped and is located in the southwest portion of the site. Runoff produced by the basin, is estimated to be 0.6 cfs for the minor storm event (5-Year) and 4.5 cfs for the major storm event (100-Year). The runoff from this basin will outfall to a low point along the southern boundary at **Design Point 10,** before overtopping a localized high point and continuing to **Design Point 11**.

Basin EXI consists of approximately 6.99 acres, which is currently undeveloped and is located in the southwest portion of the site. Runoff produced by the basin, is estimated to be 1.6 cfs for the minor storm event (5-Year) and 11.5 cfs for the major storm event (100-Year). The cumulative flows at **Design Point 11** (EXI+DP10) are 2.1 cfs for the minor storm event (5-Year) and 15.5 cfs for the major storm event (100-Year). The cumulative runoff have been routed to a low point on the southwest corner of the site where it is captured by an existing Type D area inlet and routed into the existing storm sewer system via an existing 30" RCP.

Basin EXK consists of approximately 5.92 acres, which is currently undeveloped and is located in the south-central portion of the site. The runoff from Basin **EXK** is calculated at 1.3 cfs and 9.7 cfs in the 5-Year and 100-Year storm events respectively. The combined runoff currently collects at a to a low point along the northern edge of Constitution Boulevard, where an existing 12" RCP was found. At this time it unclear if the drainage system was maintained or abandoned with recent development of the King Soopers supermarket which has been constructed on the south side of Constitution Avenue (across from the proposed development).

Basin EXL consists of approximately 11.49 acres, which is currently undeveloped and is located in the southeast portion of the site. The runoff is 2.6 cfs for the minor storm event (5-Year) and 19.1 cfs for the major storm event (100-Year). The cumulative flows at **Design Point 14** (EXL+DP5+DP6+DP7+DP9) is 77.1 cfs for the minor storm event (5-Year) and 341.2 cfs for the major storm event (100-Year). As discussed this cumulative runoff does not include the existing offsite flows conveyed by the EFSCST. All runoff from the site and contained within the channel is routed, via the EFSCST, to the southern edge of the site, where a 2-6' x11' and a 2-6' x 14' CBC convey runoff under Constitution Avenue.

Basin EXM consists of approximately 12.99 acres, which is currently undeveloped and is located in the southeast portion of the site. The runoff proposed by the basin is 2.9 cfs for the minor storm event (5-Year) and 21.6 cfs for the major storm event (100-Year). The runoff from this basin will collect at a low point at the southeast corner of the site at **Design Point 15**, where it permeates the soil and/or overflows onto the existing Constitution Avenue and continues east to Sand Creek Channel.

Basin OS-6 consists of approximately 1.15 acres, which was recently developed into a Fire Substation. The calculated runoff is estimated at 0.4 cfs for the minor storm event (5-Year) and 2.6 cfs for the major storm event (100-Year). The runoff sheet flows to the curb and gutter in existing Capital Drive where the majority of these flows are captured by an existing 10' inlet, located just to the south. Refer to the"Drainage Letter Report for Falcon Fire Station No. 4" for additional details.

EXISTING EAST FORK SAND CREEK SUBTRIBUARY CHANNEL CONDITIONS

The East Fork Sand Creek Subtributary drainageway bisects the upper and lower two parcels of the site, and lies just outside of the eastern boundary of the center parcel. A vicinity map showing the general location of the site and the relative location of the existing channel has been provided in the appendix of the report. As previously discussed, the EFSCST drainageway runs generally north to south along eastern portion of the proposed 114.30-acre development. Of the 4500'+/- of channel, approximately 1830' of the reach has been previously improved with the development of the adjacent Rocky Mt. Industrial Park site, while the remainder of the channel is currently in an unimproved state. Based upon the approved construction drawings, this improved segment of the channel was trapezoidal in shape, possessing a 35' bottom width and constructed a slope of ~1.2%. The channel section possesses a natural or primarily sand invert with 2' thick Type 'M' riprap lined 2.5:1 side slopes that were placed a top of a Mirafi blanket and was to be extended a minimum of 3 below the channel invert. The overall depth of the channel was typically set to 5'.

The drawings further indicated the construction of three (3) 3' concrete vertical drop structures with full width 3' thick riprap aprons located upstream and downstream of the drops as well as three (3) buried "Type M" Riprap check structures. Although not discussed in the drainage report, the check structures were likely constructed between the drops to aid in providing a stable channel grade should the invert of the channel find equilibrium at a flatter slope. Based upon the structure spacing in the construction drawings it appears that the long term slope anticipated by Kiowa Engineering was a bed slope of ~ 0.5%. A copy of the Rocky Mountain Industrial park channel improvement plan and profile drawings are included in the appendix of this report.

Prior to the development of the adjacent Rocky Mountain Industrial Park the segments of the EFSCST channel both upstream and downstream of the proposed Sands development had already been improved. This included the construction of a 4-cell box culvert that was designed to convey the 100-year FEMA storm event flood flows of 1720 cfs under existing Constitution Avenue near the south east corner of the proposed development and a narrower concrete and sand trapezoidal channel section north of the subject site.

Based upon the historic construction drawings provided by El Paso County, the existing channel segment located north of the subject site was designed at slope of ~ 0.64%, consisting of a trapezoidal shape section with a 35' bottom. This section of the channel has a natural invert with concrete lined 1.5:1 side slopes placed atop compacted soil which extended a minimum of 3' below the channel invert. The typical depth of the channel immediately upstream of the site was 7.6'. Drawings of the box culvert structure at Constitution and EFSCST were not available.

Cursory field inspection of the various channel segments and the box culvert were conducted during the writing of this report.   All improved channel sections appear to be functioning as intended and appear to be stable with no significant erosion or structural failure noted. As anticipated the unimproved channel segments show erosion along the unprotected channel banks.

Erosion within the upstream undeveloped watershed and from the unimproved channel segments is currently resulting in some sediment deposition throughout the flatter improved channel segments and at the box culvert structure. The most notable concern from this is the reduction of the proposed channel capacity.

PROPOSED SITE DRAINAGE CHARACTERISTICS

The following paragraphs provide a detailed description of the offsite and onsite basins, offsite bypass flows, and the overall future drainage characteristics for the development of The Sands. Calculations have been provided in the appendix of the report to verify the adequacy of the recommended infrastructure to both treat and convey runoff safely runoff for the planned development. It should be noted that the design points and basins were analyzed using the Rational Method since each individual basin is less than 100 acres and the combined acreage at any Design Point also less than 100 acres. This method offers a more conservative approach to sizing swales and storm drains, when times of concentration are relatively short.

As discussed in the existing conditions section of the report, drainage analysis and documentation for much of the master planned areas north and east of the subject site, (MS Industrial Park Development in 1985 by Simons and Li) was not readily available at that the time of this writing of this report and thus the some assumptions have been made regarding the offsite watersheds (OS-0 thru OS-5) flow rates, and proposed and existing infrastructure capacity. As noted USGS contour mapping, Google Earth aerial imagery and onsite inspection were utilized to make good engineering assumptions for the purposes of the hydrologic and hydraulic calculation provided in this report.   Whenever possible the assumed data has been cross checked against available report data to confirm assumptions if possible. A proposed drainage plan for the fully developed condition is presented graphically in the map pocket located before the back cover.

Detailed Description

Basin OS0 is located to the north of the subject site and consists of approximately 7.99 acres, which is currently developed and utilized by Centurylink as center for installation and maintenance. Runoff produced by the basin has been estimated to be 19.9 cfs for the minor storm event (5-Year) and 37.1 cfs for the major storm event (100-Year). Currently runoff from this basin is not anticipated to reach the subject site due to concrete and earthen swales located on site.   Runoff collected by the swales are directed eastward to a trapezoidal shaped cutout in a portion of the existing partially concrete lined portion of the EFSCST at **Design Point 0**.   The aforementioned calculated runoff rate is generally in line with the values shown on existing drainage map provided by El Paso County for Lot 16 of Marksheffel Industrial Park of 16.4 and 33.7 cfs. Should the existing channel in **Basin OSO** become blocked or become sediment laden, runoff could overflow onsite into Sub-basin A and discharge to the channel via an existing 3’ deep earthen channel.

Basin A consists of approximately 2.7 acres of land located in northwest corner of the site. As in the existing condition the basin will retain its existing water quality treatment facility, a small earthen swale, a large earthen channel and riprap spillway. The existing pond was designed to treat WQ event runoff from approximately 15.8 acres of Marksheffel Road, requiring a design volume of slightly over a half acre foot. The 100-year outflow from the pond was listed to be 206 cfs and was estimated to flow 1.6' above the spillway crest. A 25' wide 4:1 SS, 3' minimum deep earthen trapezoidal channel was to be graded at 0.5% to direct the combined 10 year (141 cfs) and 100-year runoff (226 cfs) to the EFSCST. No significant changes to the **Basin A** are anticipated with the proposed development of The Sands site with the exception of some minor embankment grading along the east side of the exiting earthen channel will need to be to ensure that runoff not impact the proposed residential development so that it ties nicely into the grouted boulder drop structure at **Design Point 1.** The existing maintenance road, which currently runs along the south side of the Existing WQ Pond #4, will need to be extended to provide access to the EFSCST channel.

Basin B consists of approximately 10.99 acres of proposed single family residential lots and streets and an open space/utility corridor that parallels Marksheffel Road. Runoff produced within Basin B will have anticipated flow rates of 11.6 cfs for the minor storm event (5-Year) and 31.1 cfs for the major storm event (100-Year). This runoff is planned to be conveyed overland via side lot swales, into the curb and gutter of the proposed roadways to a pair of proposed 8' sump inlet located at **Design Point 2**. Collected runoff is to be conveyed to a proposed private Full Spectrum Detention (FSD) pond at **Design Point 11** via proposed 24" (Pipe 101) and 30" (Pipe 102) RCP storm drains. Should the inlets become clogged flows could continue over top the curb to pond 1 and ultimately to the EFSCST.

Basin K consists of approximately 0.97 acres set aside for the construction of a proposed full spectrum detention basin. Runoff produced within **Basin K** of 0.7 cfs for the minor storm event (5-Year) and 2.8 cfs will combine with runoff from Pipes 102 at **Design Point 11** where flows are expected to peak at 12.1 cfs and 33.3 cfs respectively. Based upon contributing watershed characteristics, the UD-Detention worksheet (refer to hydraulic calculations portion of the appendix) estimates that a 0.91 ac-ft FSD Extended Detention Basin (EDB) (Pond 1) with a multi stage concrete outlet structure would be required to detain and discharge runoff at pre-development flow rates. A restricted 18" RCP (Pipe 103) would discharge runoff from the pond to the channel at a peak flow rate of approximately 0.2 and 13.8 cfs in the 5 and 100-year events respectively. A riprap lined spillway and rip rap apron would be provided to dissipate energy and prevent local scour from both the outlet pipe and along the embankment slope in the condition that overtopping occurred. It should be noted that spillway may need to be traversable to allow for the maintenance/trail on the west side on the EFSCST. Should the outlet become clogged flows will over top the spillway and drain to the EFSCST.

Basin C is approximately 3.44 acres in size and consists of a few residential backyards located along west side of the major drainage channel as well as an improved section of the EFSCST. Basin C has a proposed design flow rate of 4.0 cfs for the minor storm event (5-Year) and 12.5 cfs for the major storm event (100-Year). Refer to Proposed Channel Improvements section of the report for addition information regarding the EFSCST.

Basin OS1 consists of approximately 92.92 acres, which is currently undeveloped and is located to the north and east of the proposed industrial development portion of the subject site. (Refer to offsite basin exhibit in appendix) As previously mentioned, no information regarding the master development drainage plan for this offsite watershed was available, with the exception of design point runoff flow rates illustrated in the Lot 16 of the Marksheffel Industrial Park (MIP) Drainage Map.

As it's unclear whether El Paso County will require the offsite developments to hold to the existing flow or to those established by the map, multiple runoff calculations were ran to back into both. The existing flow rates for the 5-year and 100-year events were estimated to be 21.5 and 133.8 cfs, while increasing the runoff coefficients to 0.32 and 0.51 resulted in flow rates of 77.2 and 206.5 cfs for the 5 and 100-year events. For the time being the slightly higher developed values will allow for the adequate design of conveyance facilities to be constructed thru the site in the proposed condition while the existing flow rates will be brought forward in the existing condition analysis. The proposed calculations do allude to the fact that the offsite area should not be developed in entirety (as industrial) without some type of significant detention. Currently two existing 42” culverts are located at **Design Point 3** to aid in conveying runoff (77.2 cfs / 206.5 cfs) from the east to the west side of the existing roadway.

Due to limited headwater at the existing 42" culverts, the offsite runoff is likely in excess of the pipe capacity and thus consideration should be given to upsize the existing culverts or allow for runoff in excess of the culverts capacity to safely overtop the roadway section when the roadway is extended. For the purposes of this report, it is assumed that a stabilized embankment slope will be provided with the formalization of a low point in the roadway and minor overtopping will occur which will direct runoff westward to **Design Point 4**, assuming the current flow pattern is permanent.

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, 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 13.6 cfs for the minor storm event (5-Year) and 25.4 cfs for the major storm event (100-Year) which is just somewhat higher than the flows shown on the MIP map of 8.1 and 16.7 cfs. As in the existing condition runoff from **Basin OS2** combines with flows **from DP-3**, and discharges to an existing swale currently crossing the planned industrial lots. In the proposed condition, runoff is routed via a proposed swale to **Design Point 4**.

Basin OS3 is located to the west of **Basin OS2** and consists of approximately 3.97 acres of existing light industrial buildings, warehouses, landscaping and gravel parking and storage lots. Similarly to **Basin OS2**, the size of the offsite watershed, and site topography and flow patterns were estimated using the Marksheffel Industrial Park Drainage Map, while onsite inspection and aerial imagery was utilized to verify these assumptions. Runoff produced by the basin is calculated to flow at a rate of 12.3 cfs in the minor storm event (5-Year) and 22.9 cfs for the major storm event (100-Year). This is slightly higher than the flows shown on the MIP Drainage plan of 8.1 and 16.7 cfs. The combined runoff from **Basin OS2** and **DP-3** is routed via a proposed swale to **Design Point 4**.

Basin D consists of approximately 0.42 acres of the proposed industrial development area. Runoff from the basin is calculated to possess peak flow rates of 2.0 cfs for the minor storm event (5-Year) and 3.5 cfs for the major storm event (100-Year). The proposed basin will consist of a 35'w drainage easement or tract 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 D, OS2, 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. Peak flow rates of 80.7 cfs for the minor storm event (5-Year) and 203.9 cfs for the major storm event (100-Year) have been calculated to reach **DP4**. Coordination with the two adjacent property owners (**Basins OS2 & OS3**) is likely needed prior to final design to implement a drainage solution that benefits all shareholders.

Basin E consists of approximately 7.03 acres of future industrial development. **Basin E** has a proposed design flow rate of 21.4 cfs for the minor storm event (5-Year) and 39.8 cfs for the major storm event (100-Year). For the purposes of the MDDP, it is anticipated that runoff from **Basin E** will be conveyed as surface drainage to western edge of the development to a private Full Spectrum Detention Pond located at **Design Point 5**.

Based upon contributing watershed characteristics, the UD-Detention worksheet (refer to hydraulic calculations portion of the appendix) estimates that an 1.2 ac-ft FSD Extended Detention Basin (EDB) (Pond 2) with a multi stage concrete outlet structure would be required to detain and discharge runoff at pre-development flow rates. A restricted 18" RCP (Pipe 104) would discharge runoff from the pond to the adjacent channel at a peak flow rate of approximately 0.4 and 4.9 cfs in the 5 and 100-year events, respectively. A riprap lined spillway and rip rap apron would be provided to dissipate energy and prevent local scour from the outlet pipe and along the embankment slope. It should be noted that spillway may need to be traversable to allow for the maintenance of the relocated sanitary sewer should this location for the relocation be selected. Should the inlet become clogged flows will over top the spillway and drain into the EFSCST.

Basin OS5 is approximately 1.0 acres in size and consists of the east half of future Capital Drive. Runoff produced by the basin totals 3.8 cfs for the minor storm event (5-Year) and 6.7 cfs for the major storm event (100-Year). Runoff produced by the basin will be collected and conveyed by the curb and gutter of the roadway to a proposed low point located at **Design Point 8**.

Basin G is approximately 1.0 acres in size and consists of the west half of future Capital Drive. Runoff produced by the basin totals 3.8 cfs for the minor storm event (5-Year) and 6.7 cfs for the major storm event (100-Year). Runoff produced by the basin will be collected and conveyed by the curb and gutter of the roadway to a proposed low point located at **Design Point 8**. A pair of proposed 4' sump inlets located at proposed low point in the roadway at **DP8** will collect the runoff and 18" (**Pipe 107**) and 24" RCP (**Pipe 108**) storm drain pipes will convey the runoff westward to the proposed Pond 3. Should the inlets or pipes at **DP8** become clogged or blocked runoff reaching that location would be able to over top the curb and reach the proposed swale and ultimately the EFSCST.

Basin F consists of approximately 6.58 acres of future industrial development. **Basin F** has a proposed design flow rate of 20.0 cfs for the minor storm event (5-Year) and 37.2 cfs for the major storm event (100-Year). For the purposes of the MDDP, it is anticipated that runoff from **Basin F** and **DP 8** will be conveyed as surface drainage to western edge of the development to a private Full Spectrum Detention Pond located at **Design Point 6**. The cumulative flows at **DP6** are 27.5 and 50.6 cfs in the 5 and 100-year events, respectively.

Based upon contributing watershed characteristics, the UD-Detention worksheet (refer to hydraulic calculations portion of the appendix) estimates that a 1.4 ac-ft FSD Extended Detention Basin (EDB) (Pond 3) with a multi stage concrete outlet structure would be required to detain and discharge runoff at pre-development flow rates. A restricted 18" RCP (Pipe 105) would discharge runoff from the pond to the adjacent channel at a peak flow rate of approximately 0.5 and 6.0 cfs in the 5 and 100-year events, respectively. A riprap lined spillway and rip rap apron would be provided to dissipate energy and prevent local scour from the outlet pipe and in the case the emergency overflow was required to function. It should be noted that spillway will need to be traversable to allow for the maintenance acess atop of the relocated sanitary sewer. Should the inlet become clogged flows will over top the spillway and drain into the EFSCST.

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. Although two drainage reports have been provided by El Paso County, which discuss various portions of the area, limited information was obtained regarding how the development in its entirety is to function. Therefore assumptions were required to be made to complete this analysis and will likely need to be furthered with final design.

The size of the offsite watershed, topography, ground cover and development conditions were estimated to using USGS topography maps and aerial imagery and the Weatherford drainage report data. Since the full build out of the facility is not known at this time and the methods of onsite water quality detention and unclear, runoff from the basin was calculated under the assumption that the entire contributing watershed could be eventually developed for industrial usage and that an overflow path for the 100-year flows would need to be conveyed to the EFSCST channel. Runoff produced by the basin, under this assumption has been estimated to be 67.4 cfs for the minor storm event (5-Year) and 125.5 cfs for the major storm event (100-Year).

With the development of the subject site's industrial park, Capital Drive would likely be constructed along the frontage of the industrial development and the old roadway that currently fronts the Weatherford site would be abandoned or utilized as a service roadway for the business. In either instance the construction of the roadway could function to ensure that all offsite runoff is directed to the existing low point at **Design Point 7**. Currently a 24" and a 48" CMP culverts are located on the east and west side of existing Capital Drive to aid in collecting a portion of the runoff produced by **Basin OS-4**. The removal of the two existing culverts and the construction of either a new single 48" RCP culvert (**Pipe 106**) or multiple culverts with the same conveyance capacity will be needed to convey the offsite flows from **Design Point 7** (67.4 cfs/125.5 cfs) to the west side of Capital Drive.

Basin H consists of approximately 0.67 acres of the proposed industrial development area. **Basin H** has a proposed design flow rate of 2.5 cfs for the minor storm event (5-Year) and 4.7 cfs for the major storm event (100-Year). The basin emcompasses about ½ of the existing 80' wide roadway and utility easement dedicated for the extension of Genoa Road and utilities, however, the proposed plan will not seek to construct the DPBS recommended box culvert crossing at the EFSCST channel, and thereby leaving the property to remain as exists for maintenance access, utility and a drainage corridor. A proposed 1.5% sloped, 3.0' deep, 6' bottom width 2:1 SS riprap lined trapezoidal swale constructed within **Basin H** would function to collect runoff from **Design Point 9** (67.4 cfs/125.5 cfs) and convey it to **Design Point 10** (62.6 cfs/116.7 cfs) and protect the adjacent proposed industrial development. The proposed swale would terminate just upsteam of the embankment to the EFSCST where a pair of proposed 36" RCP culverts (**Pipes 109 & 110**) would discharge the 5-year and 100-year flows of 62.6 cfs and 116.7 cfs to EFSCST. The culverts would be recommended over daylighting the swale to the channel to reduce disruption in the EFSCST flows considering the limited available freeboard.

It should be noted that, at the time of the writing of this report, Kiowa Engineering is attempting to find a copy of the Simons Li and Associates Marksheffel Industrial Park Master Development Drainage Plan (1985) that may provide additional information regarding the planned conveyance routing of the offsite runoff adjacent to the proposed Industrial portion of the subject site. This maybe useful with subsequent design of the parcel and the preparation of the final drainage reports.

Basin I consists of approximately 5.03 acres of proposed single family residential lots and streets, located to the east of Marksheffel Road. **Basin I** has a proposed design flows rate of 6.6 cfs for the minor storm event (5-Year) and 15.9 cfs for the major storm event (100-Year). Runoff from **Basin I** will flow overland via side lot swales to the curb and gutter of the proposed roads and to a pair of proposed 5' at-grade inlets located at **DP13** (6.6 cfs / 15.9 cfs). Collected runoff is to be conveyed to **Design Point 14** (Full Spectrum Detention) via a proposed 18" RCP (**Pipe 113**) and a proposed 24" RCP (**Pipe 114**). Should the inlets become clogged flows could continue over top the curb to the pond and ultimately to the EFSCST.

Basin J consists of approximately 4.40 acres of proposed single family residential lots and streets, located in the middle of the development just to the east of Marksheffel Road. **Basin J** has proposed design flow rates of 5.8 cfs for the minor storm event (5-Year) and 14.1 cfs for the major storm event (100-Year). Runoff from **Basin J** will flow overland via side lot swales to the curb and gutter of the proposed roads and to a pair of proposed 4' sump inlets located at **Design Point 12** (5.8 cfs / 14.1 cfs). Collected runoff is to be conveyed to **Design Point 14** (Full Spectrum Detention) via a proposed 18" RCP (**Pipe 111**) and a proposed 24" RCP (**Pipe 112)**. Should the inlets at **DP12** become clogged flows will over top the high point and be routed via curb and gutter to **DP13**.

Basin Z consists of approximately 1.21 acres set aside for the construction of a proposed extended detention basin water quality pond. Runoff produced within **Basin Z** of 0.7 cfs for the minor storm event (5-Year) and 3.2 cfs will combine with runoff from **Pipe 112** and **Pipe 114** at **Design Point 14** where flows are expected to peak at 13.0 cfs and 32.8 cfs, in the 5 and 100 year events respectively. Based upon contributing watershed characteristics, the UD-Detention worksheet (refer to hydraulic calculations portion of the appendix) estimates that a 1.3 ac-ft FSD Extended Detention Basin (EDB) (**Pond D**) with a multi stage concrete outlet structure would be required to detain and discharge runoff at pre-development flow rates. A restricted 18" RCP (**Pipe 115**) would discharge runoff from the pond to the existing Sand Creek channel at a peak flow rate of approximately 0.3 and 10.5 cfs in the 5 and 100-year events respectively. A riprap lined spillway and rip rap apron would be provided to dissipate energy and prevent local scour from the outlet pipe and along the embankment slope. It should be noted that spillway may need to be traversable to allow for the maintenance/trail on the west side on the EFSCST.

Basin N consists of approximately 4.83 acres of open space and the rear half of residential lots located adjacent to Marksheffel Road to the south of Genoa Road. B**asin N** has a proposed design flows rate of 3.6 cfs for the minor storm event (5-Year) and 12.1 cfs for the major storm event (100-Year). Runoff from the area will flow overland via side lot swales a larger earthen swale that runs north-south along the subdivision boundary to an existing swale located north of existing **WQ Pond #5.** These flows combine with flows from existing **WQ Pond #5** (90.2 cfs / 180.3 cfs) at **Design Point 15** (88.5 cfs / 181.9 cfs). The WQ flows conveyed by the existing 18" RCP pipe and the 100 year flows overtopping the WQ pond spillway will be collected by the three proposed 42" culverts which route runoff under the proposed road and maintenance trail and will outfall into the EFSCST. It should be noted that the offsite regional flows tributary to the existing **WQ Pond #5** (Marksheffel Road included) will be routed through the site via the (3) 42" RCP's and thus consideration for facilities reimbursement should be given for conveyance of the public runoff through this private site.

Basin M is a small 2.89 acre basin located adjacent to a portion of the existing EFSCST channel. The basin consist of rear halves of several proposed residential lots and has proposed design flow rates of 3.0 cfs for the minor storm event (5-Year) and 9.3 cfs for the major storm event (100-Year). Runoff from **Basin M** will sheet flow overland and outfall into EFSCST.

Basin L consists of approximately 1.96 acres of proposed single family residential lots and streets, located in the middle of the development east of Marksheffel Road. **Basin L** has proposed design flow rates of 2.8 cfs for the minor storm event (5-Year) and 6.8 cfs for the major storm event (100-Year). Runoff from **Basin L** will flow overland via side lot swales to the curb and gutter of the proposed roads, to a proposed 4' sump inlet located at **Design Point 16** (2.8 cfs / 6.8 cfs). Collected runoff is to be conveyed ultimately to **Design Point 25** (Full Spectrum Detention) via a proposed 18" RCP (**Pipe 117**). Should the inlet at **DP16** become clogged flows will over top the curb and be routed via a swale to EFSCST.

Basin P consists of approximately 7.95 acres of proposed single family residential lots and streets, located in the middle of the development east of Marksheffel Road **Basin P** has proposed design flow rates of 9.8 cfs for the minor storm event (5-Year) and 23.8 cfs for the major storm event (100-Year). Runoff from **Basin P** will flow overland via side lot swales to the curb and gutter of the proposed roads, to a pair of proposed 10' at-grade inlets located at **Design Point 31** (9.8 cfs / 23.8 cfs). Collected runoff is to be conveyed via proposed 18" RCP's (**Pipe 138 & Pipe 139**) and proposed 24" RCP **Pipe 140** (9.8 cfs / 23.8 cfs) to **Design Point 25** (Full Spectrum Detention). Should the inlet at **DP31** become clogged flows will continue down the street via a curb and gutter to **Design Point 21**.

Basin O consists of approximately 4.48 acres of open space and the rear half of residential lots located adjacent to Markshefflel Road. B**asin O** has proposed design flow rates of 2.6 cfs for the minor storm event (5-Year) and 9.9 cfs for the major storm event (100-Year). Runoff from the area will be routed southward within a swale that runs north-south along the subdivision boundary to **Design Point 17** (2.6 cfs / 9.9 cfs), an existing area inlet. Care should be taken during final design to ensure that the proposed grading in the area works with the existing utilities. The proposed flows at Design Point 17 are less than the existing flows of (1.5 cfs /11.5 cfs). The flows will not adversely affect the downstream infrastructure.

Basin II is a small 0.52 acre basin located north of the proposed commercial site at the south end the project area. The basin consist of rear halves of several proposed residential lots and has proposed design flows rate of 0.9 cfs for the minor storm event (5-Year) and 2.2 cfs for the major storm event (100-Year). Runoff from **Basin II** will sheet flow overland and outfall into **Basin Q** (proposed commercial site).

Basin Q consists of approximately 4.09 acres of proposed commercial property located adjacent to Markshefflel Road, north of Constitution Avenue. **Basin Q** has a proposed design flow rates of 16.3 cfs for the minor storm event (5-Year) and 29.8 cfs for the major storm event (100-Year). For the purposes of the MDDP, it is anticipated that the combined runoff from **Basin Q** and **Basin II** will be conveyed as surface drainage to southwestern edge of the development to a proposed private Full Spectrum Detention Pond located at **Design Point 18** (16.1 cfs / 30.0 cfs).

Based upon contributing watershed characteristics, the UD-Detention worksheet (refer to hydraulic calculations portion of the appendix) estimates that a 0.82 ac-ft full spectrum Extended Detention Basin (Pond 4) with a multi stage concrete outlet structure would be required to detain and discharge runoff at pre-development flow rates. A restricted 18" RCP (Pipe 118) would discharge runoff from the pond at a peak flow rate of approximately 0.4 and 3.2 cfs in the 5 and 100-year events, respectively. Runoff from the Pond would combined with flows intercepted by the area drain at **Design Point 19** (3.0 cfs /13.8 cfs) where a existing 30" RCP would convey flows to existing downstream facilities. This combined flow is less than what was planned for the 30” as indicated by the Wilson & Company storm sewer construction plans. It should be noted that in final design the planned discharge from the emergency spillway would be best routed to the existing area drain, however this may be impacted by the site grading.

Basin JJ is a small 0.48 acre basin located north of the proposed commercial site at the south end the project area. The basin consist of rear halves of several proposed residential lots and has proposed design flows rate of 0.8 cfs for the minor storm event (5-Year) and 2.0 cfs for the major storm event (100-Year). Runoff from **Basin JJ** will sheet flow overland and outfall into a lowpoint in **Basin R** (proposed commercial site).

Basin R consists of approximately 2.91 acres of proposed commercial property located adjacent to existing Constitution Avenue. B**asin R** has a proposed design flows rate of 8.9 cfs for the minor storm event (5-Year) and 16.2 cfs for the major storm event (100-Year). Runoff from the basin is anticipated to be collected at a low point at the south end of the property by a proposed 18” RCP (**Pipe 129**). It is anticipated that the combined runoff from **Basin R** and **Basin JJ** will be collected at a low point at the north end of the commercial site by a proposed 24” RCP (Pipe 130). A proposed combined flow at **Design Point 24** (9.5 cfs / 17.8 cfs) will be routed via a 24” RCP (Pipe 130) to a proposed full spectrum detention pond 5 located to the east of the area. The proposed commercial property shall require a finished grade elevation of 6459.00 in order to utilize the FSD Pond 5. Otherwise the future commercial site will have to provide its own FSD Pond.

Basin S consists of approximately 4.46 acres of proposed single family residential lots and streets, located to the north of Constitution Avenue and east of Marksheffel Road. **Basin S** has proposed design flows rate of 6.0 cfs for the minor storm event (5-Year) and 14.5 cfs for the major storm event (100-Year). Runoff from **Basin S** will flow overland via side lot swales to the curb and gutter of the proposed roads and to a proposed 8' sump inlet located at **DP21** (6.0 cfs / 14.5 cfs). A proposed 24" RCP (Pipe 123) will convey the collected runoff east under the local street and to a proposed full spectrum detention pond 5. Should the inlet become clogged flows will over top the curb and gutter and continue east to **DP22** within the proposed street.

Basin T consists of approximately 1.89 acres of proposed park area, located to the north of Constitution Avenue and east of Marksheffel Road. **Basin T** has a proposed design flows rate of 0.6 cfs for the minor storm event (5-Year) and 4.2 cfs for the major storm event (100-Year). Runoff from **Basin T** will sheet flow overland and be capture by a swale east of the proposed road. Flows will be captured by a CDOT type C inlet at **DP23** (0.6 cfs / 4.2 cfs). A proposed 18" RCP (Pipe 128) will convey the collected runoff south to a proposed full spectrum detention pond 5. Should the inlets become clogged flows will over top localized high point and continue south and outfall into the proposed full spectrum detention pond 5.

Basin U consists of approximately 4.97 acres of proposed single family residential lots and streets, located to the south and east of **Basin T**. **Basin U** has a proposed design flows rate of 6.8 cfs for the minor storm event (5-Year) and 16.6 cfs for the major storm event (100-Year). Runoff from **Basin U** will flow overland via side lot swales to the curb and gutter of the proposed roads and to a pair of proposed 4' sump inlets located at **DP20** (6.8 cfs / 16.6 cfs). Collected runoff is to be conveyed via proposed 18" RCP’s (**Pipe 119 & Pipe 120**) and will combine with **Pipe 140** to be routed by a proposed 30” RCP **Pipe 121** (15.9 cfs /38.7 cfs) to **Design Point 25** (Full Spectrum Detention). Should the inlet at **DP20** become clogged flows will over top the street high point and be routed via a curb and gutter to **Design Point 22**. **Pipe 121** will combine with **Pipe 117** and be routed via a proposed 30” RCP **Pipe 122** (18.4 cfs /44.6 cfs) to **Design Point 22.**

Basin V consists of approximately 0.87 acres of proposed commercial property located adjacent to existing Constitution Avenue. **Basin V** has a proposed design flows rate of 3.7 cfs for the minor storm event (5-Year) and 6.8 cfs for the major storm event (100-Year). B**asin V** will flow overland to curb and gutter of the proposed road and to a pair of proposed 6' sump inlets located at **DP22 .** These flows will be routed via a 42" RCP to a proposed full spectrum detention pond 5 located to the east of the area. Should the inlets become clogged flows will over top curb and gutter and outfall into the proposed pond 5.

Basin KK consists of approximately 1.80 acres of proposed single family residential lots and streets, located to the east of **Basin KK**. **Basin KK** has proposed design flows rate of 2.7 cfs for the minor storm event (5-Year) and 6.6 cfs for the major storm event (100-Year). Runoff from **Basin KK** will flow overland via side lot swales to the curb and gutter of the proposed roads and to a pair of proposed 6' sump inlets located at **DP22**. The cumulative surface runoff from **Basin KK** and **Basin V** to **DP22** (9.4 cfs / 21.3 cfs). Runoff at **DP22** will be routed via proposed 18" RCP's (**Pipe 124 and Pipe 126**). The routed flows from **Pipe 122** thru **Pipe 126** will combined in **Pipe 127** (32.4cfs / 77.2 cfs) . These flows will be routed via a 42" RCP to a proposed full spectrum detention pond 5.

Basin W consists of approximately 1.32 acres set aside for the construction of a proposed extended detention basin water quality pond. Runoff produced within **Basin W** of 0.8 cfs for the minor storm event (5-Year) and 3.5 cfs will combine with runoff from **Pipe 127, Pipe 128** and **Pipe 130** at **Design Point 25** where flows are expected to peak at 41.8 cfs and 99.2 cfs, in the 5 and 10 year events respectively. Based upon contributing watershed characteristics, the UD-Detention worksheet (refer to hydraulic calculations portion of the appendix) estimates that a 3.0 ac-ft FSD Extended Detention Basin (EDB) (**Pond 5**) with a multi stage concrete outlet structure would be required to detain and discharge runoff at pre-development flow rates. A restricted 24" RCP (**Pipe 131**) would discharge runoff from the pond to the channel at a peak flow rate of approximately 0.7 and 38.6 cfs in the 5 and 100-year events respectively. A riprap lined spillway and rip rap apron would be provided to dissipate energy and prevent local scour from the outlet pipe and along the embankment slope. It should be noted that spillway may need to be traversable to allow for the maintenance/trail on the west side on the EFSCST. Should the inlet become clogged flows will over top the spillway and drain into the EFSCST.

Basin Y consists of approximately 1.77 acres of proposed commercial property located adjacent to Constitution Avenue. **Basin Y** has a proposed design flow rates of 7.3 cfs for the minor storm event (5-Year) and 13.3 cfs for the major storm event (100-Year). For the purposes of the MDDP, it is anticipated that the combined runoff from **Basin Y** will be conveyed as surface drainage to south edge of the development to a proposed Full Spectrum Detention Pond 6 located at **Design Point 26** (7.3 cfs / 13.3 cfs).

Based upon contributing watershed characteristics, the UD-Detention worksheet (refer to hydraulic calculations portion of the appendix) estimates that a 0.32 ac-ft full spectrum Extended Detention Basin (EDB) (Pond 6) with a multi stage concrete outlet structure would be required to detain and discharge runoff at pre-development flow rates. A restricted 18" RCP (Pipe 132) would discharge runoff from the pond at a peak flow rate of approximately 0.2 and 1.2 cfs in the 5 and 100-year events, respectively. Should the inlet become clogged flows will over top the spillway and to EFSCST.

Basin GG is a small 0.40 acre basin located east of EFSCST at the south end the project area. The basin consist of rear halves of several proposed residential lots and has proposed design flows rate of 0.6 cfs for the minor storm event (5-Year) and 1.6 cfs for the major storm event (100-Year). Runoff from **Basin GG** will sheet flow overland and outfall into a lowpoint in **Basin HH** (proposed park site).

Basin HH consists of approximately 5.39 acres of proposed park area, located to the east of EFSCST at the south end of the project area. **Basin HH** has a proposed design flow rates of 1.7 cfs for the minor storm event (5-Year) and 11.2 cfs for the major storm event (100-Year). Runoff from **Basin HH** will sheet flow overland and be capture by a swale east of the EFSCST. Flows will be captured by a CDOT type C inlet at **DP27** (2.2 cfs / 12.5 cfs). A proposed 18" RCP (Pipe 136) will convey the collected runoff south to a proposed full spectrum detention pond 7.

Basin AA consists of approximately 4.68 acres of proposed single family residential lots and streets, located to the south end of the project area. **Basin AA** has proposed design flow rates of 6.1 cfs for the minor storm event (5-Year) and 14.8 cfs for the major storm event (100-Year). Runoff from **Basin AA** will flow overland via side lot swales to the curb and gutter of the proposed roads and to a pair of proposed 6' sump inlets located at **DP28**. The cumulative surface runoff will be routed via a 30" RCP to a proposed Full Spectrum Detention Pond 7.

Basin BB consists of approximately 4.67 acres of proposed single family residential lots and streets, located to the south end of the project area. **Basin BB** has proposed design flow rates of 6.1 cfs for the minor storm event (5-Year) and 14.9 cfs for the major storm event (100-Year). Runoff from **Basin BB** will flow overland via side lot swales to the curb and gutter of the proposed roads and to a pair of proposed 6' sump inlets located at **DP28**. The combined will be routed via a two 18" RCP (Pipe 133 and Pipe 134) to a 24" RCP **Pipe 135** (12.2 cfs / 29.5 cfs) and ultimately to a proposed Full Spectrum Detention Pond 7.

Basin CC consists of approximately 0.93 acres set aside for the construction of a proposed extended detention basin water quality pond. Runoff produced within **Basin CC** of 0.6 cfs for the minor storm event (5-Year) and 2.7 cfs will combine with runoff from **Pipe 135** and **Pipe 136** at **Design Point 29** where flows are expected to peak at 14.8 cfs and 44.1 cfs, in the 5 and 10 year events respectively. Based upon contributing watershed characteristics, the UD-Detention worksheet (refer to hydraulic calculations portion of the appendix) estimates that a 1.7 ac-ft FSD Extended Detention Basin (EDB) (**Pond 7**) with a multi stage concrete outlet structure would be required to detain and discharge runoff at pre-development flow rates. A restricted 18" RCP (**Pipe 137**) would discharge runoff from the pond to the channel at a peak flow rate of approximately 0.4 and 16.2 cfs in the 5 and 100-year events respectively. A riprap lined spillway and rip rap apron would be provided to dissipate energy and prevent local scour from the outlet pipe and along the embankment slope. It should be noted that spillway may need to be traversable to allow for a maintenance/trail on the west side on the EFSCST. Should the inlet become clogged flows will over top the spillway and drain into the EFSCST.

Basin X is approximately 2.95 acres in size and consists of an improved section of the EFSCST. **Basin X** has a proposed design flow rate of 1.5 cfs for the minor storm event (5-Year) and 6.6 cfs for the major storm event (100-Year). Refer to Proposed Channel Improvements section of the report for addition information regarding the EFSCST.

Basin OS6 is a small 1.15 acre basin located west of Capital Drive at the south end the project area. The basin consist of an existing fire station which is discussed in "Drainage Letter Report for Falcon Fire Station No.4 2710 Capital Drive, El Paso County, CO," prepared by JPS Engineering, dated rev. May 2016. Per the report the runoff is 3.8 cfs for the minor storm event (5-Year) and 8.0 cfs for the major storm event (100-

Year). Per the report, flows are routed to a Rain Garden water quality pond and then are routed into the existing storm sewer system, in Capital Drive.

Basin DD is a small 0.68 acre basin located east of EFSCST at the south end the project area. The basin consist of rear halves of several proposed residential lots and has proposed design flows rate of 0.6 cfs for the minor storm event (5-Year) and 2.1 cfs for the major storm event (100-Year). Runoff from **Basin DD** will sheet flow overland and be routed via a swale to the curb and gutter in Capital Drive. The routed flows will be captured by an existing 10" type R inlet. The developed flows for **Basin DD** are less than the combined historic flows for **Basin DD** and **Basin OS6** (0.6 cfs / 4.2 cfs).

Basin EE is a small 1.66 acre basin adjacent to Capital Drive, at the south end the project area. The basin consist of rear halves of several proposed residential lots and has proposed design flows rate of 1.4 cfs for the minor storm event (5-Year) and 5.0 cfs for the major storm event (100-Year). Runoff from **Basin EE** will sheet flow overland and outfall onto Capital Drive which will be routed south to Constitution Avenue. The proposed runoff that outfall onto Capital Drive are less than the historic flows calculated for **Basin EXM** (2.9 cfs /21.6 cfs).

Basin FF is a small 0.86 acre basin adjacent to Constitution Avenue, at the south end the project area. The basin consist of rear halves of several proposed residential lots and has proposed design flows rate of 0.8 cfs for the minor storm event (5-Year) and 2.7 cfs for the major storm event (100-Year). Runoff from **Basin FF** will sheet flow overland and outfall onto Constitution Avenue. The proposed runoff that outfall onto Constitution Avenue are less than the historic flows calculated for **Basin EXM** (2.9 cfs /21.6 cfs).

FOUR STEP PROCESS

Step 1 Employ Runoff Reduction Practices. –Approx. 8.7 Acres of ground within the project is being set aside for Open Space/Neighborhood Park. Roof drains will be directed to side yard swales and as possible to a grass lined swale will be constructed to aid minimize direct connection of impervious surfaces.

Step 2 Implement BMPs that provide a water quality capture volume with slow release. – Multiple Full Spectrum Detention Facilities are planned for the site which will incorporate water quality capture volumes that are intended to slowly drain in 40 hours and excess urban runoff volumes that are intended to drain within 72 hours.

Step 3 Stabilize streams. – The development of the site will stabilize the unimproved sections of the EFSCST through the installation of soil-filled riprap side slopes and buried toe protection, grouted boulder and grouted riprap drop structures with concrete cutoff walls and riprap aprons will reduce the overall channel slope. Additionally the runoff from the proposed residential commercial and industrial developments will be reduced to predevelopment conditions thru the construction and utilization of several full spectrum detention facilities. A few onsite constructed grasslined swales are also to be constructed which to convey runoff and provide water quality benefits.

Step 4 Implement site specific and other source control BMPs. – The proposed project will use silt fence, a vehicle tracking control pad, concrete washout area, inlet protection, check dams, sediment control logs, mulching and reseeding to mitigate the potential for erosion across the site.

INTERBASIN TRANSFER EAST FORK SAND CREEK TO EAST FORK SAND CREEK SUBTRIBUTARY

It should be noted that the proposed development plan for the 114.30 acre of The Sands redistributes portion of the small percentage of the historic watershed between East Fork Sand Creek and East Fork Sand Creek Subtributary drainage basins.

Prior to development approximately 101.33 acres of The Sands runoff was collected by the East Fork Sand Creek Subtributary watershed with the remaining 13.00 acres directed to the East Fork Sand Creek.

After development approximately 9.80 acres will be redirected from the East Fork Sand Creek into the East Fork Sand Creek Subtributary, resulting in 111.13 acres of The Sands directed to the East Fork Sand Creek Subtributary.

This modification is minor resulting in a 9.1% change which is driven primarily by grading constraints associated with the lot layout and existing topography coupled with a sensible utility layout.

EAST FORK SAND CREEK SUB-TRIBUTARY PROPOSED CONCEPT CHANNEL IMPROVEMENTS AND HYDRAULIC ANALYSIS

As mentioned, two segments of the EFSCST channel require improvement with the planned development. The two segments of proposed channel improvements recommended by M&S Civil Consultant are intended provide 100-year flood flow conveyance capacity through the proposed Sands development while creating a contiguous channel section that incorporates and/or mimics the previously approved existing segment of channel in the center of the site, thereby bringing stability and uniformity to the subject reach. A summary of the proposed concept improvements is as follows:

The southern segment of channel reach slated for improvement is approximately 1415’ in length. This improved concept channel section is currently planned to be constructed at slope of 0.5% and consists of a trapezoidal section with a 40’ bottom. The concept channel possess a sand invert with 2’ thick Type ‘M’ riprap lined 2.5:1 side slopes a top of granular bedding material and a drainage fabric. In this example, four (4) 3’ concrete vertical drop structures with full width 3’ thick riprap aprons located upstream and downstream of the proposed drops will aid in taking up the vertical differential associated with flatting the slope to a 0.5%. Based upon Figure 12-4 illustrated in the DCM, a channel with approximately 1720 cfs and no sediment supply would seek an equilibrium slope of approximately 0.22%. In the event that the sediment supply was no longer available and the channel sought a slope of 0.22%, the proposed improvements could be design to be stable a maximum of 5’ vertical at the lowest drop (No.1) and the subsequent 3 drops (Nos. 2, 3, and 4) vertical wall exposure increasing to 3.5’. Final design could include minor modifications such a extending the toe of the channel lining and creating a sloped riprap scour protection that would further stabilize the channel to a flatter equilibrium slope. The typical channel section will need to be a minimum of 6’ deep or deeper where addition freeboard is required based upon the final super elevation calculations.

The north segment of channel reach is approximately 1130’ feet in length and the concept design for this section of the channel could be designed to mimic the south reach in that the channel invert is to be constructed at slope of 0.5% and also consists of a trapezoidal section with a 40’ bottom. Similarly, the proposed channel will possess a sand invert with 2’ thick Type ‘M’ riprap lined 2.5:1 side slopes a top of granular bedding material and a drainage fabric, which would also extend a min of 3’ below the channel invert. The channel improvements for this segment, could also include the construction of one (1) riprap grade control check structure, one (1) 3' concrete vertical drop structures with full width 3' thick riprap aprons located upstream and downstream of the proposed drop. A dual maximum 6' tall grouted boulder drop structures could be constructed immediately downstream of the existing concrete lined section to aid in providing a more bullet proof drop structure immediately downstream of where the channel flows is most consolidated. In the event that the sediment supply was no longer available and the channel, sought a 0.22% slope the proposed improvements remain stable with 2.5 feet exposed of the sloping check structure, 2 additional feet of vertical at drop No.5 (5' total) and about 1' of the toe of the grouted boulder drop structure to be exposed. Similarly minor modifications to the channel lining and extended scour protection may be evaluated to reduce the need for long term maintenance. A copy of the concept construction plans for the EFSCST channel improvements is included in the appendix of this report.

It should be noted that the quantitiy of the number of proposed channel improvements is greater than what was anticipated by the DBPS. This is due in part to the changes in criteria, which function ultimately to reduce the allowable channel slope, and there by increases the need to address a greater more vertical differential.

EAST FORK SAND CREEK SUB-TRIBUTARY HYDROLOGIC MODELING

Hydrologic modeling of the proposed site and the contributing offsite EFSCST watershed was not performed as a portion of the analysis; instead the future anticipated peak flow rates as defined within the approved Sand Creek Drainage Basin Planning Study (SCDBPS) of 950 cfs in the 10-year event and 1,720 cfs in the 100-year event were utilized in concept channel modeling. As discussed these flow rate should be adequately conservative considering the proposed Sands development and upper watershed development north of the site will implement Full Spectrum Detention.

In addition to the aforementioned flow rates the current Flood Insurance Study flow rate accepted by FEMA of 1,970 cfs and an assumed flow rate or 475 cfs were also initially modeled. It should be noted that the CLOMR submittal will utilize the higher FEMA flow rate.

The existing flow rates defined by the SCDBPS of 1,330cfs and 240 cfs were not evaluated.

EAST FORK SAND CREEK SUB-TRIBUTARY TOPOGRAPHIC DATA

The existing drainage features integrated into the hydraulic model were developed from an as-built topographic survey conducted by Barron Land Survey as part of an ALTA survey. The data was collected during November of 2015. Where data was not present construction drawing data was utilized in the conceptual analysis. Supplement surveys has been performed by M&S Civil during the summer and fall of 2017 that will be utilized in final design and the subsequent CLOMR submittal.

EAST FORK SAND CREEK SUB-TRIBUTARY HYDRAULIC ANALYSIS

Two hydraulic models representing the proposed and existing channel segments within the subject reach were created using the USACE HEC-RAS computer program. The geometry and flow rates analyzed in the two models are identical, however in accordance with the Drainage Criteria Manual, the Manning's' values utilized in the two models were adjusted to evaluate various channel flow characteristics. All models were processed using upstream boundary conditions of normal depth at 0.0064 feet per foot and a downstream boundary condition of critical depth. The models were run using a mixed flow regime.

The first model evaluated velocities, shear and Froude numbers values within the channel. This model utilized Manning's 'n' values of 0.013 for concrete surfaces, 0.03 for sandy bed channel, 0.04 for Type 'M' riprap channel bottom, 0.045 for Type 'M' riprap channel side slope protection, and 0.05 where grouted Boulders were present on the channel bottom and 0.06 where boulder lining was present on the side slopes.

The second model is intended to evaluate the channel for water surface elevation and water depth. This model utilized Manning's 'n' values of 0.017 for concrete surfaces, 0.04 for sandy bed channel, 0.05 for Type 'M' riprap channel bottom, 0.055 for Type 'M' riprap channel side slope protection, and 0.06 where grouted Boulders were present on the channel bottom and 0.07 where boulder lining was present on the side slopes. The above sets of values appear to be in line with the recommendations from the City of Colorado Springs and Urban Drainage and Flood Control District.

It should be noted that the existing portion of the channel in the center of the site (portion improved with Rocky Mountain Industrial Park) was sediment laden possessing as much as 2' of deposition. The provided model was ran under the assumption that this portion of the channel was cleared or dredged of material and brought to its intended grade. Additional coordination with El Paso County will be required to complete the effort.

EAST FORK SAND CREEK SUB-TRIBUTARY CONCEPT MODELING RESULTS

The HEC-RAS hydraulic models ran yielded 100-year maximum depths associated with the proposed channel sections that ranged from 3.22' to 7.18' while the maximum 100-year depth associated with the existing channel section ranged from 2.60' to 5.11'.

The velocities associated within the 100-year event ranged from 2.59 to 9.70 feet per second on the embankment slopes to 5.18 to 18.20 feet per second on the channel bottoms along the proposed channel segments, while velocities associated with the 100-year event ranged from 4.45 to 13.48 feet per second on the embankment slopes to 10.38 to 19.15 feet per second along the channel bottom of the existing section.

The shear associated with the 100-year event ranged from 0.47 to 4.77 pounds per square foot on the embankment slopes to 0.46 to 10.14 pounds per square foot on the channel bottoms throughout the proposed channel section, while shear values associated with the 100-year event ranged from 0.70 to 3.23 pounds per square foot on the embankment slopes to 1.68 to 6.97.feet pounds per square foot along the existing channel bottom of the existing section

Froude numbers in the 100-year event ranged from 0.35 to 1.79 along the proposed channel and 0.7 to 2.18 along the existing channel section.

HEC-RAS input and output associated with the open channel analysis is contained in the appendix of this report. The output data includes various channel information for all analyzed cross sections for both the existing and proposed channel segments at the FIS, 100-year, 10-year and estimated 5-year flow rates.

ANTICIPATED DEVIATIONS FROM CRITERIA AND APPROVAL

As discussed a matrix showing the anticipated deviations from the City of Colorado Springs Drainage was presented and discussed at the meeting. This matrix with additional supplemental design backup data was submitted email to City Engineering on the July 31st for record. A copy of that submittal package is provided in the appendix of the report for reference. It should be noted that a few minor modifications to the HEC-RAS models were made to increase accuracy of the model against the current design which included some of the requested modifications by city staff.   Do to the limited changes the output; the revised models are not included with this report. A final design report with final construction drawings will be submitted back to the City concurrently with the CLOMR submittal once it is ready.

REQUESTED MODIFICATIONS AND CONDITIONAL CONCEPT PLAN APPROVAL

City of Colorado Spring Water Resources Engineering Division Review Staff members verbally indicated that the concept design should be modified so that the buried riprap toe protection of the drop structures check structures and channel lining be extended down to the anticipated 0.22% equilibrium slope.   In addition they would like to see a concrete cutoff walls incorporated into the check structures if they are used in final design. An email correspondence was sent out by staff on August 1st indicated that if the discussed changes were incorporated into final design, they would provide conditional concept approval, which basically indicates that they would not require major design changes that would otherwise place a CLOMR submittal to FEMA at risk, this however to not guarantee immediate approval and individual deviation request would also need to be submitted with the final plans.

ADDITIONAL CHALLENGES AND CONCERNS REGARDING FINAL ENGINEERING FOR THE SANDS

Even after the importation of significant earthen material to raise the proposed development to elevations higher than the surrounding developments, the relative vertical differential between the Sand Creek East Fork Sub-Tributary Channel and the proposed development is limited.   The resultant is that there is limited hydraulic head to drain onsite subsurface systems. One way to reduce the required head is to recommend the installation of oversized internal infrastructure to slow velocities, and thereby limit hydraulic losses to ensure functioning drainage systems.   Currently concept level onsite hydraulic analysis and sizing of the recommended proposed infrastructure within this report assumes that the EFSCST is operational and the starting hydraulic grade for analysis of onsite systems is based upon the channel conveying the 10 year storm per the DBPS of 950 cfs. This is a logical approach, given that the coincidence of both the 100 year event onsite and in the adjacent channel occurring simultaneously would be rare considering the size of the overall contributing watershed when compared to the relatively small development. Flap gates on the outfall facilities are recommended to further reduce the impacts to the site when the channel is running full. It should be noted that in the case that onsite facilities became clogged or were not functioning, the proposed development can be graded in a manner that can safely direct surface runoff via swales and spillways to the channel. The recommended placement of the detention facilities being adjacent to the EFSCST makes this achievable.

It should be noted that additional coordination with the Cherokee Metro District will be required regarding the crossing of and relocation of existing utilities required to perform the work. Additional coordination with El Paso County will be required regarding removal of sediment and channel connection work outside the site property boundaries.

NATIONWIDE PERMITTING FOR CONSTRUCTION AND DETERMINATION REGARDING THREATENED AND ENDANGERED SPECIES OR HISTORIC PROPERTIES

The Army Corps of Engineers, Southern Colorado Regulatory Office has determined that the proposed channel work consisting of grade control channel realignment and channelization associated for the East Fork Sand Creek Subtribtuary will not affect any federally listed threatened or endangered species or any historic properties listed, or eligible of listing in the Nation Register of Historic Places, and has been granted a Nationwide Permit (No .29) to perform the work under the assumption that all other permits are in place. A copy of the cover letter has been included in the appendix of this report.

CONSTRUCTION COST OPINION (PRELIMINARY)

The Sands Drainage Facilities (Public, **Non-Reimbursable**)

Item	Description	Quantity	Unit Cost		Cost
1	18" RCP	1,488	$40	/LF	$59,520.00
2	24" RCP	1,440	$50	/LF	$72,000.00
3	30" RCP	615	$65	/LF	$39,975.00
4	36" RCP	110	$75	/LF	$8,250.00
5	18" FES	9	$235	/EA	$2,115.00
6	24" FES	7	$335	/EA	$2,345.00
7	36" FES	4	$475	/EA	$1,900.00
8	4' CS D-10-R Sump	5	$3,000	/EA	$15,000.00
9	6' CS D-10-R Sump	2	$4,000	/EA	$8,000.00
10	8' CS D-10-R Sump	7	$5,000	/EA	$35,000.00
11	5' CS D-10-R At-Grade	2	$4,000	/EA	$8,000.00
12	10' CS D-10-R At-Grade	2	$7,000	/EA	$14,000.00
13	CDOT Type C Area Inlet	2	$3,000	/EA	$6,000.00
					$272,105.00

The Sands Drainage Facilities (Private, **Non -Reimbursable**)

Item	Description	Quantity	Unit Cost		Cost
1	18" RCP	570	$40	/LF	$22,800.00
2	24" RCP	321	$50	/LF	$16,050.00
3	Pond 1 w/Outlet Struc	1	$20,000	/EA	$20,000.00
4	Pond 2 w/Outlet Struc	1	$20,000	/EA	$20,000.00
5	Pond 3 w/Outlet Struc	1	$20,000	/EA	$20,000.00
6	Pond D w/Outlet Struc	1	$30,000	/EA	$30,000.00
7	Pond 4 w/Outlet Struc	1	$20,000	/EA	$20,000.00
8	Pond 5 w/Outlet Struc	1	$30,000	/EA	$30,000.00
9	Pond 6 w/Outlet Struc	1	$20,000	/EA	$20,000.00
10	Pond 7 w/Outlet Struc	1	$30,000	/EA	$30,000.00
					$228,850.00

The Sands Drainage Facilities (Public, **Reimbursable w/Approval***) – Not formally addressed in DBPS

Item	Description	Quantity	Unit Cost		Cost
1	42" RCP	695	$85	/LF	$59,075.00
2	42" FES	7	$775	/EA	$5,425.00
3	Conc. Headwall	1	$9,000	/LF	$9,000.00
					$73,500.00

*****Offsite regional flows tributary to the existing **WQ Pond #5** (Marksheffel Road included) will be routed through the site via three (3) - 42" RCP and concrete headwall structure. Reimbursement of the facilities listed above will be subject to approval by Drainage Board.

DBPS REIMBURSABLE PUBLIC DRAINAGE FACILITIES

Item	Description	Quantity	Unit Cost	Cost
Remaining DBPS Reach 19 Sand Creek Sub-tributary Channel Improvements (1996 Dollars)				
1.	100-Yr Riprap Selective Lining	2,550 LF	$234/LF	$ 596,700.00
2.	Channel Grade Control Structures	4/EA	$18,900/EA	$ 75,600.00
			Total=	**$ 672,300.00**

Reach 19 Sand Creek Sub-tributary Channel Improvements (2018 Dollars)

1.	Channel Improvements	***$1,429,309.80**

*Unit cost of improvements increased by factor of 2.126 for inflation (2018 Dollars).

(Based upon City of Colorado Springs Basin Fees Increases 1996 to 2018)

The DBPS data is from the Table VII-2 and VII-7 "Drainage Conveyance Cost Estimate with Selected Alternatives, page 69 and 84. The length of lining and number of structures listed above deducts from the total, the Reach 19 improvements previously constructed with Rocky Mt Industrial Park, Filing No.1.

Sand Creek Improvements - (Public, **Reimbursable)** - Sand Creek Improvements

Item	Description	Quantity	Unit Cost	Cost
1.	100-Yr Riprap Selective Lining	2550 LF	$260/LF	$ 663,000.00
2.	Vert Channel Grade Cont.	4/EA	$50,550/EA	$ 202,200.00
				$ 865,200.00

Sand Creek Improvements - (Public, **Reimbursable w/ Approval*)** - – Not formally addressed in DBPS

Item	Description	Quantity	Unit Cost	Cost
1.	*Add Vert Channel Grade Cont.	2/EA	$50,550/EA	$ 101,100.00
2.	*Add Channel Grade Cont. Check	1/EA	$22,250/EA	$ 22,250.00
3.	*Add Grouted Boulder Drop Struc	1410/SY	$160/SY	$ 225,600.00
				$ 348,950.00

***** Additional structures required to stabilize channel (subject to approval by Drainage Board).

All Reimbursable facility determinations are preliminary, and are subject to approval by the City/County drainage board. Revisions may be made with Final Drainage Report (s). An exhibit map showing the DBPS proposed improvement locations has been included in the appendix of this report.

DRAINAGE BRIDGE & POND FEES

Approximately 114.303 of the proposed subdivision lies within the Sand Creek Drainage Basin. The 2018 Drainage Bridge and Pond fees per the City of Colorado Springs for The Sands are as follows;

Drainage Fee:	$11,851/acre x 114.303 acres	$1,354,604.85
Bridge Fee:	$ 713/acre x 114.303 acres	$81,498.04
Pond Fee (Land):	$ 1,070/acre x 114.303 acres	$122.304.21
Pond Fee (Facilities):	$ 3,445/acre x 114.303 acres	$393,773.84
	Total fees:	**$ 1,952,180.94**

Public Facilities:		
Total Drainage Fees		$1,354,604.85
Total public, Reimbursable drainage facilities		$1,429,309.80
Total Drainage Fees Due	difference/credit	$ -74,704.95
Estimated Additional Reimbursable Onsite & Channel drainage facilities*		$ 74,704.95
(Not formally addressed in DBPS)		$348,950.00
	difference/credit	$423,654.95

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 2018. Upon completion of the aforementioned improvements, M & S shall submit the actual construction costs to the City of Colorado Springs/City Drainage Board for reimbursement.

SUMMARY

Proper implementation of the concepts presented in this MDDP will provide for the development of the proposed site without negative impacts to the receiving water course and surrounding developments. The final location of all the proposed storm water conveyances and permanent BMP’s shall be finalized with future drainage reports. At such time all necessary drainage easements and rights of way shall also be defined.

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.) "Drainage Letter Report for Falcon Fire Station No. 4, 2710 Capital Drive, El Paso County CO", prepared by JPS Engineering, revised May 12, 2016.

8.) "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.

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

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

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

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

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

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

15.) Marksheffel Road Drainage Bid Set, prepared by CH2MHill and Wilson & Company, August 2009.

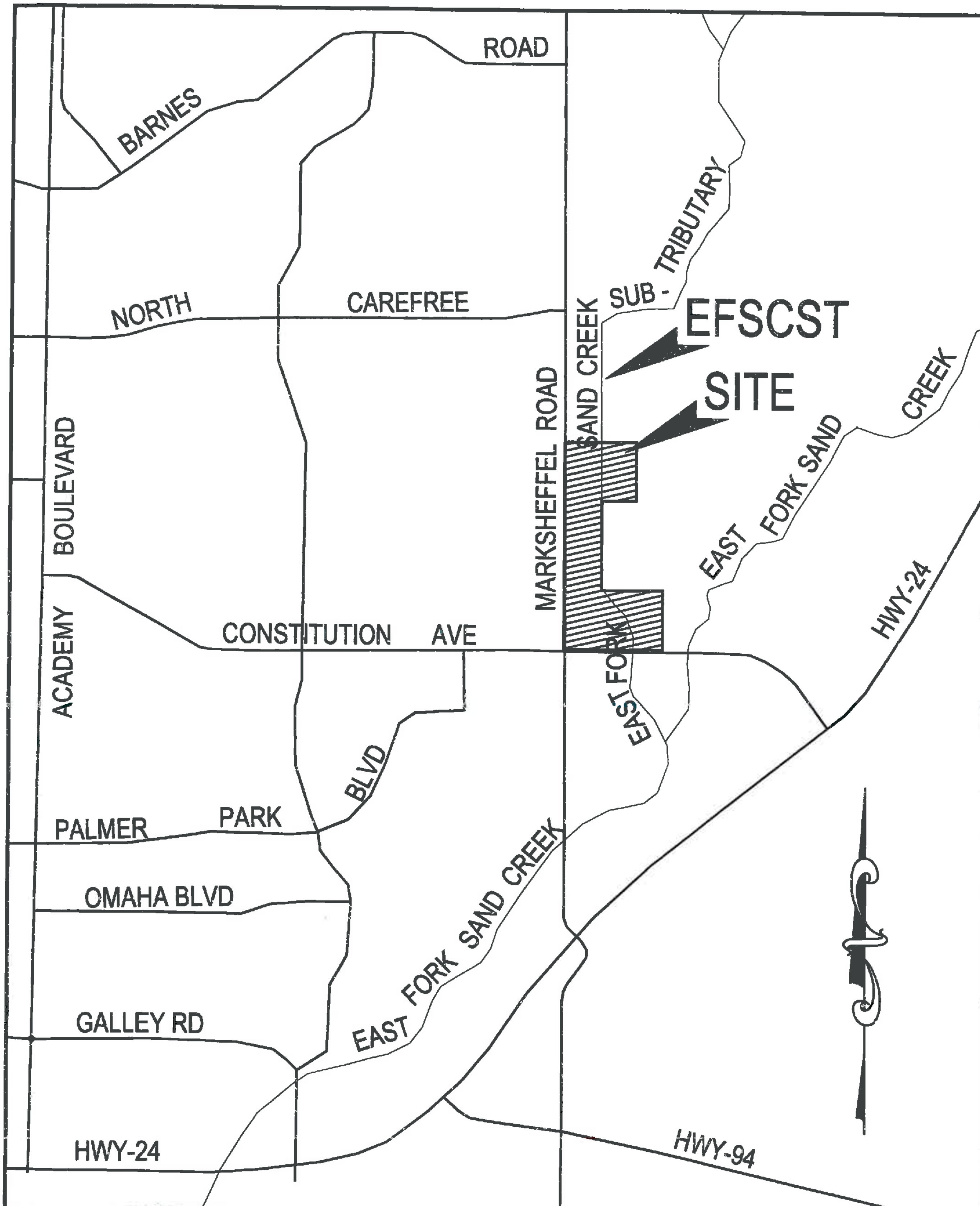
16.) Rocky Mountain Industrial Park Filing No.1 Subdivision Construction Drawings", prepared by Kiowa Engineering, November 2001.

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

18.) "Marksheffel Road Draft Drainage Plans, prepared by Wilson & Company

APPENDIX

VICINITY MAP

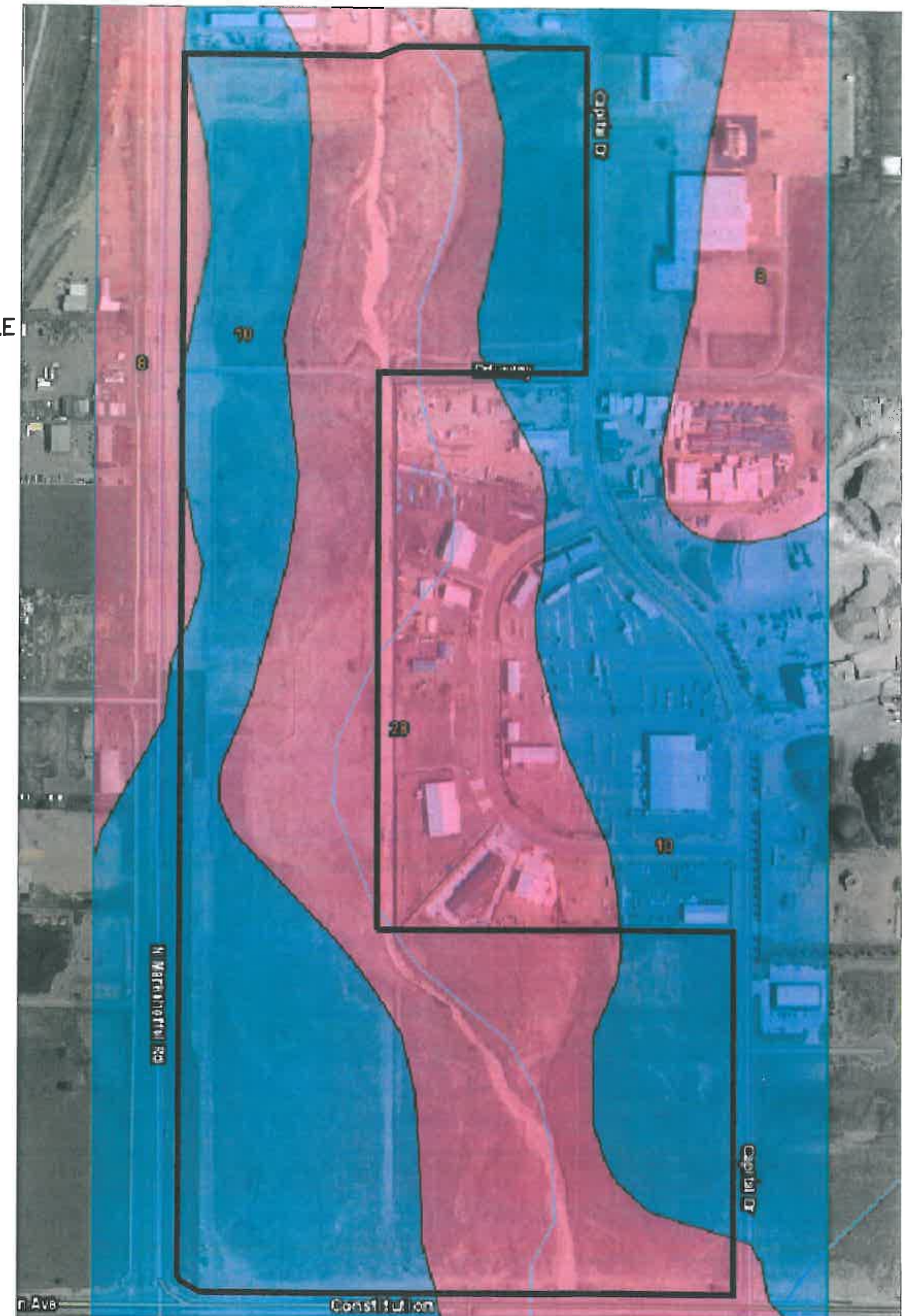


VICINITY MAP

N.T.S.

SOILS MAP

NOT TO SCALE



Tables — Hydrologic Soil Group — Summary By Map Unit

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

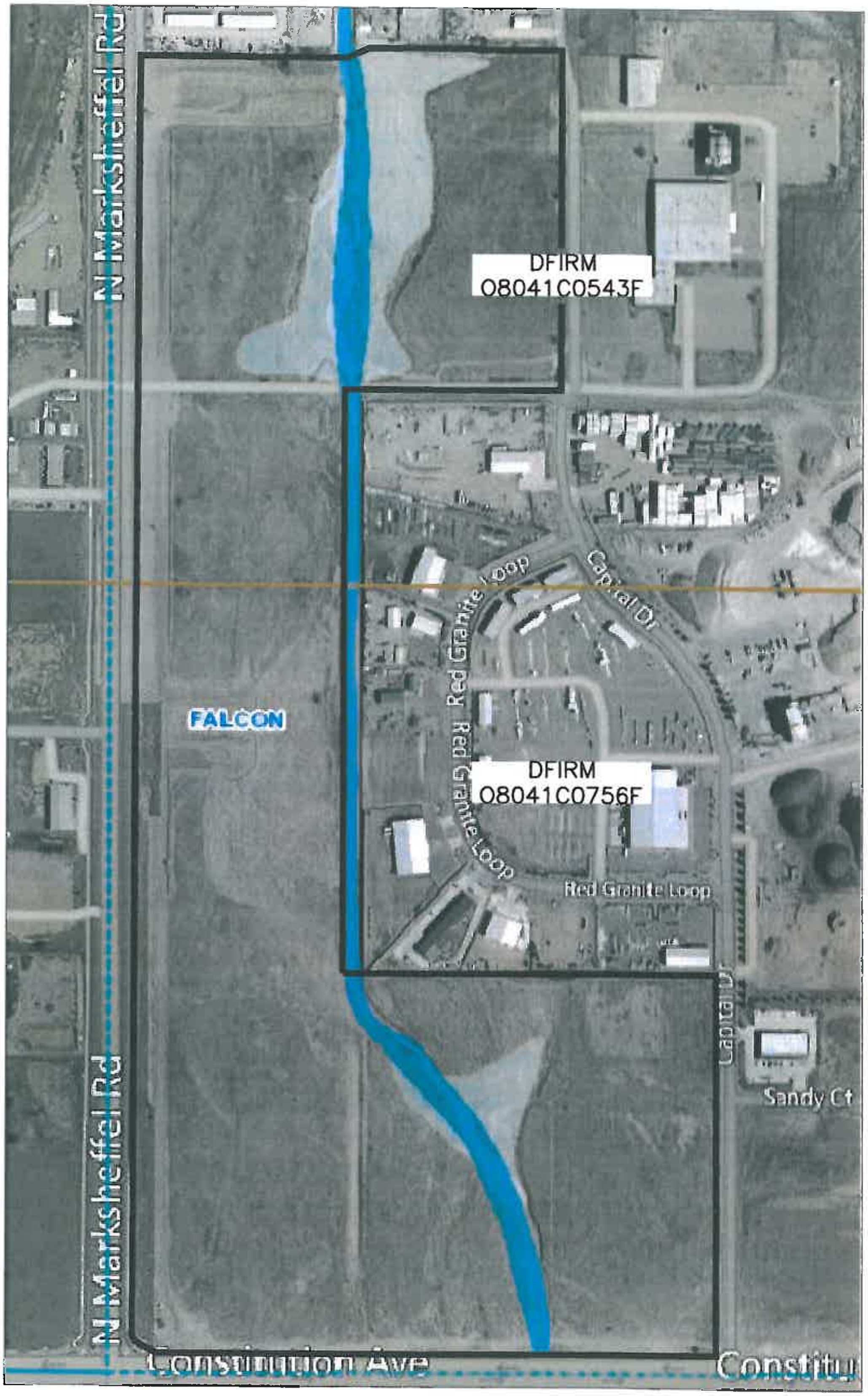
Map unit symbol	Map unit name	Rating
8	Blakeland loamy sand, 1 to 9 percent slopes	A
10	Blendon sandy loam, 0 to 3 percent slopes	B
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	A
Totals for Area of Interest		

MARKSHEFFEL
CONSTITUTION
SOILS MAP

CIVIL CONSULTANTS, INC.

FLOODPLAIN EXHIBIT

NOT TO SCALE



ZONE 'X' – 500 YEAR FLOODING

ZONE 'AE' – 100 YEAR FLOODING

THE SANDS

FLOODPLAIN MAP

CIVIL CONSULTANTS, INC.

SITE HYDROLOGIC CALCULATIONS

CONSTITUTION & MARKSHEFFEL
MASTER DEVELOPMENT DRAINAGE CALCULATIONS
(Existing Area Runoff Coefficient Summary)

			LAND TYPE I			*LAND TYPE II*			*LAND TYPE III*			*WEIGHTED*	
BASIN	**TOTAL AREA (Sq Ft)**	**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}
			EXISTING CONDITIONS DESIGN REPORT										
OS0	*348046*	7.99	7.99	0.73	0.81	0.00	0.20	0.44	0.00	0.08	0.35	*0.73*	*0.81*
OS1	*4047611*	92.92	0.00	0.32	0.51	0.00	0.20	0.44	92.92	0.08	0.35	*0.09*	*0.36*
OS2	*196892*	4.52	4.52	0.73	0.81	0.00	0.20	0.44	0.00	0.08	0.35	*0.73*	*0.81*
OS3	*172934*	3.97	3.97	0.73	0.81	0.00	0.20	0.44	0.00	0.08	0.35	*0.73*	*0.81*
OS4	*1442277*	33.11	8.90	0.90	0.96	2.66	0.73	0.81	21.55	0.08	0.35	*0.35*	*0.55*
OS5	*47377*	1.09	0.22	0.90	0.96	0.00	0.20	0.44	0.87	0.08	0.35	*0.24*	*0.47*
EXA	*592756*	13.61	0.00	0.90	0.96	0.00	0.20	0.44	13.61	0.08	0.35	*0.08*	*0.35*
EXB	*770296*	17.68	0.00	0.90	0.96	0.00	0.20	0.44	17.68	0.08	0.35	*0.08*	*0.35*
EXD	*70419*	0.78	0.00	0.90	0.96	0.00	0.20	0.44	0.78	0.08	0.35	*0.08*	*0.35*
EXE	*640992*	14.72	0.00	0.90	0.96	0.00	0.20	0.44	14.72	0.08	0.35	*0.08*	*0.35*
***EXF WQ POND #5*	*1593867*	36.59	6.48	0.90	0.96	28.68	0.59	0.70	1.43	0.08	0.35	*0.62*	*0.73*
EXG	*89262*	2.05	0.00	0.90	0.96	0.00	0.20	0.44	2.05	0.08	0.35	*0.08*	*0.35*
EXH	*931967*	21.40	0.00	0.90	0.96	0.00	0.20	0.44	21.40	0.08	0.35	*0.08*	*0.35*
EXI	*304455*	6.99	0.00	0.90	0.96	0.00	0.20	0.44	6.99	0.08	0.35	*0.08*	*0.35*
EXJ	*104578*	2.40	0.00	0.90	0.96	0.00	0.20	0.44	2.40	0.08	0.35	*0.08*	*0.35*
EXK	*257942*	5.92	0.00	0.90	0.96	0.00	0.20	0.44	5.92	0.08	0.35	*0.08*	*0.35*
EXL	*500368*	11.49	0.00	0.90	0.96	0.00	0.20	0.44	11.49	0.08	0.35	*0.08*	*0.35*
EXM	*565994*	12.99	0.00	0.90	0.96	0.00	0.20	0.44	12.99	0.08	0.35	*0.08*	*0.35*
****OS6*	*50094*	1.15	0.00	0.64	0.77	0.00	0.20	0.44	1.15	0.08	0.35	*0.08*	*0.35*
EXF WQ #5 OLD CRITERIA	*1593867*	36.59	6.48	0.88	0.95	28.68	0.66	0.80	1.43	0.22	0.35	*0.68*	*0.81*

CONSTITUTION & MARKSHEFFEL
MASTER DEVELOPMENT DRAINAGE CALCULATIONS
(Existing Area Drainage Summary)

From Area Runoff Coefficient Summary				OVERLAND				STREET / CHANNEL FLOW				Time of Travel (T_t)		INTENSITY *		TOTAL FLOWS	
BASIN	AREA TOTAL (Acres)	C_5 (From DCM Table 5-1)	C_{100}	C_5	Length (ft)	Height (ft)	T_C (min)	Length (ft)	Slope (%)	Velocity (fps)	T_t (min)	TOTAL (min)	CHECK (min)	I_5 (in/hr)	I_{100} (in/hr)	Q_5 (c.f.s.)	Q_{100} (c.f.s.)
Existing Area Drainage Summary																	
OS0	7.99	0.73	0.81	0.73	100	0.5	8.9	995	0.5%	0.7	23.5	32.3	16.1	3.4	5.7	19.9	37.1
OS1	92.92	0.09	0.36	0.09	200	16	13.8	3100	2.0%	2.8	18.3	32.0	28.3	2.6	4.0	21.5	133.8
OS1 Semi developed	92.92	0.32	0.51	0.32	100	2	12.1	3100	2.0%	2.1	24.4	36.4	27.8	2.6	4.4	77.2	206.5
OS2	4.52	0.73	0.81	0.73	100	2	5.6	680	1.7%	2.6	4.3	9.9	14.3	4.1	6.9	13.7	25.4
OS3	3.97	0.73	0.81	0.73	100	2	5.6	625	2.0%	2.8	3.7	9.3	14.0	4.2	7.1	12.3	22.9
OS4	33.11	0.35	0.55	0.35	150	3	6.9	2450	2.0%	1.4	28.9	35.7	24.4	2.8	4.7	32.6	85.4
OS5	1.09	0.24	0.47	0.24	100	1	15.5	871	1.7%	2.0	7.4	22.8	15.4	2.9	4.9	0.8	2.5
EXA	13.61	0.08	0.35	0.08	100	10	8.6	1219	1.0%	1.5	13.7	22.3	17.3	2.9	4.9	3.2	23.4
EXB	17.68	0.08	0.35	0.08	100	6	10.2	1434	1.6%	1.9	12.6	22.8	18.5	2.9	4.9	4.1	30.0
EXD	0.78	0.08	0.35	0.08	100	5	10.8	461	1.3%	1.7	4.5	15.3	13.1	3.5	5.9	0.2	1.6
EXE	14.72	0.08	0.35	0.08	100	5	10.8	1177	2.3%	2.3	8.6	19.5	17.1	3.3	5.3	3.9	27.1
**EXF WQ POND #5	36.59	0.62	0.73	0.62	65	1.3	5.5	1518	1.9%	2.8	9.2	14.7	18.8	3.6	6.0	81.3	159.9
EXG	2.05	0.08	0.35	0.08	100	1	18.4	587	1.5%	1.8	5.4	23.8	13.8	2.8	4.7	0.5	3.4
EXH	21.40	0.08	0.35	0.08	100	9	8.9	2050	1.7%	1.9	17.7	26.6	21.9	2.7	4.5	4.6	33.5
EXI	6.99	0.08	0.35	0.08	100	2	14.7	1266	2.2%	2.2	9.5	24.1	17.6	2.8	4.7	1.6	11.5
EXJ	2.40	0.08	0.35	0.08	100	2	14.7	572	2.5%	2.3	4.1	18.7	13.7	3.2	5.4	0.6	4.5
EXK	5.92	0.08	0.35	0.08	100	1	18.4	773	2.2%	2.2	5.8	24.2	14.9	2.8	4.7	1.3	9.7
EXL	11.49	0.08	0.35	0.08	100	3	12.8	1248	1.6%	1.9	11.0	23.8	17.5	2.8	4.7	2.6	19.1
EXM	12.99	0.08	0.35	0.08	100	3	12.8	1275	1.7%	1.9	11.0	23.8	17.6	2.8	4.7	2.9	21.6
***OS6	1.15	0.08	0.35	0.08	100	2	14.7	213	2.0%	2.1	1.7	16.3	11.7	3.9	6.5	0.4	2.6

* Intensity equations assume a minimum travel time of 10 minutes, for undeveloped conditions .

** EXF WQ POND #5 existing C values and Intensity's as studied in the Marksheffel Drainage Report

*** Refer to "Drainage Letter Report for Falcon Fire Station No.4 2710 Capital Drive, El Paso County, CO" prepared by JPS Engineering, dated May 2016.

"Final Drainage Report for Marksheffel Rd. from Constitution Ave. to Dublin Rd." prepared by CH2M Hill, dated 2008

Calculated by: GT
Date: 2/9/2016
Checked by: VAS

CONSTITUTION & MARKSHEFFEL
MASTER DEVELOPMENT DRAINAGE CALCULATIONS
(Existing 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
EXISTING DRAINAGE BASIN ROUTING SUMMARY																	
DP0	OS0	5.83	6.47									16.1	3.4	5.7	*19.9*	*37.1*	EX WEIR IN CONC. LINED CHANNEL (MSI Report shows 16.4/33.7)
DP1	OS1	8.36	33.45									28.3	2.6	4.0	*21.5*	*133.8*	EX DUAL 42" RCP'S (MSI Report shows 89.6/194.5)
DP2	OS3	2.90	3.22									9.3	4.2	7.1	*12.3*	*22.9*	EX SWALE
DP3	DP1+OS2	11.66	37.11									28.[illegible]	2.6	4.0	*29.9*	*148.4*	EX SWALE
DP4	OS4+OS5	11.94	18.76									24.4	2.8	4.7	*33.3*	*87.8*	DP4 @ CAPTURE @EX CULVERT & RELEASE TO EX SWALE
DP5	EXB +DP3+DP4	25.02	52.06									28.3	2.9	4.9	*72.5*	*304.8*	DP5 RELEASE INTO EX EAST FORK EFSCST
DP6	EXA	1.09	4.76									22.3	2.9	4.9	*3.2*	*23.4*	DP6 RELEASE INTO EX EAST FORK EFSCST
DP7	EXD	0.06	0.27									15.3	3.5	5.9	*0.2*	*1.6*	DP7 RELEASE INTO EX EAST FORK EFSCST
DP8	EXE + **EXF WQ POND #5	24.04	31.95									19.5	3.3	5.3	*79.9*	*167.8*	DP8 RELEASE INTO EX SWALE
DP9	EXG	0.16	0.72									23.8	2.8	4.7	*0.5*	*3.4*	DP9 RELEASE INTO EX EAST FORK EFSCST
DP10	EXJ	0.19	0.84									18.7	3.2	5.4	*0.6*	*4.5*	DP10 RELEASE INTO DP 11
DP11	EXI + DP10	0.75	3.39									24.1	2.8	4.7	*2.1*	*15.5*	DP11 RELEASE INTO 68.6
DP12	EXH + DP8	25.76	39.44									26.6	2.7	4.5	*68.6*	*176.2*	DP12 ROUTED TO LOW POINT
DP13	EXK	0.47	2.07									24.2	2.8	4.7	*1.3*	*9.7*	DP13 ROUTED TO LOW POINT & 12" RCP
DP14	EXL+DP5+DP6+ DP7+DP9	27.25	71.83									23.8	2.8	4.7	*77.1*	*341.2*	DP14 RELEASE INTO EX EAST FORK EFSCST
DP15	EXM	1.04	4.55									23.8	2.8	4.7	*2.9*	*21.6*	DP15 ROUTED TO LOW POINT

* Intensity equations assume a minimum travel time of 10 minutes, for undeveloped conditions.
** 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 CH2M Hill, dated 2008

Calculated by: GT
Date: 2/9/2016
Checked by: VAS

THE SANDS
MASTER DEVELOPMENT DRAINAGE CALCULATIONS
(Area Runoff Coefficient Summary)

			TYPE I LAND USE			*TYPE II LAND USE*			*TYPE 3 LAND USE*			*WEIGHTED*	
BASIN	**TOTAL AREA** (Sq Ft)	**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	*117132*	2.69	BASIN A IS A PORTION OF 38.50 ACRE BASIN OSP4A FROM MARKSHEFFEL DESIGN REPORT										
B	*478513*	10.99	8.79	0.38	0.55	0.00	0.20	0.44	2.20	0.09	0.36	*0.32*	*0.51*
C	*149754*	3.44	1.42	0.38	0.55	2.02	0.16	0.41	0.00	0.09	0.36	*0.25*	*0.47*
D	*18478*	0.42	0.42	0.90	0.96	0.00	0.20	0.44	0.00	0.09	0.36	*0.90*	*0.96*
E	*306219*	7.03	7.03	0.73	0.81	0.00	0.20	0.44	0.00	0.09	0.36	*0.73*	*0.81*
F	*286425*	6.58	6.58	0.73	0.81	0.00	0.20	0.44	0.00	0.09	0.36	*0.73*	*0.81*
G	*43514*	1.00	1.00	0.90	0.96	0.00	0.20	0.44	0.00	0.09	0.36	*0.90*	*0.96*
H	*29092*	0.67	0.67	0.73	0.81	0.00	0.20	0.44	0.00	0.09	0.36	*0.73*	*0.81*
I	*219265*	5.03	5.03	0.38	0.55	0.00	0.20	0.44	0.00	0.09	0.36	*0.38*	*0.55*
J	*191749*	4.40	4.40	0.38	0.55	0.00	0.20	0.44	0.00	0.09	0.36	*0.38*	*0.55*
K	*42190*	0.97	0.00	0.38	0.55	0.97	0.16	0.41	0.00	0.09	0.36	*0.16*	*0.41*
L	*85248*	1.96	1.96	0.38	0.55	0.00	0.12	0.39	0.00	0.09	0.36	*0.38*	*0.55*
EXF (WQ POND #5)	*1593867*	36.59	6.48	0.90	0.97	28.68	0.68	0.82	1.43	0.09	0.36	*0.70*	*0.83*
EXF WQ #5 OLD CRITERIA	*1593867*	36.59	6.48	0.88	0.95	28.68	0.66	0.80	1.43	0.08	0.35	*0.68*	*0.81*
M	*125889*	2.89	1.33	0.38	0.55	1.56	0.16	0.41	0.00	0.09	0.36	*0.26*	*0.47*
N	*210515*	4.83	1.34	0.38	0.55	3.49	0.16	0.41	0.00	0.09	0.36	*0.22*	*0.45*
O	*195030*	4.48	0.60	0.38	0.55	3.88	0.16	0.41	0.00	0.09	0.36	*0.19*	*0.43*
P	*346311*	7.95	7.95	0.38	0.55	0.00	0.68	0.82	0.00	0.09	0.36	*0.38*	*0.55*
Q	*178066*	4.09	4.09	0.81	0.88	0.00	0.20	0.44	0.00	0.09	0.36	*0.81*	*0.88*
R	*126761*	2.91	2.91	0.81	0.88	0.00	0.66	0.80	0.00	0.09	0.36	*0.81*	*0.88*
S	*194485*	4.46	4.46	0.38	0.55	0.00	0.20	0.44	0.00	0.09	0.36	*0.38*	*0.55*
T	*82194*	1.89	0.00	0.38	0.55	0.00	0.16	0.41	1.89	0.09	0.36	*0.09*	*0.36*
U	*216359*	4.97	4.97	0.38	0.55	0.00	0.90	0.96	0.00	0.09	0.36	*0.38*	*0.55*
V	*37958*	0.87	0.65	0.81	0.88	0.22	0.90	0.96	0.00	0.09	0.36	*0.83*	*0.90*
W	*57495*	1.32	0.00	0.38	0.55	1.32	0.16	0.41	0.00	0.09	0.36	*0.16*	*0.41*
X	*128377*	2.95	0.00	0.38	0.55	2.95	0.16	0.41	0.00	0.09	0.36	*0.16*	*0.41*
Y	*76908*	1.77	1.77	0.81	0.88	0.00	0.20	0.44	0.00	0.09	0.36	*0.81*	*0.88*
Z	*52816*	1.21	0.00	0.38	0.55	1.21	0.16	0.41	0.00	0.09	0.36	*0.16*	*0.41*
AA	*203653*	4.68	4.68	0.38	0.55	0.00	0.20	0.44	0.00	0.09	0.36	*0.38*	*0.55*
BB	*203487*	4.67	4.67	0.38	0.55	0.00	0.20	0.44	0.00	0.09	0.36	*0.38*	*0.55*
CC	*40642*	0.93	0.00	0.38	0.55	0.93	0.16	0.41	0.00	0.09	0.36	*0.16*	*0.41*
DD	*29621*	0.68	0.17	0.38	0.55	0.51	0.16	0.41	0.00	0.09	0.36	*0.22*	*0.45*
EE	*72287*	1.66	0.35	0.38	0.55	1.31	0.16	0.41	0.00	0.09	0.36	*0.21*	*0.44*
FF	*37598*	0.86	0.28	0.38	0.55	0.58	0.16	0.41	0.00	0.09	0.36	*0.23*	*0.46*
GG	*17215*	0.40	0.40	0.38	0.55	0.00	0.20	0.44	0.00	0.09	0.36	*0.38*	*0.55*
HH	*234958*	5.39	0.00	0.38	0.55	0.00	0.20	0.44	5.39	0.09	0.36	*0.09*	*0.36*
II	*22587*	0.52	0.52	0.38	0.55	0.00	0.20	0.44	0.00	0.09	0.36	*0.38*	*0.55*
JJ	*20903*	0.48	0.48	0.38	0.55	0.00	0.20	0.44	0.00	0.09	0.36	*0.38*	*0.55*
KK	*78254*	1.80	1.80	0.38	0.55	0.00	0.20	0.44	0.00	0.09	0.36	*0.38*	*0.55*
OSO	*347842*	7.99	7.99	0.73	0.81	0.00	0.20	0.44	0.00	0.09	0.36	*0.73*	*0.81*
OS1	*4047379*	92.9	0.00	0.73	0.81	92.92	0.32	0.51	0.00	0.09	0.36	*0.32*	*0.51*
*OS1**													
*DEV OS1***	*4047379*	92.92	92.92	0.73	0.81	0.00	0.20	0.44	0.00	0.09	0.36	*0.73*	*0.81*
EX OS1	*4047379*	92.92	0.00	0.73	0.81	0.00	0.20	0.44	92.92	0.09	0.36	*0.09*	*0.36*
OS2	*196767*	4.52	4.52	0.73	0.81	0.00	0.20	0.44	0.00	0.09	0.36	*0.73*	*0.81*
OS3	*173125*	3.97	3.97	0.73	0.81	0.00	0.20	0.44	0.00	0.09	0.36	*0.73*	*0.81*
OS4	*1442324*	33.11	33.11	0.73	0.81	0.00	0.09	0.36	0.00	0.09	0.36	*0.73*	*0.81*
OS5	*43514*	1.00	1.00	0.90	0.96	0.00	0.20	0.44	0.00	0.09	0.36	*0.90*	*0.96*
OS6	*49900*	1.15	1.15	0.64	0.80	0.00	0.20	0.44	0.00	0.09	0.36	*0.64*	*0.80*

Calculated by: DLM/GT
Date: 5/21/2017
Checked by: VAS

THE SANDS
MASTER DEVELOPMENT DRAINAGE CALCULATIONS
(Area Drainage Summary)

From Area Runoff Coefficient Summary				OVERLAND				STREET / CHANNEL FLOW				Time of Travel		INTENSITY *		TOTAL FLOWS	
BASIN	AREA TOTAL (Acres)	C_5 (From DCM Table 5-1)	C_{100}	C_5	Length (ft)	Height (ft)	T_C (min)	Length (ft)	Slope (%)	Velocity (fps)	T_t (min)	TOTAL (min)	CHECK (min)	I_5 (in/hr)	I_{100} (in/hr)	Q_5 (c.f.s.)	Q_{100} (c.f.s.)
Proposed Area Drainage Summary																	
A	38.50	FLOWS FROM MARKSHEFFEL DESIGN REPORT/CONST. PLANS														141**	226.0
B	10.99	0.32	0.51	0.32	100	2	12.0	1196	1.0%	2.0	10.0	22.0	17.2	3.3	5.6	11.6	31.1
C	3.44	0.25	0.47	0.25	50	2.3	7.2					7.2	10.3	4.6	7.8	4.0	12.5
D	0.42	0.90	0.96	0.90	50	2	1.7					5.0	10.3	5.2	8.7	2.0	3.5
E	7.03	0.73	0.81	0.73	100	2	5.6	500	1.0%	2.0	4.2	9.8	13.3	4.2	7.0	21.4	39.8
F	6.58	0.73	0.81	0.73	100	2	5.6	500	1.0%	2.0	4.2	9.8	13.3	4.2	7.0	20.0	37.2
G	1.00	0.90	0.96	0.90	50	1	2.1	900	1.0%	2.0	7.5	9.6	15.3	4.2	7.0	3.8	6.7
H	0.67	0.73	0.81	0.73	50	2	3.2	0	1.0%	2.0	0.0	5.0	10.3	5.2	8.7	2.5	4.7
I	5.03	0.38	0.55	0.38	100	2	11.2	965	1.4%	2.4	6.8	18.0	15.9	3.4	5.8	6.6	15.9
J	4.40	0.38	0.55	0.38	100	2	11.2	893	1.5%	2.4	6.1	17.3	15.5	3.5	5.8	5.8	14.1
K	0.97	0.16	0.41	0.16	75	7.5	7.5	165	0.5%	1.4	1.9	9.5	11.3	4.2	7.1	0.7	2.8
L	1.96	0.38	0.55	0.38	57	1	8.8	447	1.0%	2.0	3.7	12.6	12.8	3.8	6.4	2.8	6.8
EXF (WQ POND #5)	36.59	0.70	0.83	0.70	65	1.3	5.1	1600	1.9%	2.8	9.7	14.8	19.3	3.5	5.9	90.2	180.3
EXF WQ #5 OLD CRITERIA	36.59	0.68	0.81	0.68	65	1.3	5.3	1600	1.9%	2.8	9.7	15.0	19.3	3.5	5.9	87.1	174.9
M	2.89	0.26	0.47	0.26	100	2	13.1					13.1	10.6	4.0	6.8	3.1	9.3
N	4.83	0.22	0.45	0.22	100	5	10.2	1154	1.9%	1.0	19.9	30.1	17.0	3.3	5.6	3.6	12.1
O	4.48	0.19	0.43	0.19	85	6	8.7	1788	1.9%	1.0	30.9	39.6	20.4	3.1	5.1	2.6	9.9
P	7.95	0.38	0.55	0.38	100	2	11.2	1338	1.5%	2.4	9.1	20.3	18.0	3.2	5.5	9.8	23.8
Q	4.09	0.81	0.88	0.81	50	1	3.1	400	1.5%	2.4	2.7	5.9	12.5	4.9	8.3	16.3	29.8
R	2.91	0.81	0.88	0.81	100	2	4.5	1000	1.0%	2.0	8.3	12.8	16.1	3.8	6.3	8.9	16.2
S	4.46	0.38	0.55	0.38	55	1	8.6	870	1.0%	2.0	7.3	15.8	15.1	3.5	5.9	6.0	14.5
T	1.89	0.09	0.36	0.09	100	2	15.4	518	1.5%	2.4	3.5	18.9	13.4	3.7	6.2	0.6	4.2
U	4.97	0.38	0.55	0.38	100	2	11.2	633	2.0%	2.8	3.7	14.9	14.1	3.6	6.1	6.8	16.6
V	0.87	0.83	0.90	0.83	65	1.3	3.3	200	1.0%	2.0	1.7	5.0	11.5	5.2	8.7	3.7	6.8
W	1.32	0.16	0.41	0.16	100	8	9.4	207	0.5%	1.1	3.3	12.6	11.7	3.9	6.5	0.8	3.5
X	2.95	0.16	0.41	0.16	50	8	5.3	1400	1.0%	1.5	15.6	20.8	18.1	3.2	5.4	1.5	6.6
Y	1.77	0.81	0.88	0.81	50	1	3.1	250	1.0%	2.0	2.1	5.2	11.7	5.1	8.6	7.3	13.3
Z	1.21	0.16	0.41	0.16	50	6	5.8	344	0.5%	0.5	11.6	17.4	12.2	3.8	6.4	0.7	3.2
AA	4.68	0.38	0.55	0.38	100	2	11.2	984	1.5%	2.4	6.7	17.9	16.0	3.4	5.7	6.1	14.8
BB	4.67	0.38	0.55	0.38	100	2	14.8	920	1.2%	2.2	7.0	21.8	15.7	3.5	5.8	6.1	14.9
CC	0.93	0.16	0.41	0.16	50	5	6.2	235	0.5%	1.1	3.7	9.8	11.6	4.2	7.0	0.6	2.7
DD	0.68	0.22	0.45	0.22	100	2	13.9					13.9	10.6	4.0	6.8	0.6	2.1
EE	1.66	0.21	0.44	0.21	75	2	11.1					11.1	10.4	4.1	6.8	1.4	5.0
FF	0.86	0.23	0.46	0.23	75	2	10.7					10.7	10.4	4.1	6.8	0.8	2.7
GG	0.40	0.38	0.55	0.38	75	2	8.8					8.8	10.4	4.3	7.2	0.6	1.6
HH	5.39	0.09	0.36	0.09	100	2	15.4	950	1.5%	1.8	8.6	24.0	15.8	3.4	5.8	1.7	11.2
II	0.52	0.38	0.55	0.38	60	2	7.3					7.3	10.3	4.6	7.7	0.9	2.2
JJ	0.48	0.38	0.55	0.38	60	2	7.3					7.3	10.3	4.6	7.7	0.8	2.0
KK	1.80	0.38	0.55	0.38	60	2	7.3	470	2.0%	2.1	3.7	11.0	12.9	4.0	6.7	2.7	6.6
OS0	7.99	0.73	0.81	0.73	100	0.5	8.9	995	0.5%	0.7	23.5	32.3	16.1	3.4	5.7	19.9	37.1
OS1	92.92	0.32	0.51	0.32	100	2	12.1	3100	2.0%	2.1	24.4	36.4	27.3	2.6	4.4	77.2	206.5
OS1*	?	FLOWS FROM MARKSHEFFEL DESIGN REPORT/CONST. PLANS														89.6	194.5
DEV OS1**	92.92	0.73	0.81	0.73	200	16	5.0	3100	2.0%	2.8	18.3	23.3	28.3	2.9	4.8	194.1	361.5
EX OS1	92.92	0.09	0.36	0.09	200	16	13.8	3100	2.0%	2.8	18.3	32.0	28.3	2.6	4.0	21.5	133.8
OS2	4.52	0.73	0.81	0.73	100	2	5.6	680	1.7%	2.6	4.3	9.9	14.3	4.1	6.9	13.6	25.4
OS3	3.97	0.73	0.81	0.73	100	2	5.6	625	2.0%	2.8	3.7	9.3	14.0	4.2	7.1	12.3	22.9
OS4	33.11	0.73	0.81	0.73	150	3	6.9	2450	2.0%	1.4	28.9	35.7	24.4	2.8	4.7	67.4	125.5
OS5	1.00	0.90	0.96	0.90	50	1	2.1	900	1.0%	2.0	7.5	9.6	15.3	4.2	7.0	3.8	6.7
OS6	1.15	0.64	0.80	0.64	20	1.5	1.6	395	1.4%	2.4	2.8	5.0	12.3	5.2	8.7	3.8	8.0

* Evaluation of offsite basin (assumes developed condition)

** Reported flow is for 10 year event

Calculated by: DLM/GT

Date: 5/21/2017

Checked by: VAS

THE SANDS
MASTER DEVELOPMENT 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
PROPOSED DRAINAGE BASIN ROUTING SUMMARY																	
0	OS0	5.83	6.47									16.1	3.4	5.7	*19.9*	*37.1*	EX WEIR IN CONC. LINED CHANNEL
																	(MSI Report shows 16.4/33.7)
1	OSP4A/WQ#4														*141.0*	*226.0*	(Taken from MS Road FD Report)
																	REMOVE/REPLACE RIPRAP
																	AT SCEFST
2	B	3.49	5.58									17.2	3.3	5.6	*11.6*	*31.1*	DUAL 8' SUMP INLETS
3	OS-1	29.73	47.39									27.8	2.6	4.4	*77.2*	*206.5*	(MSI Report shows 89.6/194.5)
																	EX DUAL 48" RCP'S
4	DP-3	29.73	47.39												*66.1*	*176.8*	PROP. 8' BW CONC. TRAP CHANNEL
	OS-2	3.30	3.66												*7.3*	*13.6*	
	OS-3	2.90	3.22												*6.4*	*12.0*	
	D	0.38	0.41					DP 5 TO DP 6							*0.8*	*1.5*	
		36.31	54.67					500	0.5%	1.1	7.9	35.6	2.2	3.7	*80.7*	*203.9*	PROP. 8' BW CONC. TRAP CHANNEL
5	E	5.13	5.69									9.8	4.2	7.0	*21.4*	*39.8*	FULL SPECTRUM DETENTION POND 2
																	OUTLET W/18" RCP
6	F	4.80	5.33									9.8	4.2	7.0	*27.5*	*50.6*	FULL SPECTRUM DETENTION POND 3
	DP8	1.80	1.92														OUTLET W/18" RCP
		6.60	7.24														
7	OS4	24.17	26.82									24.4	2.8	4.7	*67.4*	*125.5*	REMOVE EXISTING 24"
																	EXTEND 48" CMP
																	OR REPLACE WITH 48" RCP
8	G	0.90	0.96									9.6	4.2	7.0	*3.8*	*6.7*	PROP. 4' SUMP INLETS
	OS5	0.90	0.96												*3.8*	*6.7*	W/18 & 24" RCP AND (2) CDS
		1.80	1.92												*7.5*	*13.5*	
9	DP7	24.17	26.82									24.4	2.8	4.7	*67.4*	*125.5*	PROP. 4' SUMP INLETS
																	W/18 & 24" RCP AND A CDS UNIT
10	DP9	24.17	26.83									24.4	2.8	4.7	*67.4*	*125.5*	PROP. 6' BW RIPRAP LINED CHANNEL
	H	0.49	0.54												*1.2*	*2.3*	W/ 36" DUAL RCP CULVERTS
		24.66	27.36					500	1.6%	1.9	4.4	26.8	2.5	4.3	*62.6*	*116.7*	USE DP 9 FOR SWALE SIZING

Calculated by: DLM/GT

Date: 5/21/2016

Checked by: VAS

THE SANDS
MASTER DEVELOPMENT 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
PROPOSED DRAINAGE BASIN ROUTING SUMMARY																	
11	K	0.15	0.40									17.2	3.3	5.6	*12.1*	*33.3*	FULL SPECTRUM DETENTION POND 1
	DP2	3.49	5.58														OUTLET W/18" RCP
		3.65	5.98														
12	J	1.67	2.42									15.5	3.5	5.8	*5.8*	*14.1*	PROP. 4' SUMP INLET
																	W/18" & 24" RCP
13	I	1.91	2.77									15.9	3.4	5.8	*6.6*	*15.9*	PROP. 5' AT-GRADE INLET
																	W/18" & 24" RCPS
14	DP12	1.67	2.42									15.9	3.4	5.8	*13.0*	*32.8*	FULL SPECTRUM DETENTION POND D
	DP13	1.91	2.77														OUTLET W/18" RCP
	Z	0.19	0.50														
		3.78	5.69														
14				ADD DISCHARGE FLOW TO BASIN N AND WQ POND #5 TOTAL											*0.3*	*10.5*	FULL SPECTRUM DETENTION POND D
																	OUTLET W/18" RCP
																	HISTORIC RELEASE RATE
15	WQ POND #5 (EXF)	25.46	30.32									17.0	3.3	5.6	*88.5*	*181.9*	
	N	1.07	2.17														
		26.53	32.49												*88.5*	*181.9*	PROP. 3~ 36" RCP
16	L	0.74	1.08									12.6	3.8	6.4	*2.8*	*6.8*	PROP. 4' SUMP INLET
																	W/18" RCPS
17	O	0.85	1.92									20.4	3.1	5.1	*2.6*	*9.9*	EARTHEN SWALE
18	Q	3.31	5.60									7.3	4.6	7.7	*16.1*	*30.0*	FULL SPECTRUM DETENTION POND 4
	II	0.20	0.29														OUTLET W/ 30" RCP
		3.51	5.88														
19	DP17	0.85	1.92												*3.0*	*13.8*	POND OUTFALL & DP17
	PIPE 118			CUMMULATIVE FLOW FROM POND AND DP17													TOTAL TO EXISTING 30"
20	U	1.89	2.73									14.1	3.6	6.1	*6.8*	*16.6*	PROP. 4' SUMP INLETS
																	W/18" & 18" RCP
21	S	1.70	2.46									15.1	3.5	5.9	*6.0*	*14.5*	PROP. 8' SUMP INLET
																	W/ 24" RCP

Calculated by: DLM
Date: 5/22/2017
Checked by: VAS

THE SANDS
MASTER DEVELOPMENT 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
PROPOSED DRAINAGE BASIN ROUTING SUMMARY																	
22	U	1.89	2.73									14.1	3.6	6.1	*9.4*	*21.3*	PROP. 6' SUMP INLETS
	V	0.73	0.78														W/24" & 24" RCP
		2.61	3.52														
23	T	0.17	0.68									13.4	3.7	6.2	*0.6*	*4.2*	CDOT TYPE C AREA INLET
																	W/18" RCP
24	1/2 R	1.16	1.28									12.8	3.8	6.3	*9.5*	*17.8*	CDOT TYPE C AREA INLET
	1/2 R+JJ	1.36	1.54														W/18" RCP
		2.54	2.82														
25	PR127	9.96	14.15									18.0	3.2	5.5	41.8	99.2	FULL SPECTRUM DETENTION POND 5
	PR128	0.17	0.68														OUTLET W/24" RCP
	PR130	2.54	2.82														
	W	0.21	0.54														
		12.88	18.20														
26	Y	1.43	1.55									5.2	5.1	8.6	*7.3*	*13.3*	FULL SPECTRUM DETENTION POND 6
																	OUTLET W/18" RCP
27	GG	0.15	0.22									15.8	3.4	5.8	*2.2*	*12.5*	CDOT TYPE C AREA INLET
	HH	0.49	1.94														W/18" RCP
		0.64	2.16														
28	AA	1.78	2.57									16.0	3.4	5.7	*12.2*	*29.5*	PROP. 8' SUMP INLETS
	BB	1.78	2.57														W/24" RCP
		3.55	5.14														
29	DP27	0.64	2.16									16.0	3.4	5.7	*14.8*	*44.1*	FULL SPECTRUM DETENTION POND 7
	DP28	3.55	5.14														OUTLET W/18" RCP
	CC	0.15	0.38														
		4.34	7.68														
30	DD	0.15	0.30									10.6	4.0	6.8	*0.6*	*2.1*	GRASS LINED SWALE
31	P	3.02	4.37									18.0	3.2	5.5	*9.8*	*23.8*	PROP. 10' AT-GRADE INLETS
																	W/18" & 18" RCP

Calculated by: DLM/GT
Date: 5/22/2017
Checked by: VAS

Marksheffel and Constitution
Master Development Drainage Plan

Hydrologic Analysis Comparison for Basin OS-1									
Basin	Basin	Site	C5	C100	Tc	Q5	Q100	Recom. Infrast. Size	Existing Infrastr. Size
ID	Size	Development			(mins)	(cfs)	(cfs)	at DP-5	at DP-5
	Area	Use						(assuming 1% FFC*)	
M&S Civil									
EX OS1	92.92	Undeveloped	0.09	0.32	27.8	19.9	133.8	Ex. Dual 42" RCP @ 1%	Ex Dual 42" CMPs
DEV OS1	92.92	Heavy Industrial	0.73	0.81	23.3	194.5	361.5	Prop. Dual 60" RCP @ 1%	
OS1	92.92	Unidentified	0.32	0.51	32	77.2	206.5	Prop. Dual 48" RCP @ 1%	
(From MS Lot 16 Map)									
OS1*	Unk	Unk	Unk	Unk	Unk	98.6	194.5	Prop. Dual 48" RCP @ 1%	
* Assuming FFC @ 1 using n=0.013, Pipe Depth unknown thus HW/D not used									

SITE HYDRAULIC CALCULATIONS

MARKSHEFFEL & CONSTITUTION
MASTER DEVELOPMENT 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}	
101	1/2 DP2	1.75	2.79	16.1	3.4	5.7	6.0	16.0	24" RCP
102	DP2	3.49	5.58	16.1	3.4	5.7	11.9	32.0	30" RCP
103	OUTFALL FSD 1	TAKEN FROM UD-DETENTION (POND 1)					0.2	13.8	24" RCP
104	OUTFALL FSD 2	TAKEN FROM UD-DETENTION (POND 2)					1.0	4.9	18" RCP
105	OUTFALL FSD 3	TAKEN FROM UD-DETENTION (POND 3)					1.2	6.0	18" RCP
106	DP7	24.17	26.82	24.4	2.8	4.7	67.4	125.5	48" RCP
107	1/2 DP8	0.90	0.96	9.6	4.2	7.0	3.8	6.7	18" RCP
108	DP8	1.80	1.92	9.6	4.2	7.0	7.5	13.5	24" RCP
109	1/2 DP10	12.33	13.68	28.8	2.5	4.3	31.3	58.3	36" RCP
110	1/2 DP10	12.33	13.68	28.8	2.5	4.3	31.3	58.3	36" RCP
111	1/2 DP12	0.84	1.21	15.5	3.5	5.8	2.9	7.1	18" RCP
112	DP12	1.67	2.42	15.5	3.5	5.8	5.8	14.1	24" RCP
113	1/2 DP13	0.96	1.38	15.9	3.4	5.8	3.3	8.0	18" RCP
114	DP13	1.91	2.77	15.9	3.4	5.8	6.6	15.9	24" RCP
115	DP14	TAKEN FROM UD-DETENTION (POND D)					0.3	10.5	18" RCP
116	DP15	26.53	32.49	17.0	3.3	5.6	88.5	181.9	3-42" RCP
117	DP16	0.74	1.08	12.6	3.8	6.4	2.8	6.8	18" RCP

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

DP - Design Point
EX - Existing Design Point
FB- Flow By from Design Point
INT- Intercepted Flow from Design Point

Calculated by: DLM/GT
Date: 5/21/2017
Checked by: VAS

MARKSHEFFEL & CONSTITUTION
MASTER DEVELOPMENT DRAINAGE CALCULATIONS
(Storm Sewer Routing Summary)

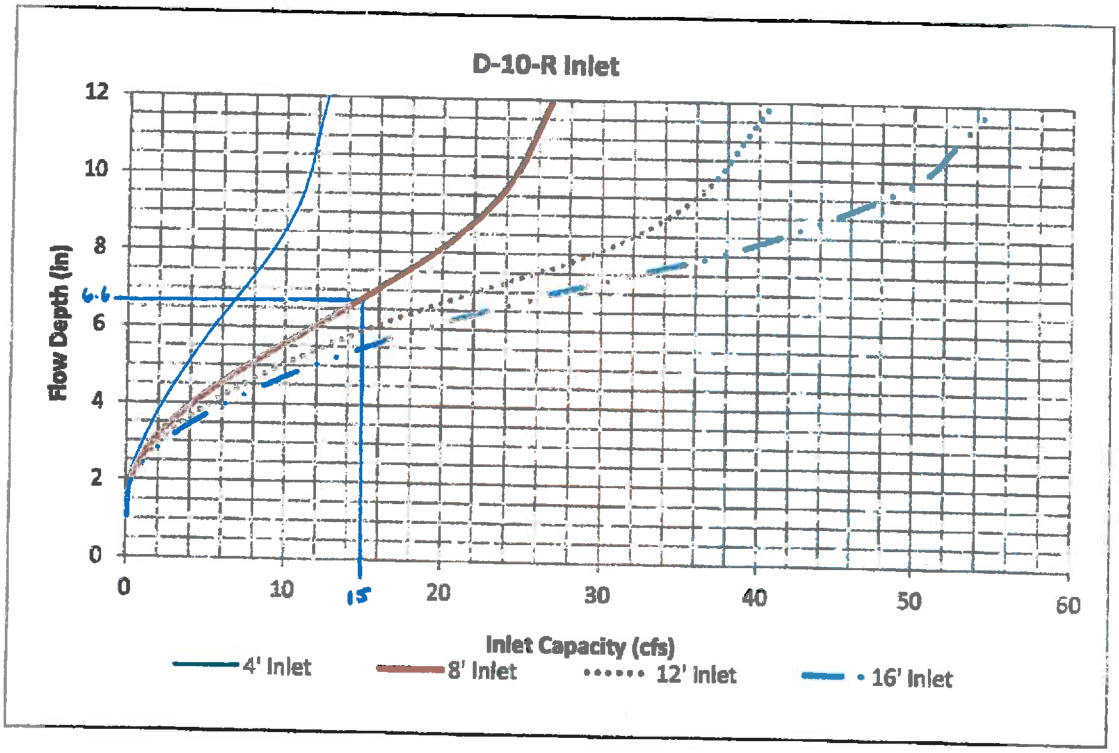
PIPE RUN	Contributing Pipes/Design Points	Equivalent CA_5	Equivalent CA_{100}	Maximum T_C	Intensity*		Flow		PIPE SIZE
					I_5	I_{100}	Q_5	Q_{100}	
118	DP18	RELEASE FROM POND 4					0.7	3.2	18" RCP
119	1/2 PIPE DP20	0.94	1.37	14.1	3.6	6.1	3.4	8.3	18" RCP
120	1/2 PIPE DP20	0.94	1.37	14.1	3.6	6.1	3.4	8.3	18" RCP
121	DP20, PR140	4.91	7.10	18.0	3.2	5.5	15.9	38.7	30" RCP
122	PR117+PR121	5.65	8.18	18.0	3.2	5.5	18.4	44.6	30" RCP
123	DP21	1.70	2.46	15.1	3.5	5.9	6.0	14.5	24" RCP
124	1/2 DP22	1.31	1.76	14.1	3.6	6.1	4.7	10.7	18" RCP
125	PR122+PR123+PR124	8.66	12.39	18.0	3.2	5.5	28.1	67.6	42" RCP
126	1/2 DP22	1.31	1.76	14.1	3.6	6.1	4.7	10.7	18" RCP
127	PR125+PR126	9.96	14.15	18.0	3.2	5.5	32.4	77.2	42" RCP
128	DP23	0.17	0.68	13.4	3.7	6.2	0.6	4.2	18" RCP
129	1/2 BASIN R	1.18	1.28	12.8	3.8	6.3	4.4	8.1	18" RCP
130	BASIN R + BASIN JJ	2.54	2.82	12.8	3.8	6.3	9.5	17.8	24" RCP
131	OUTFALL FSD 5	TAKEN FROM UD-DETENTION (POND 5)					0.7	38.6	24" RCP
132	OUTFALL FSD 6	TAKEN FROM UD-DETENTION (POND 6)					7.3	13.3	18" RCP
133	1/2 DP28	1.78	2.57	16.0	3.4	5.7	6.1	14.8	18" RCP
134	1/2 DP28	1.78	2.57	16.0	3.4	5.7	6.1	14.8	18" RCP
135	PR133+PR134	3.55	5.14	16.0	3.4	5.7	12.2	29.5	24" RCP
136	DP27	0.64	2.16	15.8	3.4	5.8	2.2	12.5	18" RCP
137	DP29	TAKEN FROM UD-DETENTION (POND 7)					0.4	16.2	18" RCP
138	1/2 DP31	1.51	2.19	18.0	3.2	5.5	4.9	11.9	18" RCP
139	1/2 DP31	1.51	2.19	18.0	3.2	5.5	4.9	11.9	18" RCP
140	DP31	3.02	4.37	18.0	3.2	5.5	9.8	23.8	24" RCP

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

DP - Design Point
EX - Existing Design Point
FB- Flow By from Design Point
INT- Intercepted Flow from Design Point

Calculated by: DLM/GT
Date: 5/21/2017
Checked by: VAS

Figure 8-12. Inlet Capacity Chart Sump Conditions, Curb Opening (D-10-R) Inlet



DP 2 Q_{100} = 15.55 cfs

Partially Full Pipe Flow Calculator and Equations

Fluid Flow Table of Contents | Hydraulic and Pneumatic Knowledge
Fluid Power Equipment

This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D =	24	in
Depth of flow, y =	17	in

(must have $y \geq D/2$)

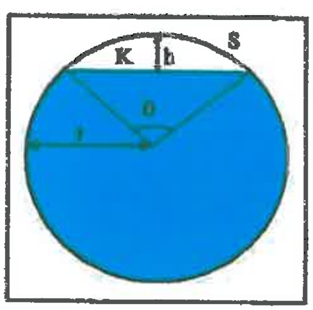
Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.01	ft/ft

Calculations

n/n_{full} =	1.145833:
Partially Full Manning roughness, n =	0.015

Calculations

Pipe Diameter, D =	2	ft
Pipe Radius, r =	1	ft
Circ. Segment Height, h =	0.583	ft
Central Angle, q =	2.28	radians
Cross-Sect. Area, A =	2.38	ft^2
Wetted Perimeter, P =	4.0	ft
Hydraulic Radius, R =	0.59	ft
Discharge, Q =	16.83	cfs
Ave. Velocity, V =	7.07	ft/sec
pipe % full [(A/A_{full})*100%] =	75.7%	



Partially Full Pipe Flow Parameters (More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$ P

$$\theta = 2\arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r^*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)^{\wedge}0.5$ (for $0.5 \leq y/D \leq 1$)

$\frac{1}{2}$ DP 2 $Q_{100} = 15.55$ cfs

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Partially Full Pipe Flow Calculator and Equations

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This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

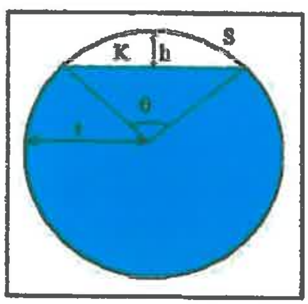
Pipe Diameter, D =	30	in
Depth of flow, y =	22	in
(must have $y \geq D/2$)		
Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.01	ft/ft

Calculations

n/n_{full} =	1.133333
Partially Full Manning roughness, n =	0.015

Calculations

Pipe Diameter, D =	2.5	ft
Pipe Radius, r =	1.25	ft
Circ. Segment Height, h =	0.667	ft
Central Angle, q =	2.17	radians
Cross-Sect. Area, A =	3.86	ft²
Wetted Perimeter, P =	5.1	ft
Hydraulic Radius, R =	0.75	ft
Discharge, Q =	32.22	cfs
Ave. Velocity, V =	8.35	ft/sec
pipe % full [(A/A_{full})*100%] =	78.6%	



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$ P

$$\theta = 2 \arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \leq y/D \leq 1$)

DP 2 Q_{100} = 37.1 cfs

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Partially Full Pipe Flow Calculator and Equations

Fluid Flow Table of Contents | Hydraulic and Pneumatic Knowledge
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This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D =	48	in
Depth of flow, y =	33.5	in

(must have $y \geq D/2$)

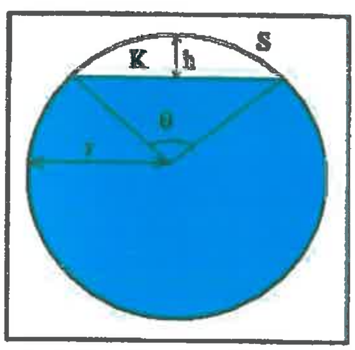
Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.01	ft/ft

Calculations

n/n_{full} =	1.151041(
Partially Full Manning roughness, n =	0.015

Calculations

Pipe Diameter, D =	4	ft
Pipe Radius, r =	2	ft
Circ. Segment Height, h =	1.208	ft
Central Angle, q =	2.33	radians
Cross-Sect. Area, A =	9.37	ft^2
Wetted Perimeter, P =	7.9	ft
Hydraulic Radius, R =	1.18	ft
Discharge, Q =	104.36	cfs
Ave. Velocity, V =	11.14	ft/sec
pipe % full $[(A/A_{full})*100\%]$ =	74.5%	



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$ p

$$\theta = 2 \arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \leq y/D \leq 1$)

DP 3 Q_{100} = 103.25 cfs /PER PIPE

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Partially Full Pipe Flow Calculator and Equations

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This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D =	48	in
Depth of flow, y =	38	in

(must have $y \geq D/2$)

Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.01	ft/ft

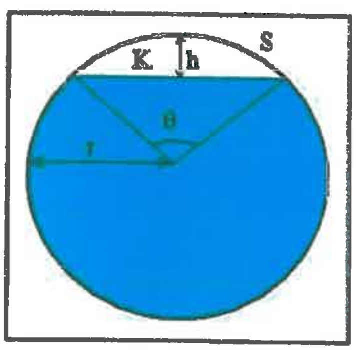
Calculations

n/n_{full} =	1.104166(
Partially Full Manning roughness, n =	0.014

Calculations

Pipe Diameter, D =	4	ft
Pipe Radius, r =	2	ft
Circ. Segment Height, h =	0.833	ft
Central Angle, q =	1.90	radians
Cross-Sect. Area, A =	10.67	ft^2
Wetted Perimeter, P =	8.8	ft
Hydraulic Radius, R =	1.22	ft
Discharge, Q =	126.18	cfs
Ave. Velocity, V =	11.83	ft/sec

pipe % full $[(A/A_{full})*100\%]$ = 84.9%



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$ P

$$\theta = 2\arccos\left(\frac{r-h}{r}\right)$$

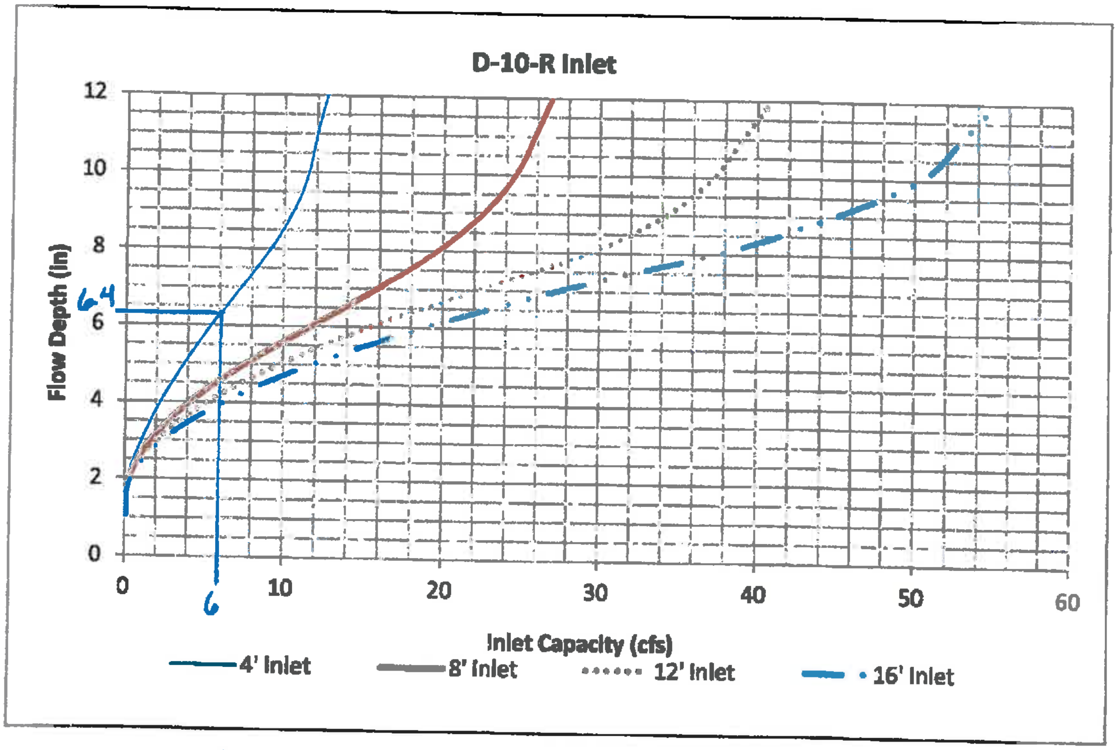
$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \leq y/D \leq 1$)

DP7 Q_{100} = 125.5 cfs

Figure 8-12. Inlet Capacity Chart Sump Conditions, Curb Opening (D-10-R) Inlet



½ DP B Q_{100} = 6.7 cfs

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Ultimate - GD&T Wall Chart
ASME Y14.5-2009 Standard
Laminated, 24" x 36" - Awesome!

ASME Y14.5-2009, Geometric Boundaries II GD&T Reference Book

Partially Full Pipe Flow Calculator and Equations

[Fluid Flow Table of Contents] | [Hydraulic and Pneumatic Knowledge]
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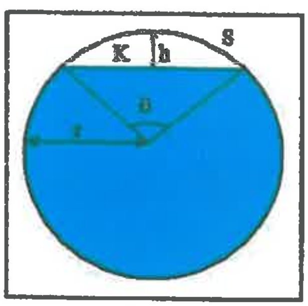
This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs			Calculations		
Pipe Diameter, D =	24	in	Pipe Diameter, D =	2	ft
Depth of flow, y =	15	in	Pipe Radius, r =	1	ft
(must have $y \geq D/2$)			Circ. Segment Height, h =	0.750	ft
Full Pipe Manning roughness, n_{full} =	0.013		Central Angle, q =	2.64	radians
Channel bottom slope, S =	0.01	ft/ft	Cross-Sect. Area, A =	2.07	ft²
			Wetted Perimeter, P =	3.6	ft
Calculations			Hydraulic Radius, R =	0.57	ft
n/n_{full} =	1.1875		Discharge, Q =	13.65	cfs
Partially Full Manning roughness, n =	0.015		Ave. Velocity, V =	6.61	ft/sec
			pipe % full [(A/A_{full})*100%] =	65.7%	



Partially Full Pipe Flow Parameters
(More Than Half Full)

r = D/2

h = 2r - y

(hydraulic radius)

R = A/P

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

V = Q/A

$$\theta = 2\arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)^{0.5}$ (for $0.5 \leq y/D \leq 1$)

DP 8 Q_{100} = 13.5 cfs

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Partially Full Pipe Flow Calculator and Equations

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This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D =	36	in
Depth of flow, y =	30	in

(must have $y \geq D/2$)

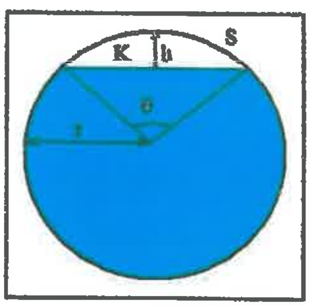
Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.01	ft/ft

Calculations

n/n_{full} =	1.083333:
Partially Full Manning roughness, n =	0.014

Calculations

Pipe Diameter, D =	3	ft
Pipe Radius, r =	1.5	ft
Circ. Segment Height, h =	0.500	ft
Central Angle, q =	1.68	radians
Cross-Sect. Area, A =	6.29	ft^2
Wetted Perimeter, P =	6.9	ft
Hydraulic Radius, R =	0.91	ft
Discharge, Q =	62.63	cfs
Ave. Velocity, V =	9.95	ft/sec
pipe % full [(A/A_{full})*100%] =	89.0%	



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$ P

$$\theta = 2 \arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r \cdot \theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)^{0.5}$ (for $0.5 \leq y/D \leq 1$)

$\frac{1}{2}$ DP 10 Q_{100} = 61.25 cfs

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Partially Full Pipe Flow Calculator and Equations

Fluid Flow Table of Contents | Hydraulic and Pneumatic Knowledge
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This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D = 54 in
Depth of flow, y = 47 in
(must have $y \geq D/2$)

Full Pipe Manning roughness, n_{full} = 0.013
Channel bottom slope, S = 0.01 ft/ft

Calculations

n/n_{full} = 1.0648148
Partially Full Manning roughness, n = 0.014

Calculations

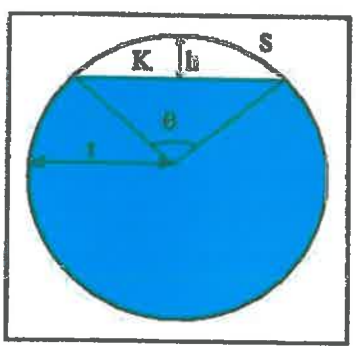
Pipe Diameter, D = 4.5 ft
Pipe Radius, r = 2.25 ft

Circ. Segment Height, h = 0.583 ft

Central Angle, q = 1.47 radians
Cross-Sect. Area, A = 14.69 ft^2

Wetted Perimeter, P = 10.8 ft
Hydraulic Radius, R = 1.36 ft
Discharge, Q = 193.94 cfs
Ave. Velocity, V = 13.20 ft/sec

pipe % full $[(A/A_{full})*100\%]$ = 92.4%



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$

$$\theta = 2 \arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \leq y/D \leq 1$)

Ex WQ Pond #5 Q_{100} = 191 cfs

Partially Full Pipe Flow Calculator and Equations

Fluid Flow Table of Contents | Hydraulic and Pneumatic Knowledge
Fluid Power Equipment

This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D =	54	in
Depth of flow, y =	45	in

(must have $y \geq D/2$)

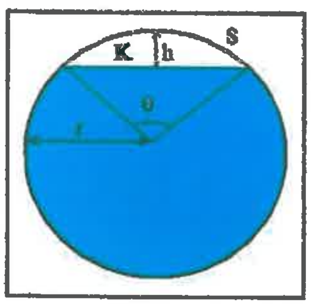
Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.01	ft/ft

Calculations

n/n_{full} =	1.083333:
Partially Full Manning roughness, n =	0.014

Calculations

Pipe Diameter, D =	4.5	ft
Pipe Radius, r =	2.25	ft
Circ. Segment Height, h =	0.750	ft
Central Angle, q =	1.68	radians
Cross-Sect. Area, A =	14.16	ft^2
Wetted Perimeter, P =	10.4	ft
Hydraulic Radius, R =	1.37	ft
Discharge, Q =	184.64	cfs
Ave. Velocity, V =	13.04	ft/sec
pipe % full [(A/A_{full})*100%] =	89.0%	



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$ P

$$\theta = 2 \arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r^*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)^*0.5$ (for $0.5 \leq y/D \leq 1$)

EX. WQ POND #5 Q_{100} = 180.3 cfs

CHECK REPORT SURVEY ALTA SHOWS 18"

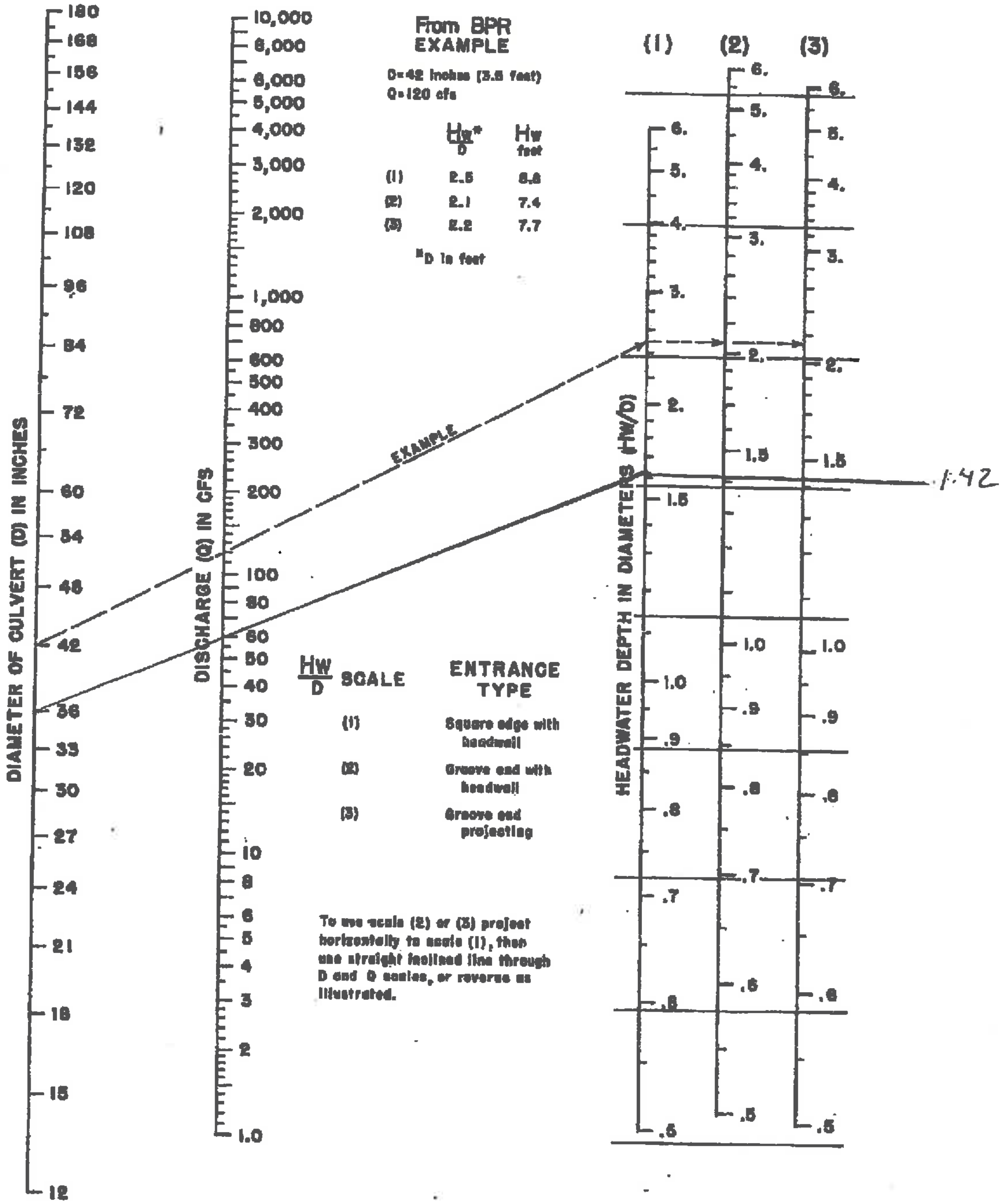
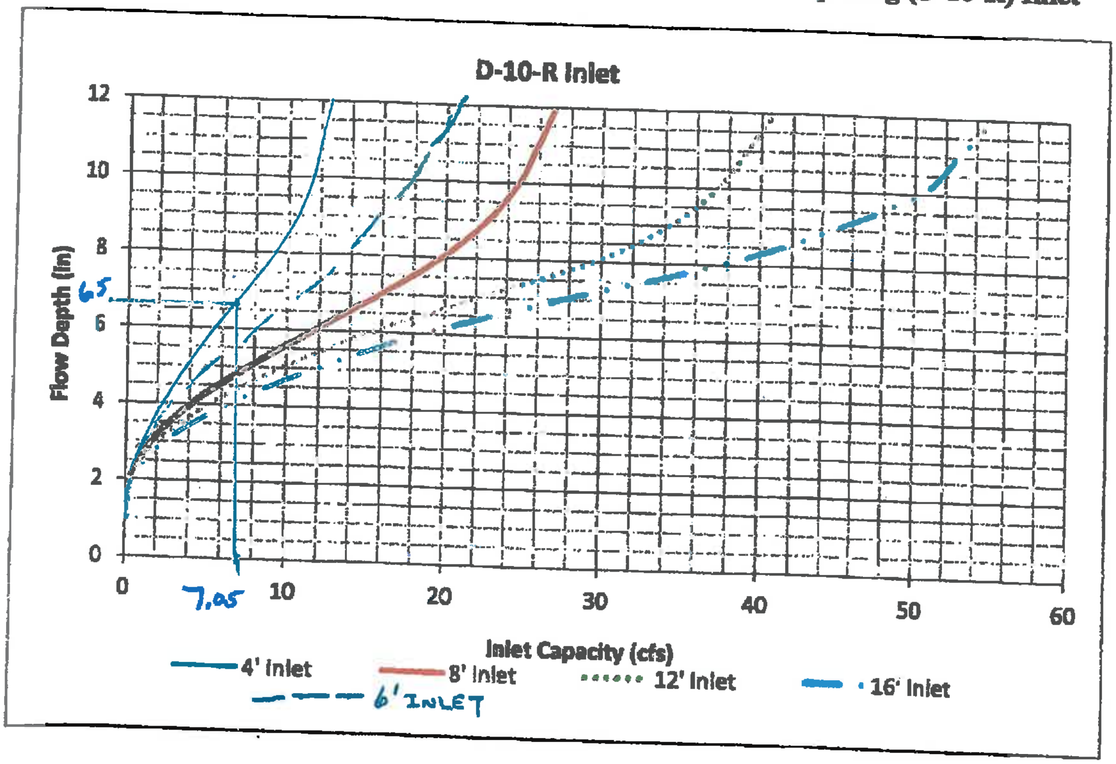


Figure CU-9—Inlet Control Nomograph—Example

DP15 Q_{100} = 181.9 cfs / 3 = 60.6 cfs

3-36" CULVERTS

Figure 8-12. Inlet Capacity Chart Sump Conditions, Curb Opening (D-10-R) Inlet



DP 12 Q_{100} = 7.05 cfs FLOW SPLIT

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Partially Full Pipe Flow Calculator and Equations

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This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D =	18	in
Depth of flow, y =	12	in

(must have $y \geq D/2$)

Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.01	ft/ft

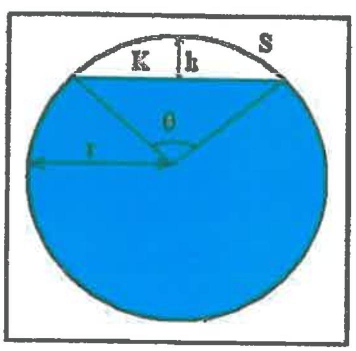
Calculations

n/n_{full} =	1.166666(
Partially Full Manning roughness, n =	0.015

Calculations

Pipe Diameter, D =	1.5	ft
Pipe Radius, r =	0.75	ft
Circ. Segment Height, h =	0.500	ft
Central Angle, q =	2.46	radians
Cross-Sect. Area, A =	1.25	ft^2
Wetted Perimeter, P =	2.9	ft
Hydraulic Radius, R =	0.44	ft
Discharge, Q =	7.08	cfs
Ave. Velocity, V =	5.65	ft/sec

pipe % full $[(A/A_{full})*100\%]$ = 70.8%



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$ P

$$\theta = 2 \arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \leq y/D \leq 1$)

$\frac{1}{2}$ DP12 Q_{100} = 7.05 cfs

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Partially Full Pipe Flow Calculator and Equations

Fluid Flow Table of Contents | Hydraulic and Pneumatic Knowledge
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This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D =	24	in
Depth of flow, y =	16	in

(must have $y \geq D/2$)

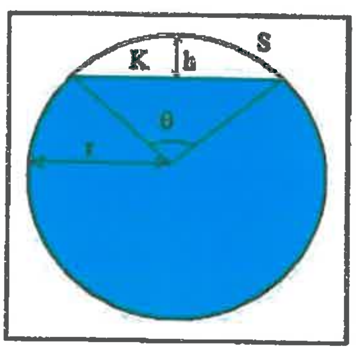
Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.01	ft/ft

Calculations

n/n_{full} =	1.166666
Partially Full Manning roughness, n =	0.015

Calculations

Pipe Diameter, D =	2	ft
Pipe Radius, r =	1	ft
Circ. Segment Height, h =	0.667	ft
Central Angle, q =	2.46	radians
Cross-Sect. Area, A =	2.22	ft^2
Wetted Perimeter, P =	3.8	ft
Hydraulic Radius, R =	0.58	ft
Discharge, Q =	15.24	cfs
Ave. Velocity, V =	6.85	ft/sec
pipe % full [$(A/A_{full})*100\%$] =	70.8%	



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$ P

$$\theta = 2\arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$

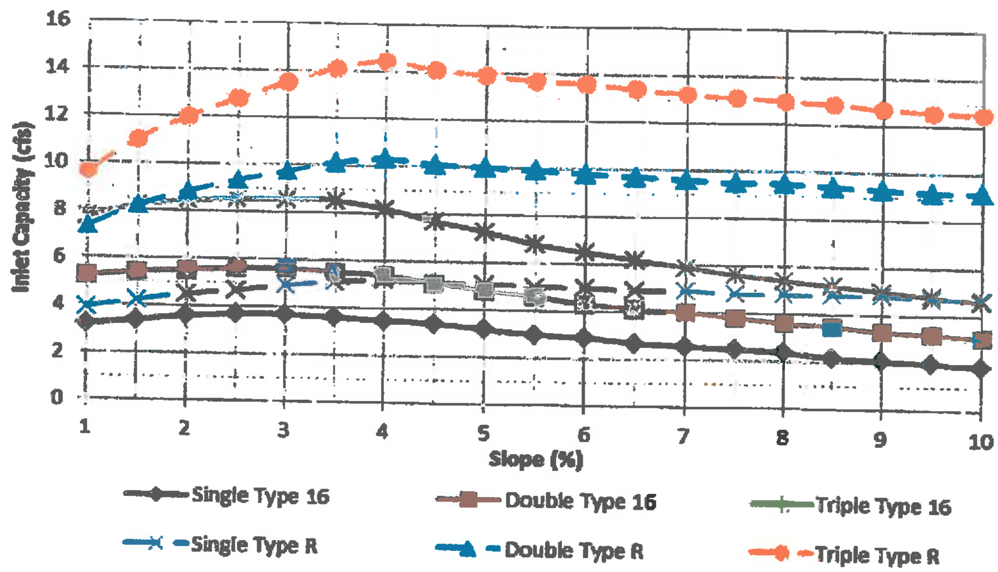
Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \leq y/D \leq 1$)

DP 12 = 14.1 cfs

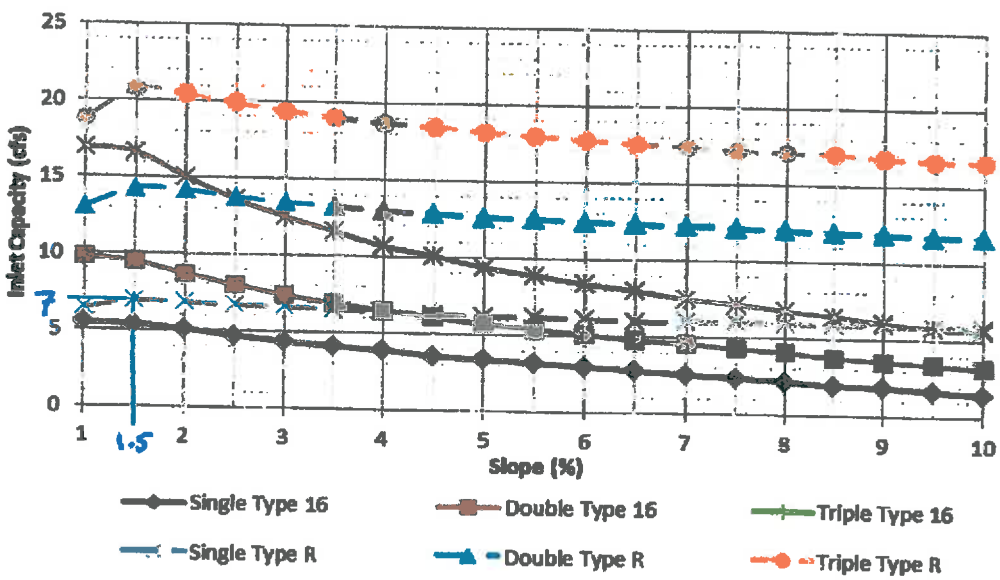
Figure 8-7. Inlet Capacity Chart Continuous Grade Conditions, Residential (Local)
(Attached and Detached Sidewalk)

Street Section Data: Street Width Flowline to Flowline = 34'
Type of Curb and Gutter: D-10-R = 8" vertical
Type 16 = 6" vertical

Minor Storm



Major Storm



The standard street section parameters as defined in Chapter 7 must apply to use these charts. For non-standard sections, the inlet capacity shall be calculated using the UDFCD spreadsheets. The maximum spread width is limited by the curb height based on no curb overtopping during a minor storm and flow being contained within the public right-of-way during the major storm. Calculations were done using UD-Inlet 3.00.xls, Mar., 2011 with the default clogging factors.

½ DP13 Q_{100} = 7.95 cfs

Partially Full Pipe Flow Calculator and Equations

This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D =	18	in
Depth of flow, y =	13	in

(must have $y \geq D/2$)

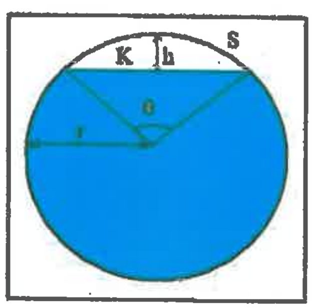
Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.01	ft/ft

Calculations

n/n_{full} =	1.138888(
Partially Full Manning roughness, n =	0.015

Calculations

Pipe Diameter, D =	1.5	ft
Pipe Radius, r =	0.75	ft
Circ. Segment Height, h =	0.417	ft
Central Angle, q =	2.22	radians
Cross-Sect. Area, A =	1.37	ft^2
Wetted Perimeter, P =	3.0	ft
Hydraulic Radius, R =	0.45	ft
Discharge, Q =	8.06	cfs
Ave. Velocity, V =	5.90	ft/sec
pipe % full [(A/A$_{full}$)*100%] =	77.3%	



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$ P

$$\theta = 2 \arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r^*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)^*0.5$ (for $0.5 \leq y/D \leq 1$)

$\frac{1}{2}$ DP 13 Q_{100} = 7.95

Partially Full Pipe Flow Calculator and Equations

Fluid Flow Table of Contents | Hydraulic and Pneumatic Knowledge
Fluid Power Equipment

This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D =	24	in
Depth of flow, y =	17	in

(must have $y \geq D/2$)

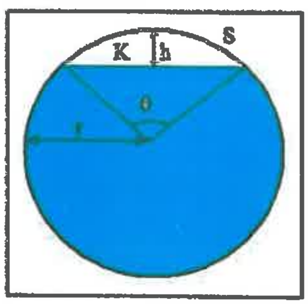
Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.01	ft/ft

Calculations

n/n_{full} =	1.1458933	
Partially Full Manning roughness, n =	0.015	

Calculations

Pipe Diameter, D =	2	ft
Pipe Radius, r =	1	ft
Circ. Segment Height, h =	0.583	ft
Central Angle, q =	2.28	radians
Cross-Sect. Area, A =	2.38	ft^2
Wetted Perimeter, P =	4.0	ft
Hydraulic Radius, R =	0.59	ft
Discharge, Q =	16.83	cfs
Ave. Velocity, V =	7.07	ft/sec
pipe % full [(A/A_{full})*100%] =	75.7%	



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$

$$\theta = 2\arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \leq y/D \leq 1$)

DP 13 Q_{100} = 15.9 cfs

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Partially Full Pipe Flow Calculator and Equations

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This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

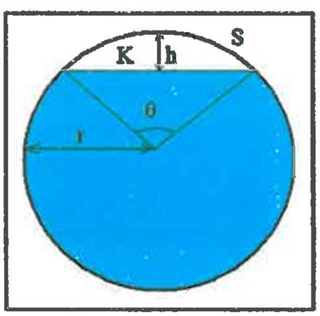
Pipe Diameter, D =	42	in
Depth of flow, y =	40	in
(must have y ≥ D/2)		
Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.003	ft/ft

Calculations

n/n_{full} =	1.0238095	
Partially Full Manning roughness, n =	0.013	

Calculations

Pipe Diameter, D =	3.5	ft
Pipe Radius, r =	1.75	ft
Circ. Segment Height, h =	0.167	ft
Central Angle, q =	0.88	radians
Cross-Sect. Area, A =	9.45	ft^2
Wetted Perimeter, P =	9.5	ft
Hydraulic Radius, R =	1.00	ft
Discharge, Q =	57.96	cfs
Ave. Velocity, V =	6.13	ft/sec
pipe % full [(A/A_{full})*100%] =	98.3%	



**Partially Full Pipe Flow Parameters
(More Than Half Full)**

r = D/2

h = 2r - y

(hydraulic radius)

R = A/P

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

V = Q/A

P

$$\theta = 2\arccos\left(\frac{r-h}{r}\right)$$

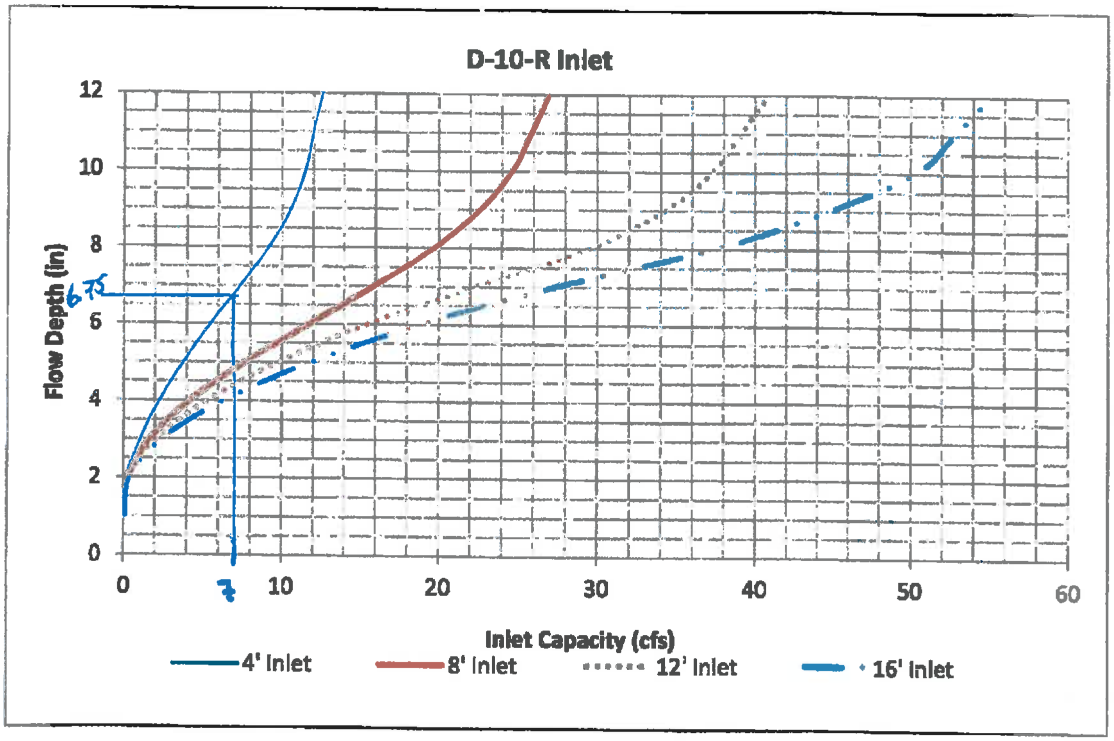
$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r^*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)^*0.5$ (for $0.5 \le y/D \le 1$)

DP 15 Q_{100}=181.9 cfs / 3 = 60.6 cfs/PIPE

Figure 8-12. Inlet Capacity Chart Sump Conditions, Curb Opening (D-10-R) Inlet



DP 16 Q100 = 6.8 cfs

Partially Full Pipe Flow Calculator and Equations

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This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V

for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

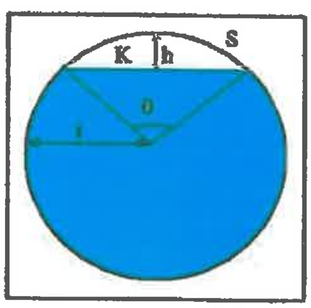
Pipe Diameter, D =	18	in
Depth of flow, y =	12	in
(must have $y \geq D/2$)		
Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.01	ft/ft

Calculations

n/n_{full} =	1.1666666	
Partially Full Manning roughness, n =	0.015	

Calculations

Pipe Diameter, D =	1.5	ft
Pipe Radius, r =	0.75	ft
Circ. Segment Height, h =	0.500	ft
Central Angle, q =	2.46	radians
Cross-Sect. Area, A =	1.25	ft^2
Wetted Perimeter, P =	2.9	ft
Hydraulic Radius, R =	0.44	ft
Discharge, Q =	7.08	cfs
Ave. Velocity, V =	5.65	ft/sec
pipe % full [(A/A_{full})*100%] =	70.8%	



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$ P

$$\theta = 2 \arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r^*\theta$$

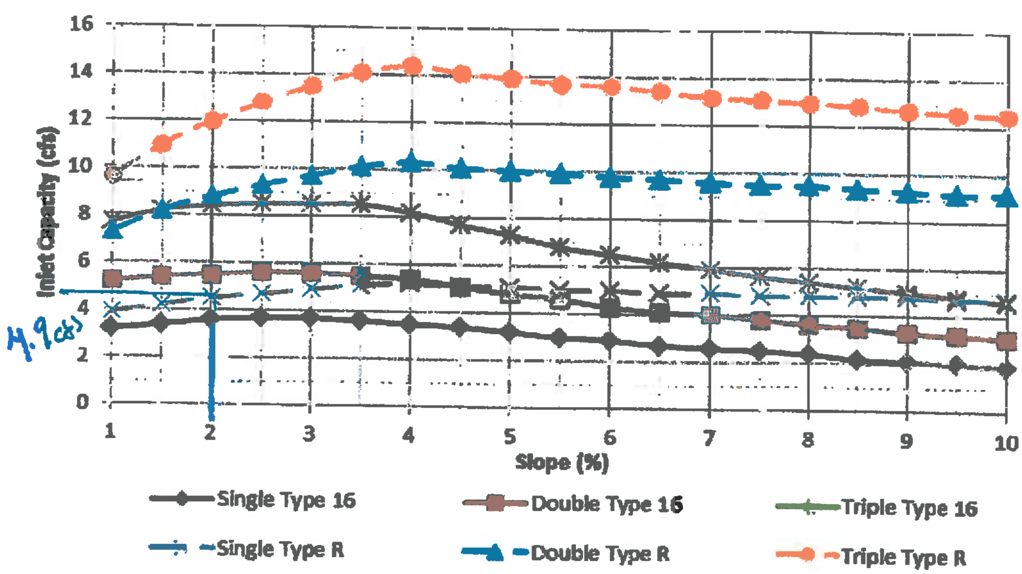
Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)^{0.5}$ (for $0.5 \leq y/D \leq 1$)

DP 16 $Q_{100} = 6.8$ cfs

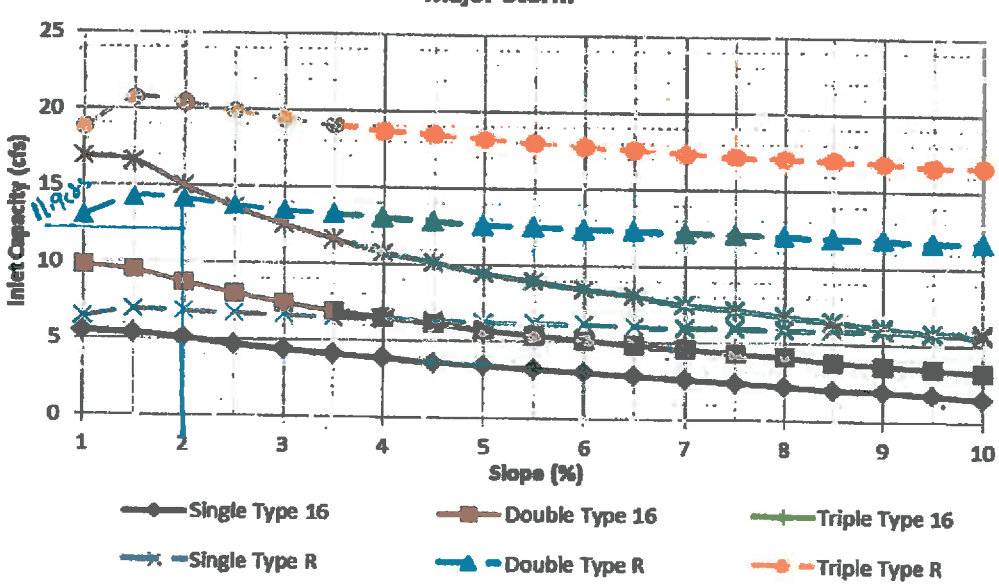
Figure 8-7. Inlet Capacity Chart Continuous Grade Conditions, Residential (Local) (Attached and Detached Sidewalk)

Street Section Data: Street Width Flowline to Flowline = 34'
Type of Curb and Gutter: D-10-R = 8" vertical
Type 16 = 6" vertical

Minor Storm



Major Storm



The standard street section parameters as defined in Chapter 7 must apply to use these charts. For non-standard sections, the inlet capacity shall be calculated using the UDFCD spreadsheets. The maximum spread width is limited by the curb height based on no curb overtopping during a minor storm and flow being contained within the public right-of-way during the major storm. Calculations were done using UD-Inlet 3.00.xls, Mar., 2011 with the default clogging factors.

½ DP31 Q_{100} = 11.9cfs

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Partially Full Pipe Flow Calculator and Equations

Fluid Flow Table of Contents | Hydraulic and Pneumatic Knowledge
Fluid Power Equipment

This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

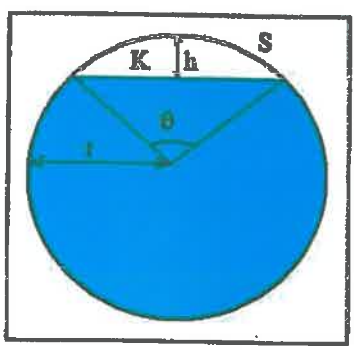
Pipe Diameter, D =	18	in
Depth of flow, y =	17	in
(must have $y \geq D/2$)		
Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.012	ft/ft

Calculations

n/n_{full} =	1.027777	
Partially Full Manning roughness, n =	0.013	

Calculations

Pipe Diameter, D =	1.5	ft
Pipe Radius, r =	0.75	ft
Circ. Segment Height, h =	0.083	ft
Central Angle, q =	0.95	radians
Cross-Sect. Area, A =	1.73	ft²
Wetted Perimeter, P =	4.0	ft
Hydraulic Radius, R =	0.43	ft
Discharge, Q =	12.07	cfs
Ave. Velocity, V =	6.98	ft/sec
pipe % full [(A/A_{full})*100%] =	97.8%	



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$ P

$$\theta = 2\arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \leq y/D \leq 1$)

$\frac{1}{2}$ DP 31 Q_{100} = 11.9 cfs

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Partially Full Pipe Flow Calculator and Equations

[Fluid Flow Table of Contents] | [Hydraulic and Pneumatic Knowledge]
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This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D =	24	in
Depth of flow, y =	23	in

(must have $y \geq D/2$)

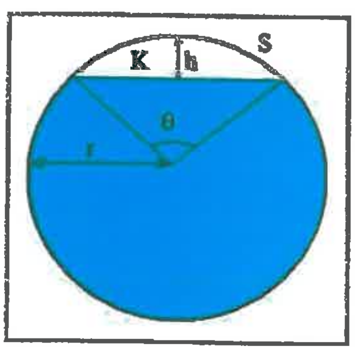
Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.01	ft/ft

Calculations

n/n_{full} =	1.020833:
Partially Full Manning roughness, n =	0.013

Calculations

Pipe Diameter, D =	2	ft
Pipe Radius, r =	1	ft
Circ. Segment Height, h =	0.083	ft
Central Angle, q =	0.82	radians
Cross-Sect. Area, A =	3.10	ft²
Wetted Perimeter, P =	5.5	ft
Hydraulic Radius, R =	0.57	ft
Discharge, Q =	23.82	cfs
Ave. Velocity, V =	7.69	ft/sec
pipe % full $[(A/A_{full})*100\%]$ =	98.6%	



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$

$$\theta = 2 \arccos\left(\frac{r-h}{r}\right)$$

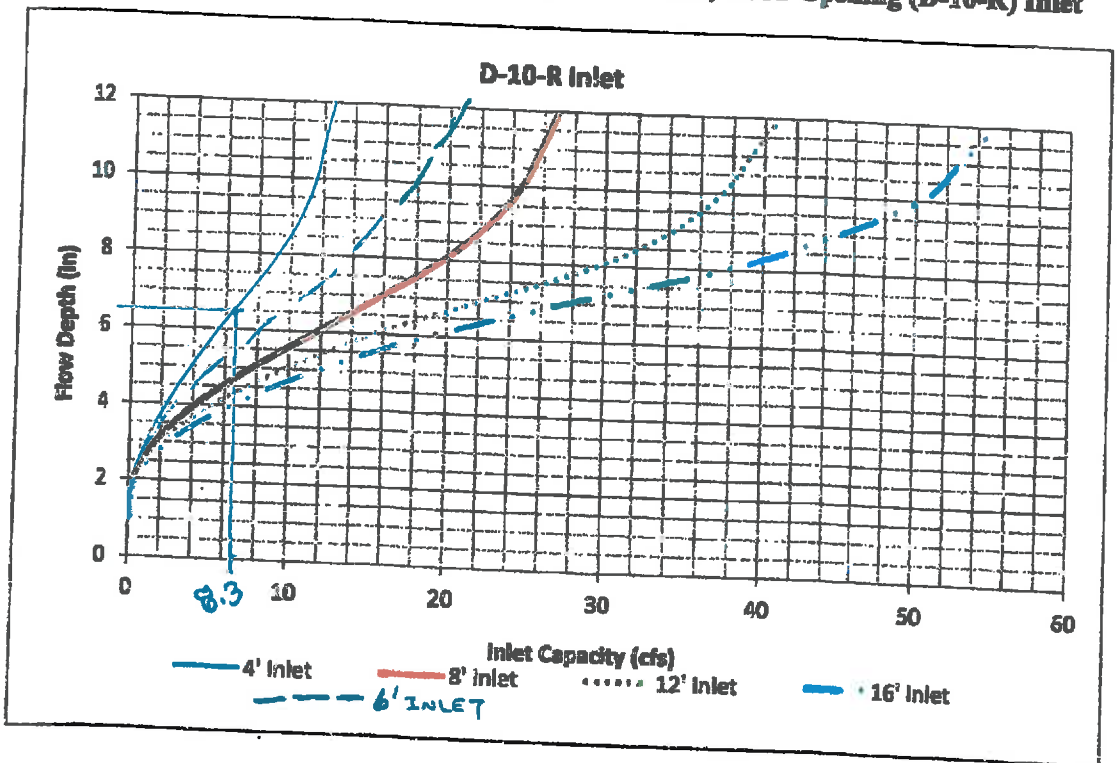
$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \leq y/D \leq 1$)

DP 31 Q_{100} = 23.8 cfs

Figure 8-12. Inlet Capacity Chart Sump Conditions, Curb Opening (D-10-R) Inlet



½ DP 20 Q_{100} = 8.3 cfs

Partially Full Pipe Flow Calculator and Equations

[Fluid Flow Table of Contents] | [Hydraulic and Pneumatic Knowledge]
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This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D = 18 in
Depth of flow, y = 14 in
(must have $y \geq D/2$)

Full Pipe Manning roughness, n_{full} = 0.013
Channel bottom slope, S = 0.01 ft/ft

Calculations

n/n_{full} = 1.111111
Partially Full Manning roughness, n = 0.014

Calculations

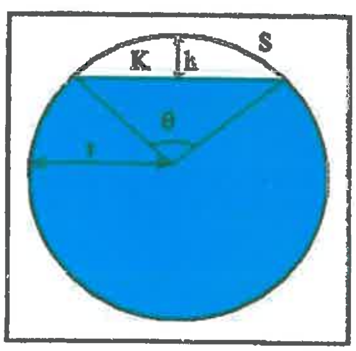
Pipe Diameter, D = 1.5 ft
Pipe Radius, r = 0.75 ft

Circ. Segment Height, h = 0.333 ft

Central Angle, q = 1.96 radians
Cross-Sect. Area, A = 1.47 ft^2

Wetted Perimeter, P = 3.2 ft
Hydraulic Radius, R = 0.46 ft
Discharge, Q = 9.00 cfs
Ave. Velocity, V = 6.10 ft/sec

pipe % full $[(A/A_{full})*100\%]$ = 83.5%



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$ P

$$\theta = 2\arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \leq y/D \leq 1$)

$\frac{1}{2}$ DP20 Q_{100} = 8.3 cfs

Partially Full Pipe Flow Calculator and Equations

Fluid Flow Table of Contents | Hydraulic and Pneumatic Knowledge
Fluid Power Equipment

This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D =	30	in
Depth of flow, y =	22	in

(must have $y \geq D/2$)

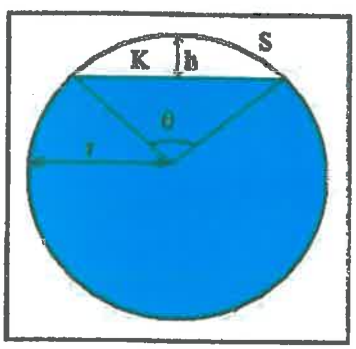
Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.015	ft/ft

Calculations

n/n_{full} =	1.133333
Partially Full Manning roughness, n =	0.015

Calculations

Pipe Diameter, D =	2.5	ft
Pipe Radius, r =	1.25	ft
Circ. Segment Height, h =	0.667	ft
Central Angle, q =	2.17	radians
Cross-Sect. Area, A =	3.86	ft^2
Wetted Perimeter, P =	5.1	ft
Hydraulic Radius, R =	0.75	ft
Discharge, Q =	39.46	cfs
Ave. Velocity, V =	10.23	ft/sec
pipe % full [(A/A_{full})*100%] =	78.6%	



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$ P

$$\theta = 2\arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \leq y/D \leq 1$)

DP20 + DP31 Q_{100} = 38.7 cfs

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Partially Full Pipe Flow Calculator and Equations

Fluid Flow Table of Contents | Hydraulic and Pneumatic Knowledge
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This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

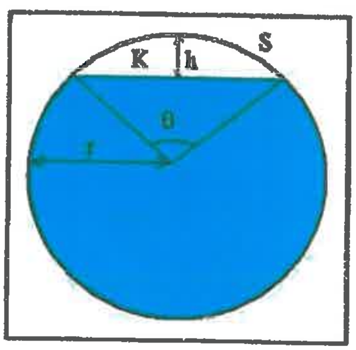
Pipe Diameter, D =	30	in
Depth of flow, y =	24	in
(must have $y \geq D/2$)		
Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.015	ft/ft

Calculations

n/n_{full} =	1.1	
Partially Full Manning roughness, n =	0.014	

Calculations

Pipe Diameter, D =	2.5	ft
Pipe Radius, r =	1.25	ft
Circ. Segment Height, h =	0.500	ft
Central Angle, q =	1.85	radians
Cross-Sect. Area, A =	4.21	ft^2
Wetted Perimeter, P =	5.5	ft
Hydraulic Radius, R =	0.76	ft
Discharge, Q =	44.76	cfs
Ave. Velocity, V =	10.63	ft/sec
pipe % full $[(A/A_{full})*100\%]$ =	85.8%	



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$

P

$$\theta = 2\arccos\left(\frac{r-h}{r}\right)$$

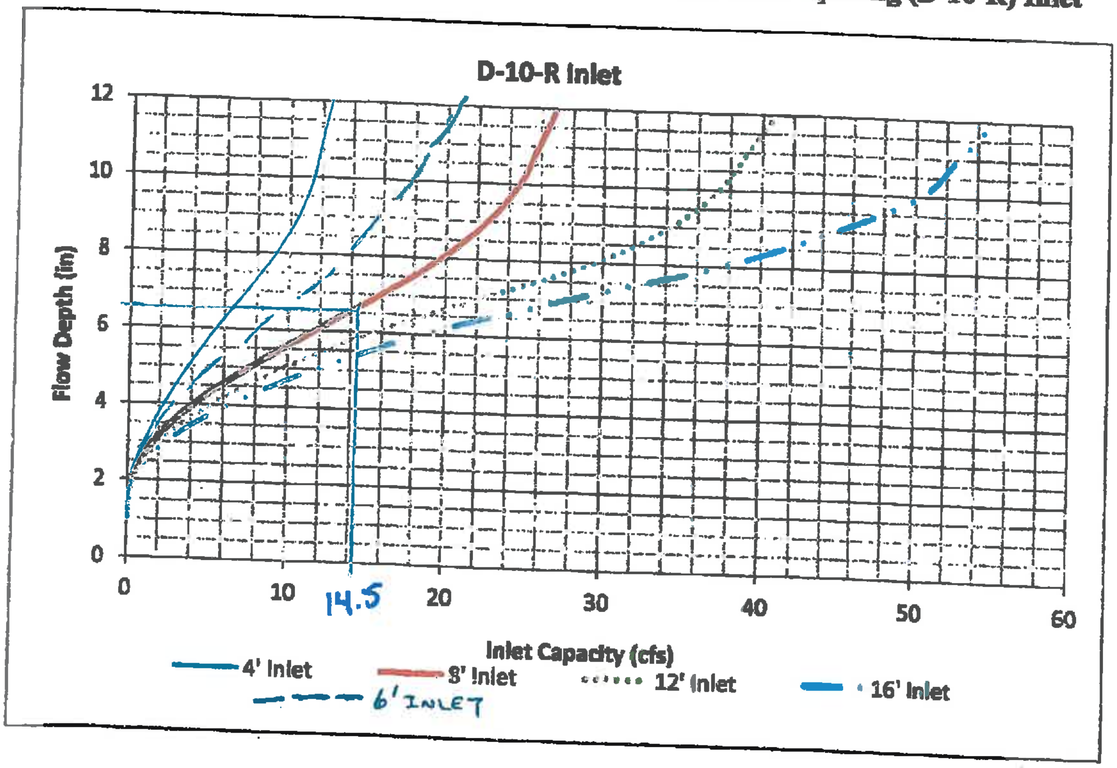
$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \leq y/D \leq 1$)

PR 117 + PR 121 Q_{100} = 44.6 cfs

Figure 8-12. Inlet Capacity Chart Sump Conditions, Curb Opening (D-10-R) Inlet



DP 21 Q_{100} = 14.5 cfs

Partially Full Pipe Flow Calculator and Equations

Fluid Flow Table of Contents | Hydraulic and Pneumatic Knowledge
Fluid Power Equipment

This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D =	24	in
Depth of flow, y =	16	in

(must have $y \geq D/2$)

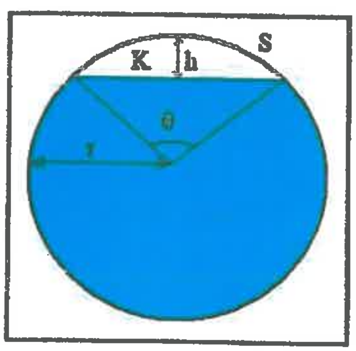
Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.01	ft/ft

Calculations

n/n_{full} =	1.166666
Partially Full Manning roughness, n =	0.015

Calculations

Pipe Diameter, D =	2	ft
Pipe Radius, r =	1	ft
Circ. Segment Height, h =	0.667	ft
Central Angle, q =	2.46	radians
Cross-Sect. Area, A =	2.22	ft^2
Wetted Perimeter, P =	3.8	ft
Hydraulic Radius, R =	0.58	ft
Discharge, Q =	15.24	cfs
Ave. Velocity, V =	6.85	ft/sec
pipe % full [(A/A_{full})*100%] =	70.8%	



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$ P

$$\theta = 2\arccos\left(\frac{r-h}{r}\right)$$

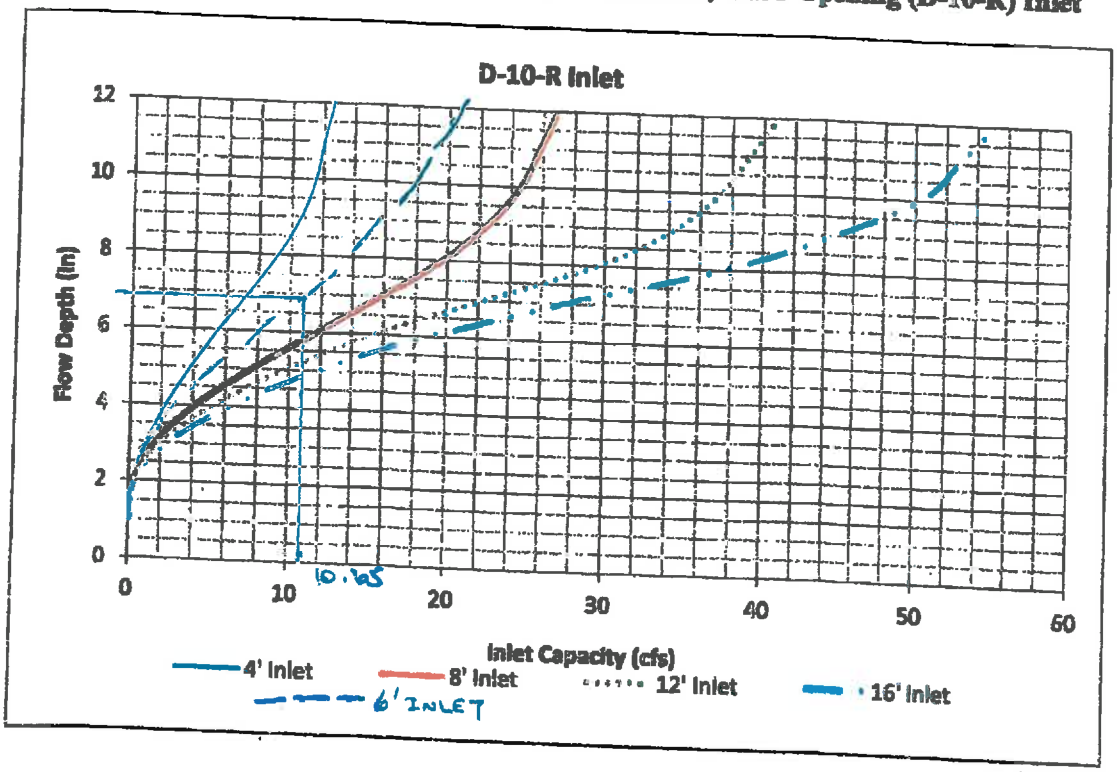
$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \leq y/D \leq 1$)

DP 21 Q_{100} = 145 cfs

Figure 8-12. Inlet Capacity Chart Sump Conditions, Curb Opening (D-10-R) Inlet



$\frac{1}{2}$ DP 22 Q_{100} = 10.65 cfs

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Partially Full Pipe Flow Calculator and Equations

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[Fluid Power Equipment]

This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D =	18	in
Depth of flow, y =	17	in

(must have $y \geq D/2$)

Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.01	ft/ft

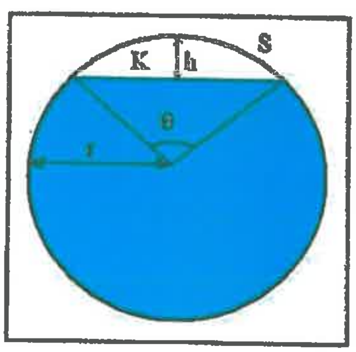
Calculations

n/n_{full} =	1.027777:
Partially Full Manning roughness, n =	0.013

Calculations

Pipe Diameter, D =	1.5	ft
Pipe Radius, r =	0.75	ft
Circ. Segment Height, h =	0.083	ft
Central Angle, q =	0.95	radians
Cross-Sect. Area, A =	1.73	ft²
Wetted Perimeter, P =	4.0	ft
Hydraulic Radius, R =	0.43	ft
Discharge, Q =	11.02	cfs
Ave. Velocity, V =	6.38	ft/sec

pipe % full $[(A/A_{full})*100\%]$ = 97.8%



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$

P

$$\theta = 2\arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \leq y/D \leq 1$)

½ DP 22 Q_{100} = 10.65cfs

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Partially Full Pipe Flow Calculator and Equations

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This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D =	42	in
Depth of flow, y =	28	in

(must have $y \geq D/2$)

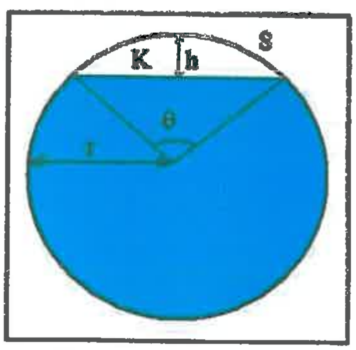
Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.01	ft/ft

Calculations

n/n_{full} =	1.166666(
Partially Full Manning roughness, n =	0.015

Calculations

Pipe Diameter, D =	3.5	ft
Pipe Radius, r =	1.75	ft
Circ. Segment Height, h =	1.167	ft
Central Angle, q =	2.46	radians
Cross-Sect. Area, A =	6.81	ft^2
Wetted Perimeter, P =	6.7	ft
Hydraulic Radius, R =	1.02	ft
Discharge, Q =	67.78	cfs
Ave. Velocity, V =	9.95	ft/sec
pipe % full [(A/A_{full})*100%] =	70.8%	



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$

$$\theta = 2\arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \leq y/D \leq 1$)

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PR 122 + PR 123 + PR 124 Q_{100} = 67.6 cfs

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Partially Full Pipe Flow Calculator and Equations

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This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

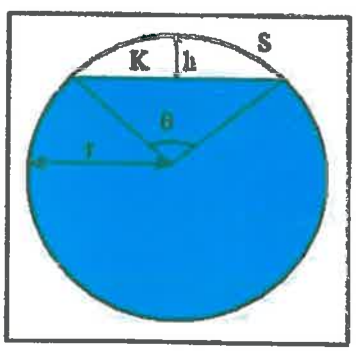
Pipe Diameter, D =	42	in
Depth of flow, y =	31	in
(must have $y \geq D/2$)		
Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.01	ft/ft

Calculations

n/n_{full} =	1.130952
Partially Full Manning roughness, n =	0.015

Calculations

Pipe Diameter, D =	3.5	ft
Pipe Radius, r =	1.75	ft
Circ. Segment Height, h =	0.917	ft
Central Angle, q =	2.15	radians
Cross-Sect. Area, A =	7.61	ft^2
Wetted Perimeter, P =	7.2	ft
Hydraulic Radius, R =	1.05	ft
Discharge, Q =	79.82	cfs
Ave. Velocity, V =	10.48	ft/sec
pipe % full [(A/A_{full})*100%] =	79.1%	



Partially Full Pipe Flow Parameters (More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$ P

$$\theta = 2\arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \leq y/D \leq 1$)

PR 125 + PR 126 $Q_{100} = 77.2$ cfs

width	2.9	area	8.41	open area x 70%		2.9435
length	2.9	blockage	0.5			
perimeter	11.6	blockage	4	avail perm.		7.6
				Orifice	Weir	
60	0			0	0	
60.125	0.125			5.010871	1.041215	
60.25	0.25			7.086442	2.945	
60.375	0.375			8.679083	5.41031	
60.5	0.5			10.02174	8.329718	
60.625	0.625			11.20465	11.64113	
60.75	0.75			12.27408	15.30267	
60.875	0.875			13.25752	19.28357	
61	1			14.17288	23.56	
61.125	1.125			15.03261	28.1128	
61.25	1.25			15.84577	32.9261	
61.375	1.375			16.61918	37.9865	
61.5	1.5			17.35817	43.28248	
61.625	1.625			18.06695	48.80399	
61.75	1.75			18.74896	54.54216	
61.875	1.875			19.40702	60.48911	
62	2			20.04348	66.63774	

DP23 $Q_{100} = 4.2$ cfs

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Partially Full Pipe Flow Calculator and Equations

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This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

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Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D = 18 in
Depth of flow, y = 10 in
(must have $y \geq D/2$)

Full Pipe Manning roughness, n_{full} = 0.013
Channel bottom slope, S = 0.01 ft/ft

Calculations

n/n_{full} = 1.222222
Partially Full Manning roughness, n = 0.016

Calculations

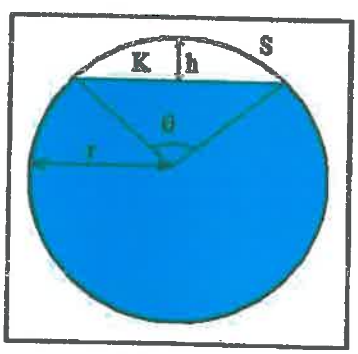
Pipe Diameter, D = 1.5 ft
Pipe Radius, r = 0.75 ft

Circ. Segment Height, h = 0.667 ft

Central Angle, q = 2.92 radians
Cross-Sect. Area, A = 1.01 ft²

Wetted Perimeter, P = 2.5 ft
Hydraulic Radius, R = 0.40 ft
Discharge, Q = 5.13 cfs
Ave. Velocity, V = 5.09 ft/sec

pipe % full $[(A/A_{full})*100\%]$ = 57.1%



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$

P

$$\theta = 2\arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \leq y/D \leq 1$)

DP 23 Q_{100} = 4.2 cfs

Partially Full Pipe Flow Calculator and Equations

Fluid Flow Table of Contents | Hydraulic and Pneumatic Knowledge
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This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

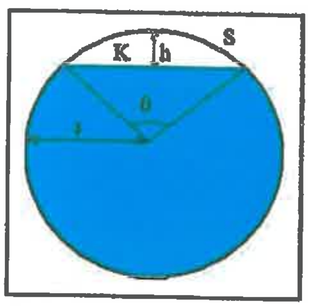
Pipe Diameter, D =	18	in
Depth of flow, y =	14	in
(must have y ≥ D/2)		
Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.01	ft/ft

Calculations

n/n_{full} =	1.111111
Partially Full Manning roughness, n =	0.014

Calculations

Pipe Diameter, D =	1.5	ft
Pipe Radius, r =	0.75	ft
Circ. Segment Height, h =	0.333	ft
Central Angle, q =	1.96	radians
Cross-Sect. Area, A =	1.47	ft^2
Wetted Perimeter, P =	3.2	ft
Hydraulic Radius, R =	0.46	ft
Discharge, Q =	9.00	cfs
Ave. Velocity, V =	6.10	ft/sec
pipe % full [(A/A_{full})*100%] =	83.5%	



Partially Full Pipe Flow Parameters
(More Than Half Full)

r = D/2

h = 2r - y

(hydraulic radius)

R = A/P

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

V = Q/A

$$\theta = 2\arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)^{*}0.5$ (for $0.5 \le y/D \le 1$)

DP 24 Q_{100} = 8.1 cfs

Partially Full Pipe Flow Calculator and Equations

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This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

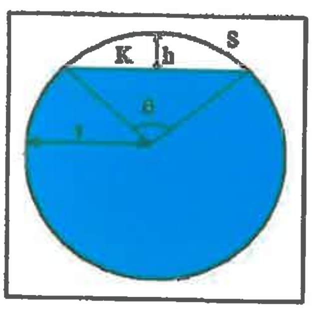
Pipe Diameter, D =	24	in
Depth of flow, y =	18	in
(must have y ≥ D/2)		
Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.01	ft/ft

Calculations

n/n_{full} =	1.125	
Partially Full Manning roughness, n =	0.015	

Calculations

Pipe Diameter, D =	2	ft
Pipe Radius, r =	1	ft
Circ. Segment Height, h =	0.500	ft
Central Angle, q =	2.09	radians
Cross-Sect. Area, A =	2.53	ft²
Wetted Perimeter, P =	4.2	ft
Hydraulic Radius, R =	0.60	ft
Discharge, Q =	18.39	cfs
Ave. Velocity, V =	7.27	ft/sec
pipe % full [(A/A_{full})*100%] =	80.4%	



Partially Full Pipe Flow Parameters
(More Than Half Full)

r = D/2

h = 2r - y

(hydraulic radius)

R = A/P

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

V = Q/A

P

$$\theta = 2\arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r^*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)^*0.5$ (for $0.5 \le y/D \le 1$)

PR 130 Q_{100} = 17.8 cfs

width	2.9		area	8.41	open area x 70%		2.9435	0.125
length	2.9		blockage	0.5				
perimeter	11.6		blockage	4	avail perm.		7.6	
					Orifice	Weir		
56	0				0	0		
56.125	0.125				5.010871	1.041215		
56.25	0.25				7.086442	2.945		
56.375	0.375				8.679083	5.41031		
56.5	0.5				10.02174	8.329718		
56.625	0.625				11.20465	11.64113		
56.75	0.75				12.27408	15.30267		
56.875	0.875				13.25752	19.28357		
57	1				14.17288	23.56		
57.125	1.125				15.03261	28.1128		
57.25	1.25				15.84577	32.9261		
57.375	1.375				16.61918	37.9865		
57.5	1.5				17.35817	43.28248		
57.625	1.625				18.06695	48.80399		
57.75	1.75				18.74896	54.54216		
57.875	1.875				19.40702	60.48911		
58	2				20.04348	66.63774		
58.125	2.125				20.66035	72.98165		
58.25	2.25				21.25933	79.515		
58.375	2.375				21.84188	86.23245		
58.5	2.5				22.4093	93.12908		
58.625	2.625				22.9627	100.2004		
58.75	2.75				23.50307	107.4421		
58.875	2.875				24.03129	114.8503		
59	3				24.54815	122.4214		
59.125	3.125				25.05436	130.1518		
59.25	3.25				25.55053	138.0385		
59.375	3.375				26.03725	146.0784		

DP 27 Q_{100} = 12.5 cfs

ENGINEERS EDGE
Solutions By Design

Partially Full Pipe Flow Calculator and Equations

Fluid Flow Table of Contents | Hydraulic and Pneumatic Knowledge
Fluid Power Equipment

This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D = 18 in
Depth of flow, y = 16 in
(must have y ≥ D/2)

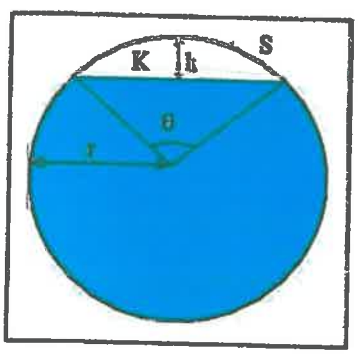
Full Pipe Manning roughness, n_{full} = 0.013
Channel bottom slope, S = 0.015 ft/ft

Calculations

n/n_{full} = 1.055555
Partially Full Manning roughness, n = 0.014

Calculations

Pipe Diameter, D =	1.5	ft
Pipe Radius, r =	0.75	ft
Circ. Segment Height, h =	0.167	ft
Central Angle, q =	1.36	radians
Cross-Sect. Area, A =	1.66	ft^2
Wetted Perimeter, P =	3.7	ft
Hydraulic Radius, R =	0.45	ft
Discharge, Q =	12.95	cfs
Ave. Velocity, V =	7.80	ft/sec
pipe % full [(A/A_{full})*100%] =	93.9%	



Partially Full Pipe Flow Parameters
(More Than Half Full)

r = D/2

h = 2r - y

(hydraulic radius)

R = A/P

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

V = Q/A

$$\theta = 2\arccos\left(\frac{r-h}{r}\right)$$

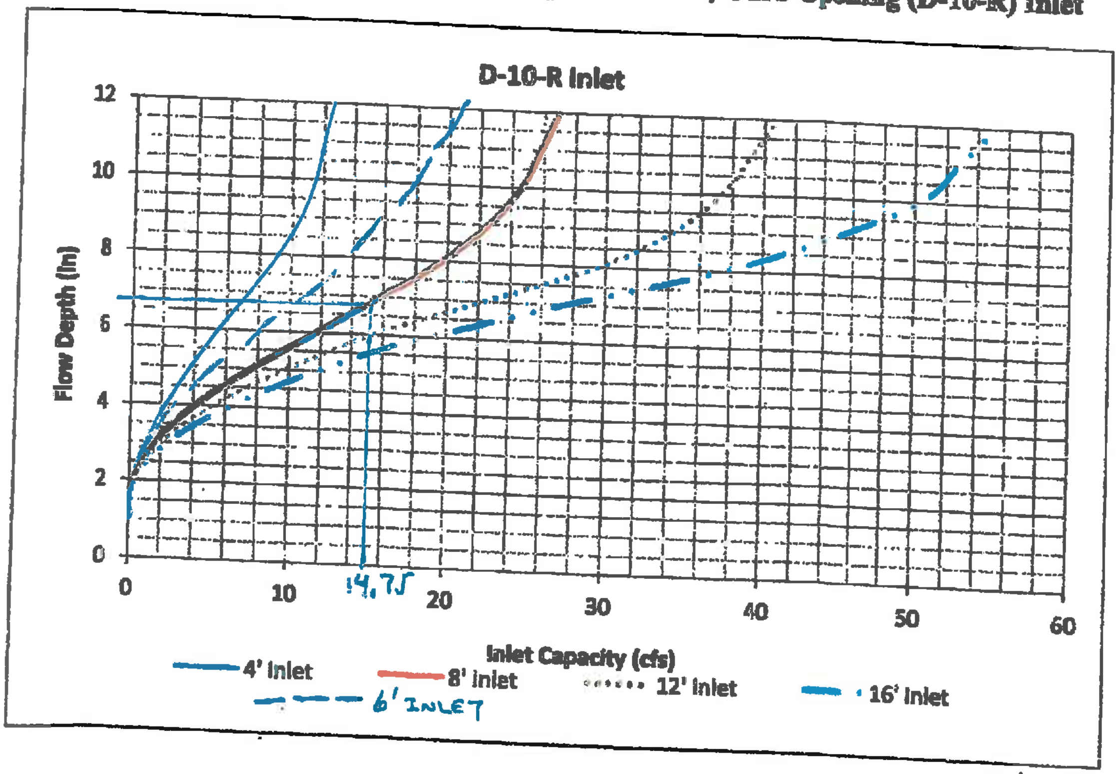
$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \le y/D \le 1$)

DP 27 Q_{100} = 12.5 cfs

Figure 8-12. Inlet Capacity Chart Sump Conditions, Curb Opening (D-10-R) Inlet



½ DP 28 Q_{100} = 14.75cfs

Partially Full Pipe Flow Calculator and Equations

[Fluid Flow Table of Contents](#) | [Hydraulic and Pneumatic Knowledge](#)
[Fluid Power Equipment](#)

This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D =	18	in
Depth of flow, y =	16	in

(must have $y \geq D/2$)

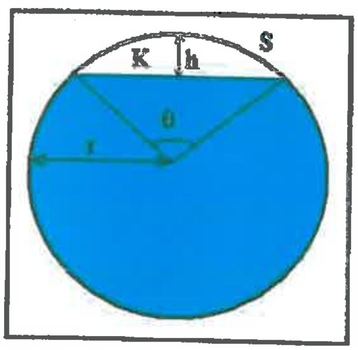
Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.02	ft/ft

Calculations

n/n_{full} =	1.055555!
Partially Full Manning roughness, n =	0.014

Calculations

Pipe Diameter, D =	1.5	ft
Pipe Radius, r =	0.75	ft
Circ. Segment Height, h =	0.167	ft
Central Angle, q =	1.36	radians
Cross-Sect. Area, A =	1.66	ft^2
Wetted Perimeter, P =	3.7	ft
Hydraulic Radius, R =	0.45	ft
Discharge, Q =	14.96	cfs
Ave. Velocity, V =	9.01	ft/sec
pipe % full [(A/A_{full})*100%] =	93.9%	



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$

P

$$\theta = 2 \arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r^*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)^*0.5$ (for $0.5 \leq y/D \leq 1$)

½ DP28 Q_{100} = 14.75cfs

Partially Full Pipe Flow Calculator and Equations

Fluid Flow Table of Contents | Hydraulic and Pneumatic Knowledge
Fluid Power Equipment

This engineering calculator determines the Flow within a partially full pipe using the Manning equation. This calculator can also be used for uniform flow in a pipe, but the Manning roughness coefficient needs to be considered to be variable, dependent upon the depth of flow.

Partially Full Pipe Flow Calculations - U.S. Units

II. Calculation of Discharge, Q, and average velocity, V
for pipes more than half full

Instructions: *Enter values in blue boxes. Calculations in yellow*

Inputs

Pipe Diameter, D =	24	in
Depth of flow, y =	20	in

(must have $y \geq D/2$)

Full Pipe Manning roughness, n_{full} =	0.013	
Channel bottom slope, S =	0.02	ft/ft

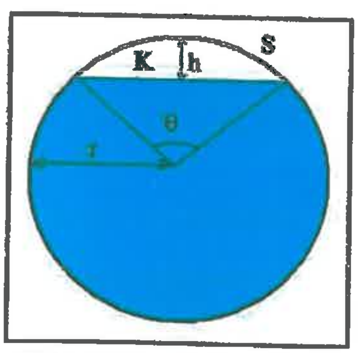
Calculations

n/n_{full} =	1.083333
Partially Full Manning roughness, n =	0.014

Calculations

Pipe Diameter, D =	2	ft
Pipe Radius, r =	1	ft
Circ. Segment Height, h =	0.333	ft
Central Angle, q =	1.68	radians
Cross-Sect. Area, A =	2.80	ft^2
Wetted Perimeter, P =	4.6	ft
Hydraulic Radius, R =	0.61	ft
Discharge, Q =	30.04	cfs
Ave. Velocity, V =	10.74	ft/sec

pipe % full $[(A/A_{full})*100\%]$ = 89.0%



Partially Full Pipe Flow Parameters
(More Than Half Full)

$r = D/2$

$h = 2r - y$

(hydraulic radius)

$R = A/P$

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

$V = Q/A$

$$\theta = 2 \arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

$$P = 2\pi r - r*\theta$$

Equation used for n/n_{full}: $n/n_{full} = 1.25 - (y/D - 0.5)*0.5$ (for $0.5 \leq y/D \leq 1$)

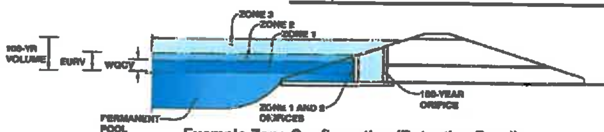
DP 28 $Q_{100} = 29.5$ cfs

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: The Sands

Basin ID: Full Spectrum Detention Pond 1



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	11.96	acres
Watershed Length =	730	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	43.30%	percent
Percentage Hydrologic Soil Group A =	53.0%	percent
Percentage Hydrologic Soil Group B =	47.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

			Optional User Override 1-hr Precipitation	
Water Quality Capture Volume (WQCV) =	0.188	acre-feet		
Excess Urban Runoff Volume (EURV) =	0.561	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.411	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.555	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.732	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.004	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.248	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.555	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet		inches
Approximate 2-yr Detention Volume =	0.385	acre-feet		
Approximate 5-yr Detention Volume =	0.522	acre-feet		
Approximate 10-yr Detention Volume =	0.675	acre-feet		
Approximate 25-yr Detention Volume =	0.788	acre-feet		
Approximate 50-yr Detention Volume =	0.856	acre-feet		
Approximate 100-yr Detention Volume =	0.978	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.188	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.373	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.417	acre-feet
Total Detention Basin Volume =	0.978	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	0	0.000		
	--	0.33	--	--	--	60	0.001	9	0.000
	--	1.50	--	--	--	1,481	0.034	897	0.021
	--	2.50	--	--	--	7,836	0.180	5,570	0.128
	--	3.50	--	--	--	9,494	0.218	14,235	0.327
	--	4.50	--	--	--	11,213	0.257	24,588	0.564
	--	5.50	--	--	--	13,040	0.299	36,715	0.843
	--	6.50	--	--	--	14,966	0.344	50,718	1.164
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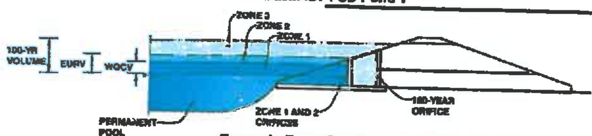
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: The Sands
Basin ID: FSD Pond 1



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.83	0.188	Orifice Plate
Zone 2 (EURV)	4.49	0.373	Orifice Plate
Zone 3 (100-year)	5.94	0.417	Weir&Pipe (Restrict)
		0.978	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 =	4.49	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	14.70	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	1.50	2.99					
Orifice Area (sq. inches)	0.82	0.82	1.20					

	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 =	4.49	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	5.73	N/A	feet
Overflow Weir Slope =	4.00	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 =	5.22	N/A	feet
Over Flow Weir Slope Length =	3.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	9.47	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	11.97	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.98	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	12.10		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.26	N/A	ft^2
Outlet Orifice Centroid =	0.57	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.92	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.95	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	11.00	feet
Spillway End Slopes =	10.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

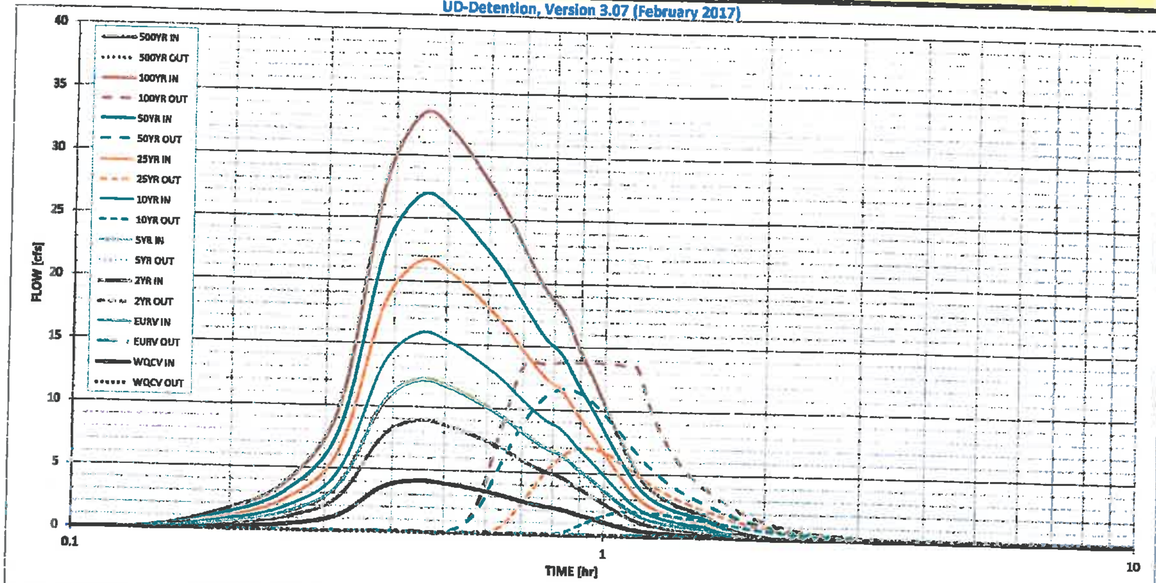
Spillway Design Flow Depth=	0.75	feet
Stage at Top of Freeboard =	7.70	feet
Basin Area at Top of Freeboard =	0.34	acres

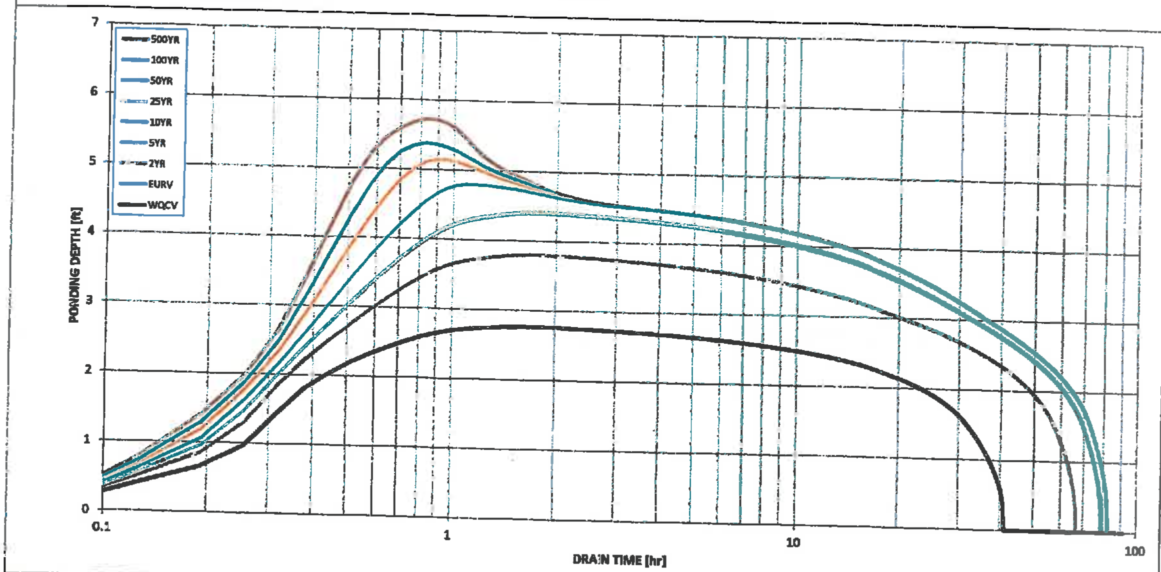
Routed Hydrograph Results

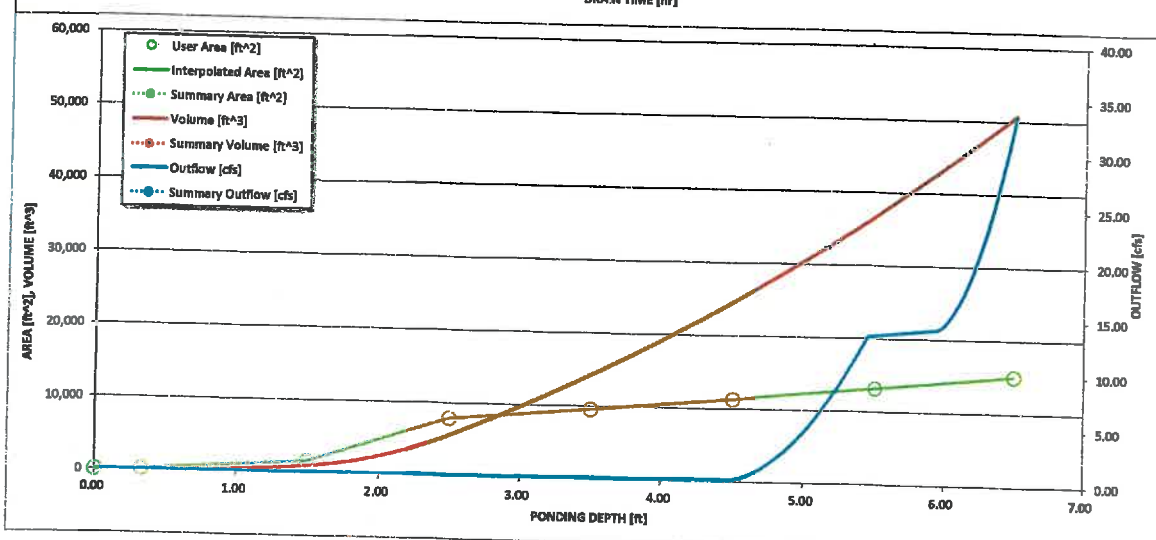
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.188	0.561	0.411	0.555	0.732	1.004	1.248	1.555	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.187	0.560	0.410	0.553	0.731	1.002	1.246	1.553	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.15	0.45	0.75	1.15	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.1	0.2	1.8	5.4	8.9	13.8	0.0
Peak Inflow Q (cfs) =	4.1	12.2	8.9	12.0	15.8	21.6	26.8	33.3	#N/A
Peak Outflow Q (cfs) =	0.1	0.2	0.1	0.2	2.0	7.0	11.6	13.8	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.7	1.1	1.3	1.3	1.0	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.2	0.6	1.0	1.1	#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	72	61	71	73	71	69	67	#N/A
Time to Drain 99% of Inflow Volume (hours) =	40	76	64	76	79	77	77	75	#N/A
Maximum Ponding Depth (ft) =	2.77	4.41	3.80	4.38	4.79	5.14	5.37	5.72	#N/A
Area at Maximum Ponding Depth (acres) =	0.19	0.25	0.23	0.25	0.27	0.28	0.29	0.31	#N/A
Maximum Volume Stored (acre-ft) =	0.176	0.541	0.392	0.534	0.638	0.738	0.801	0.907	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







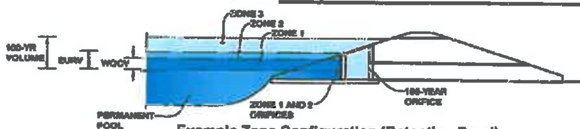
S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: The Sands

Basin ID: Full Spectrum Detention Pond 2



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	7.03	acres
Watershed Length =	355	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	90.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.235	acre-feet
Excess Urban Runoff Volume (EURV) =	0.860	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.597	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.774	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.928	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	1.086	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	1.227	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	1.405	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	0.568	acre-feet
Approximate 5-yr Detention Volume =	0.736	acre-feet
Approximate 10-yr Detention Volume =	0.873	acre-feet
Approximate 25-yr Detention Volume =	1.030	acre-feet
Approximate 50-yr Detention Volume =	1.120	acre-feet
Approximate 100-yr Detention Volume =	1.199	acre-feet

Note: L / W Ratio < 1
L / W Ratio = 0.4

Optional User Override
1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.235	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.625	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.339	acre-feet
Total Detention Basin Volume =	1.199	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Depth Increment = | | ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	0	0.000		
	--	0.33	--	--	--	60	0.001	9	0.000
	--	1.50	--	--	--	1,308	0.030	796	0.018
	--	2.50	--	--	--	7,424	0.170	5,174	0.119
	--	3.50	--	--	--	9,134	0.210	13,453	0.309
	--	4.50	--	--	--	10,935	0.251	23,487	0.539
	--	5.50	--	--	--	12,844	0.295	35,377	0.812
	--	6.50	--	--	--	14,852	0.341	49,225	1.130
	--	7.50	--	--	--	16,956	0.389	65,129	1.495
	--	8.50	--	--	--	19,209	0.441	83,211	1.910
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Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: The Sands

Basin ID: FSD Pond 2

Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.14	0.235	Orifice Plate
Zone 2 (EURV)	5.67	0.625	Orifice Plate
Zone 3 (100-year)	6.70	0.339	Weir&Pipe (Restrict)
		1.199	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	ft²
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 =	5.67	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	22.70	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft²
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft²

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	1.89	3.78					
Orifice Area (sq. inches)	0.67	2.70	3.50					

	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	ft²
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 =	5.67	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	5.70	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.90	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 =	5.67	N/A	feet
Over Flow Weir Slope Length =	2.90	N/A	feet
Grate Open Area / 100-yr Orifice Area =	29.30	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	11.57	N/A	ft²
Overflow Grate Open Area w/ Debris =	5.79	N/A	ft²

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 =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	4.95		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.39	N/A	ft²
Outlet Orifice Centroid =	0.24	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.10	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.71	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	13.00	feet
Spillway End Slopes =	10.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

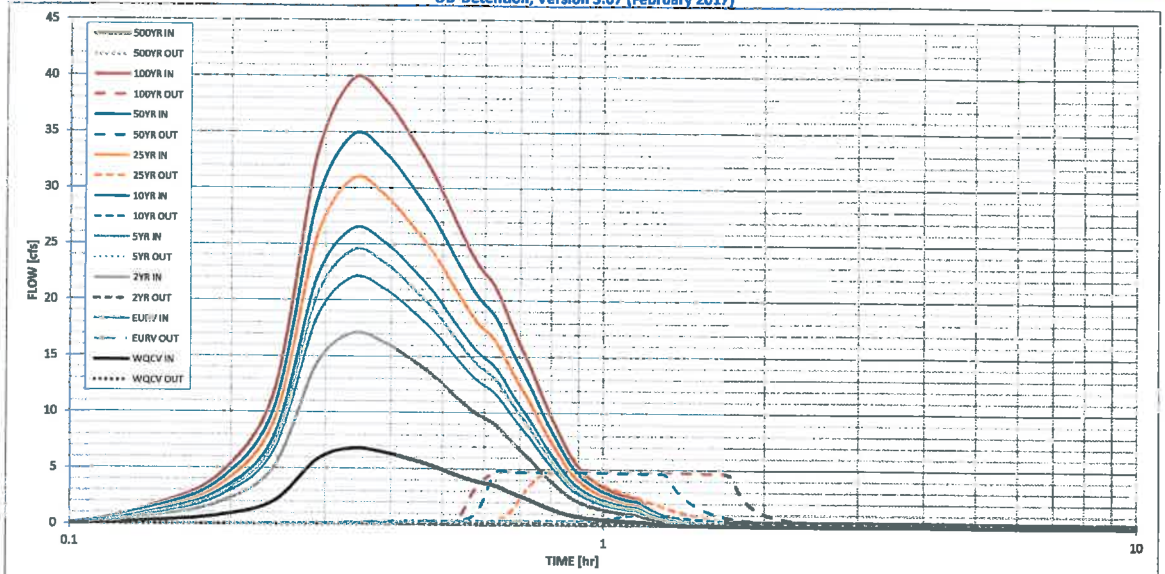
Spillway Design Flow Depth=	0.78	feet
Stage at Top of Freeboard =	8.49	feet
Basin Area at Top of Freeboard =	0.44	acres

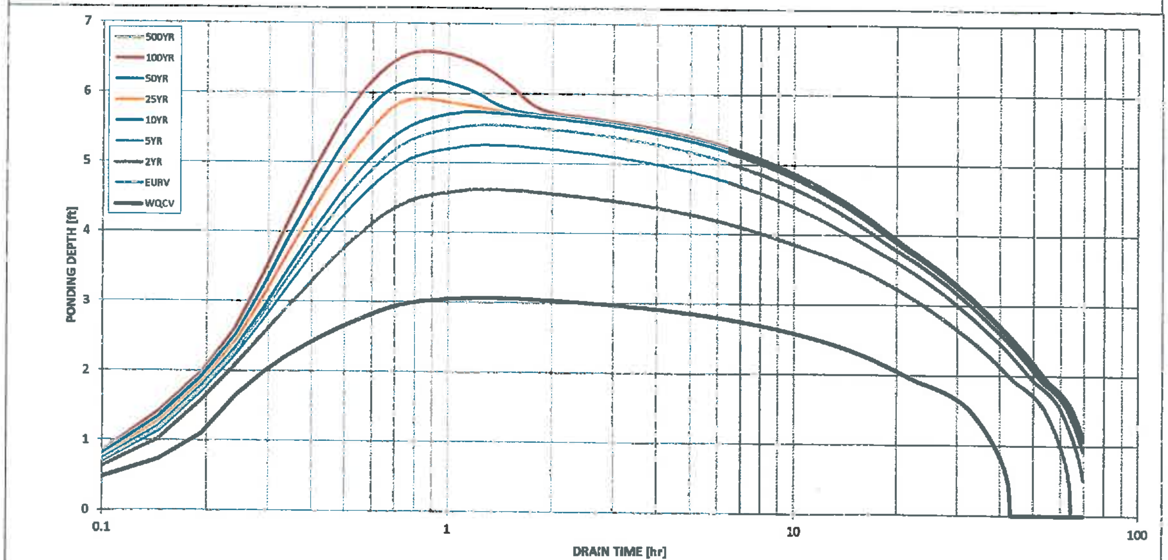
Routed Hydrograph Results

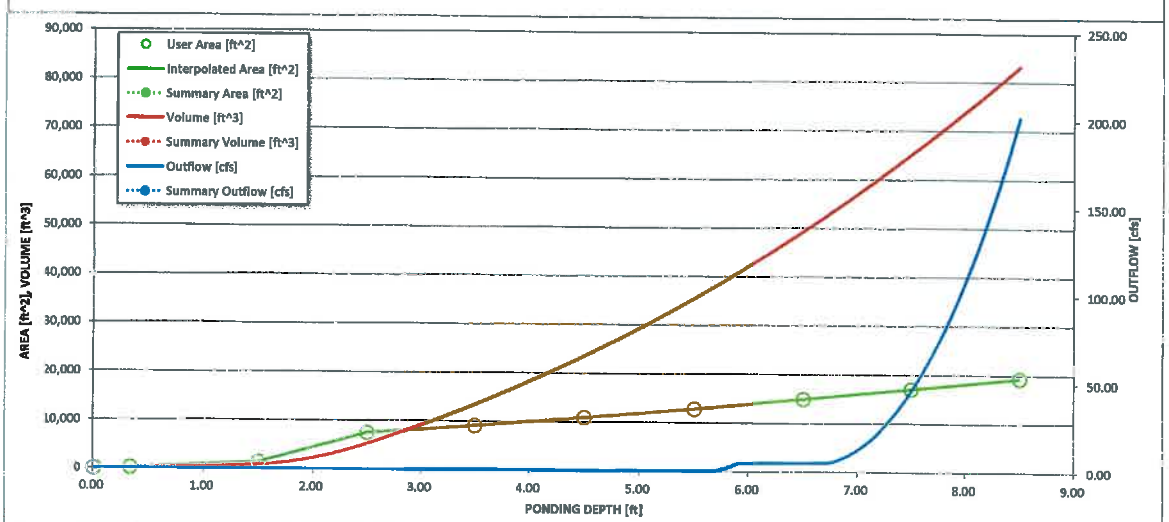
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.235	0.860	0.597	0.774	0.928	1.086	1.227	1.405	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.235	0.858	0.596	0.772	0.926	1.083	1.225	1.402	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.00	0.01	0.02	0.04	0.29	0.70	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.1	0.1	0.3	2.0	4.9	0.0
Peak Inflow Q (cfs) =	6.8	24.5	17.1	22.1	26.4	30.8	34.8	39.8	#N/A
Peak Outflow Q (cfs) =	0.1	0.4	0.3	0.4	1.0	4.5	4.7	4.9	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	6.8	7.8	16.5	2.3	1.0	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.4	0.4	0.4	#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	60	55	58	61	59	57	56	#N/A
Time to Drain 99% of Inflow Volume (hours) =	41	68	60	66	69	68	68	67	#N/A
Maximum Ponding Depth (ft) =	3.07	5.54	4.62	5.26	5.73	5.92	6.19	6.59	#N/A
Area at Maximum Ponding Depth (acres) =	0.19	0.30	0.26	0.28	0.31	0.31	0.33	0.35	#N/A
Maximum Volume Stored (acre-ft) =	0.222	0.824	0.570	0.740	0.881	0.937	1.027	1.161	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







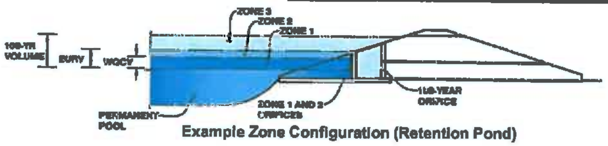
S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: The Sands

Basin ID: Full Spectrum Detention Pond 3



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	8.58	acres
Watershed Length =	365	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	90.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.287	acre-feet
Excess Urban Runoff Volume (EURV) =	1.050	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.729	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.944	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	1.133	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	1.325	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	1.498	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	1.715	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	0.693	acre-feet
Approximate 5-yr Detention Volume =	0.898	acre-feet
Approximate 10-yr Detention Volume =	1.066	acre-feet
Approximate 25-yr Detention Volume =	1.257	acre-feet
Approximate 50-yr Detention Volume =	1.367	acre-feet
Approximate 100-yr Detention Volume =	1.463	acre-feet

Note: L / W Ratio < 1
L / W Ratio = 0.4

Optional User Override
1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.287	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.763	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.414	acre-feet
Total Detention Basin Volume =	1.463	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	0	0.000		
	--	0.33	--	--	--	60	0.001	9	0.000
	--	1.50	--	--	--	1,288	0.030	786	0.018
	--	2.50	--	--	--	7,313	0.168	5,099	0.117
	--	3.50	--	--	--	9,006	0.207	13,258	0.304
	--	4.50	--	--	--	10,791	0.248	23,157	0.532
	--	5.50	--	--	--	12,683	0.291	34,894	0.801
	--	6.50	--	--	--	14,675	0.337	48,573	1.115
	--	7.50	--	--	--	16,771	0.385	64,296	1.476
	--	8.50	--	--	--	18,997	0.436	82,180	1.887
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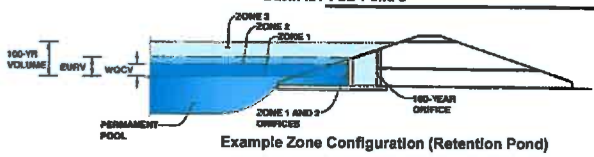
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: The Sands
Basin ID: FSD Pond 3



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.42	0.287	Orifice Plate
Zone 2 (EURV)	6.31	0.763	Orifice Plate
Zone 3 (100-year)	7.47	0.414	Weir&Pipe (Restrict)
		1.463	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 =	6.31	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	25.20	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	2.10	4.21					
Orifice Area (sq. inches)	0.80	3.60	5.00					

	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 =	6.31	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	5.70	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.90	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 =	6.31	N/A	feet
Over Flow Weir Slope Length =	2.90	N/A	feet
Grate Open Area / 100-yr Orifice Area =	24.98	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	11.57	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.79	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 =	0.25	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 =	5.55		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.46	N/A	ft^2
Outlet Orifice Centroid =	0.27	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.18	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.48	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	17.00	feet
Spillway End Slopes =	10.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

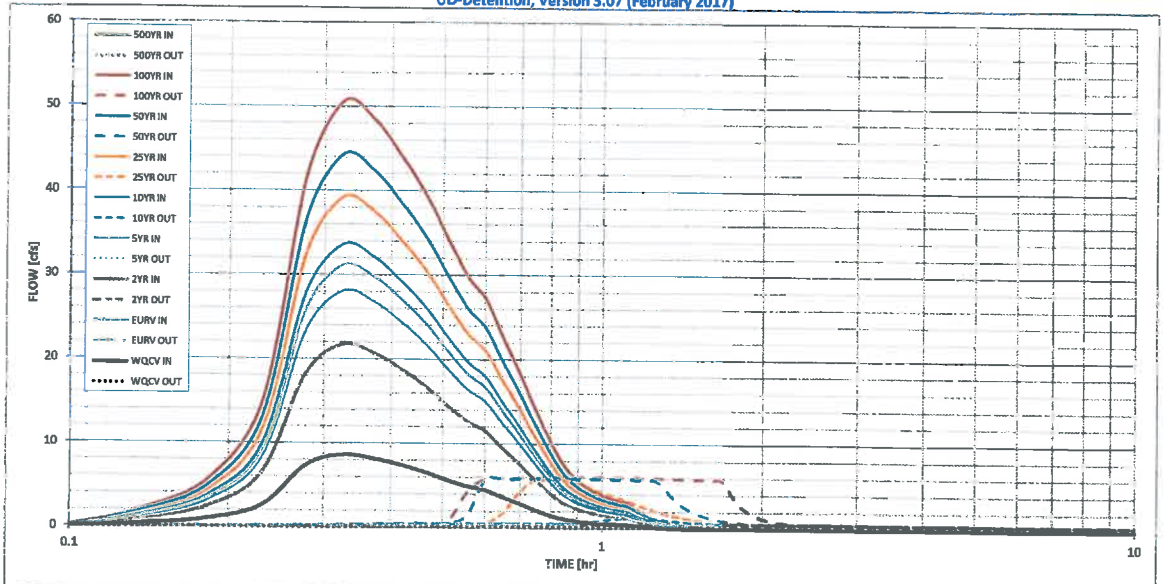
Spillway Design Flow Depth=	0.80	feet
Stage at Top of Freeboard =	9.28	feet
Basin Area at Top of Freeboard =	0.44	acres

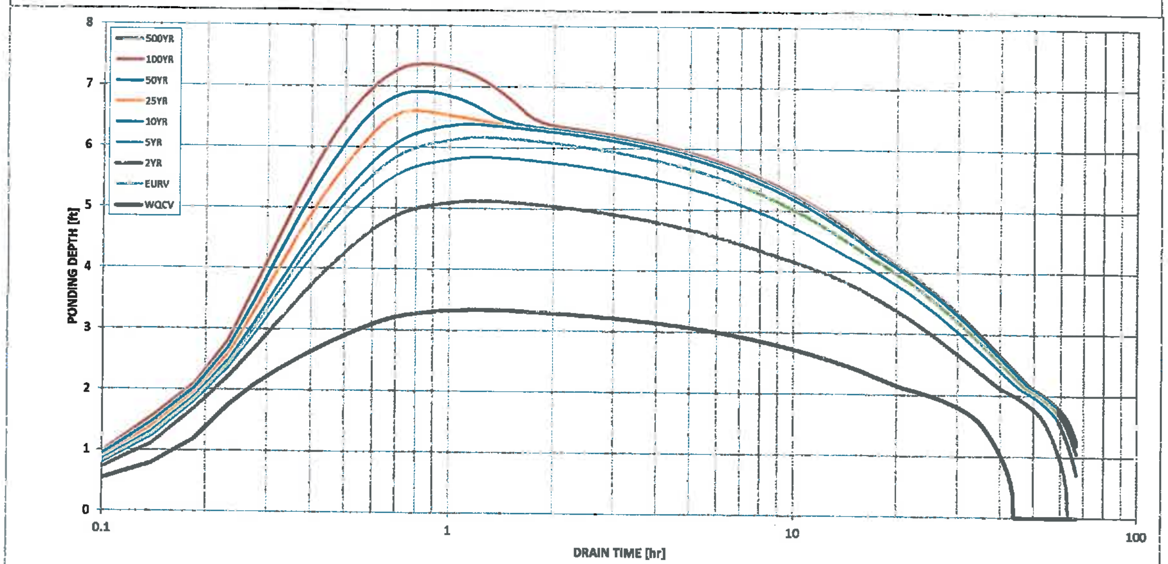
Routed Hydrograph Results

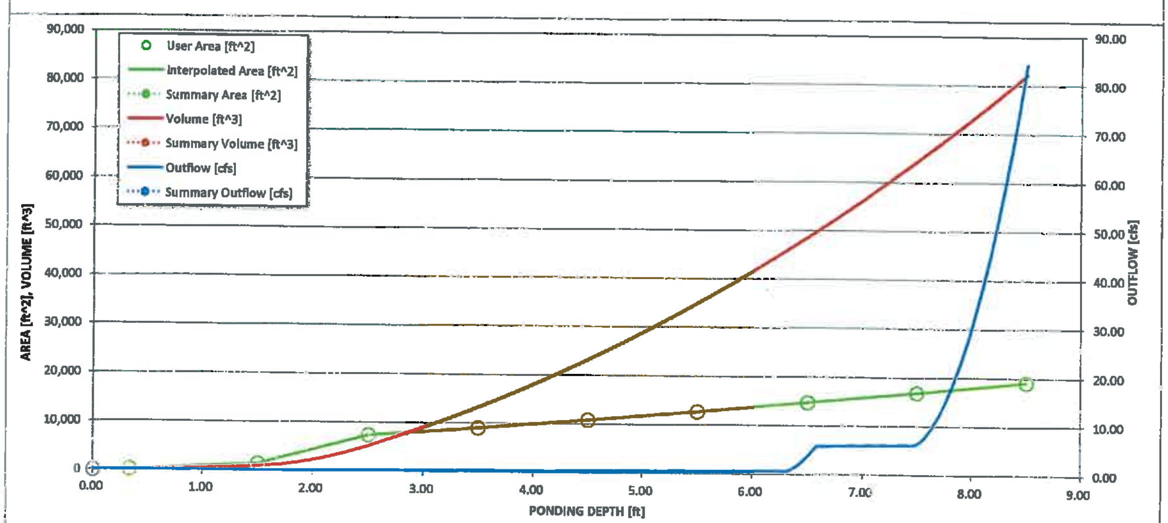
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.287	1.050	0.729	0.944	1.133	1.325	1.498	1.715	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.287	1.049	0.729	0.944	1.132	1.324	1.498	1.714	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.00	0.01	0.02	0.04	0.29	0.70	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.1	0.2	0.3	2.5	6.0	0.0
Peak Inflow Q (cfs) =	8.6	31.2	21.7	28.1	33.6	39.2	44.3	50.6	#N/A
Peak Outflow Q (cfs) =	0.2	0.5	0.4	0.5	1.3	5.7	5.9	6.0	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	7.9	8.3	16.7	2.4	1.0	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.1	0.4	0.5	0.5	#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) =	39	58	53	56	58	56	55	53	#N/A
Time to Drain 99% of Inflow Volume (hours) =	42	65	59	64	66	66	65	65	#N/A
Maximum Ponding Depth (ft) =	3.34	6.17	5.13	5.84	6.38	6.59	6.91	7.37	#N/A
Area at Maximum Ponding Depth (acres) =	0.20	0.32	0.27	0.31	0.33	0.34	0.36	0.38	#N/A
Maximum Volume Stored (acre-ft) =	0.272	1.003	0.694	0.903	1.075	1.146	1.257	1.423	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







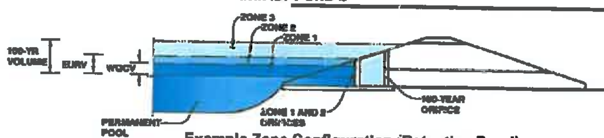
S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: The Sands

Basin ID: POND D



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	10.64	acres
Watershed Length =	870	ft
Watershed Slope =	0.015	ft/ft
Watershed Imperviousness =	76.00%	percent
Percentage Hydrologic Soil Group A =	35.9%	percent
Percentage Hydrologic Soil Group B =	64.1%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.270	acre-feet
Excess Urban Runoff Volume (EURV) =	0.949	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.742	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.974	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	1.203	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	1.467	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	1.687	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	1.965	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	0.698	acre-feet
Approximate 5-yr Detention Volume =	0.919	acre-feet
Approximate 10-yr Detention Volume =	1.131	acre-feet
Approximate 25-yr Detention Volume =	1.258	acre-feet
Approximate 50-yr Detention Volume =	1.333	acre-feet
Approximate 100-yr Detention Volume =	1.425	acre-feet

Optional User Override 1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.270	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.679	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.475	acre-feet
Total Detention Basin Volume =	1.425	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Depth Increment = 0.5 ft

	Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
6478.77	Top of Micropool	--	0.00	--	--	--	0	0.000		
6479.1		--	0.33	--	--	--	10	0.000	2	0.000
6480		--	0.99	--	--	--	13,440	0.309	4,306	0.099
6481		--	2.00	--	--	--	23,543	0.540	22,881	0.525
6482		--	3.00	--	--	--	27,153	0.623	48,464	1.113
6483		--	4.00	--	--	--	30,885	0.709	77,483	1.779
6484		--	5.00	--	--	--	34,732	0.797	110,291	2.532
6485		--	6.00	--	--	--	38,396	0.881	146,655	3.371
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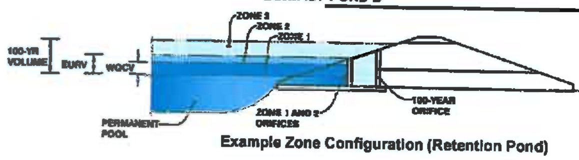
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: The Sands

Basin ID: POND D



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.46	0.270	Orifice Plate
Zone 2 (EURV)	2.74	0.679	Orifice Plate
Zone 3 (100-year)	3.49	0.475	Weir&Pipe (Restrict)
		1.425	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 =	2.74	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	6.70	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.91	1.83					
Orifice Area (sq. inches)	1.97	1.97	4.75					

	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 =	2.74	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	5.70	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 =	2.74	N/A	feet
Over Flow Weir Slope Length =	2.91	N/A	feet
Grate Open Area / 100-yr Orifice Area =	9.28	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	11.61	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.81	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 =	0.25	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 =	12.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.25	N/A	ft^2
Outlet Orifice Centroid =	0.56	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.91	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	11.00	feet
Spillway End Slopes =	10.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

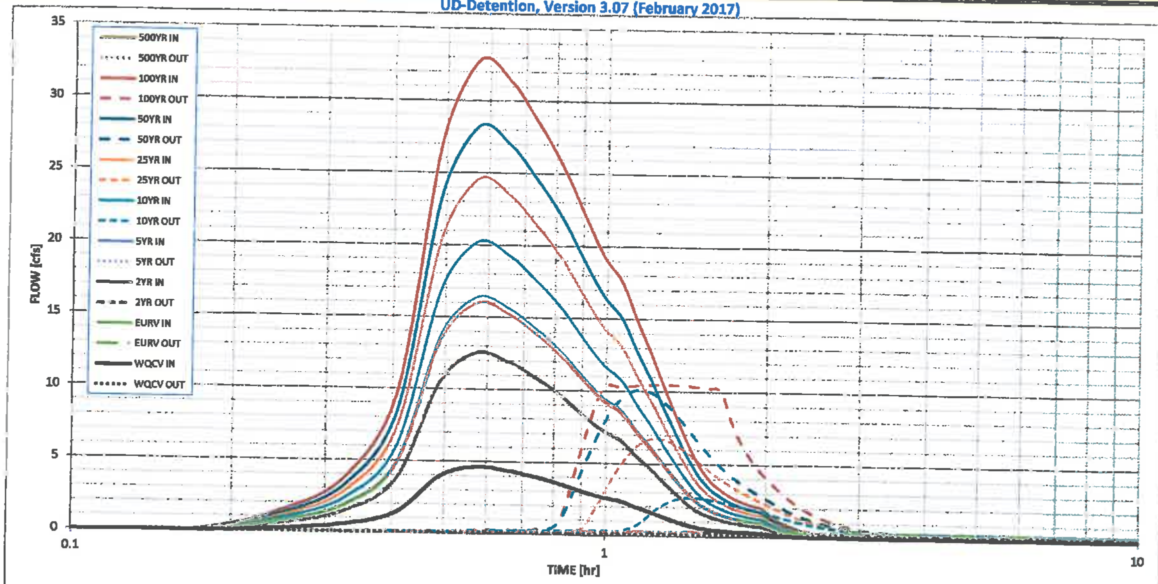
Spillway Design Flow Depth=	0.74	feet
Stage at Top of Freeboard =	5.24	feet
Basin Area at Top of Freeboard =	0.82	acres

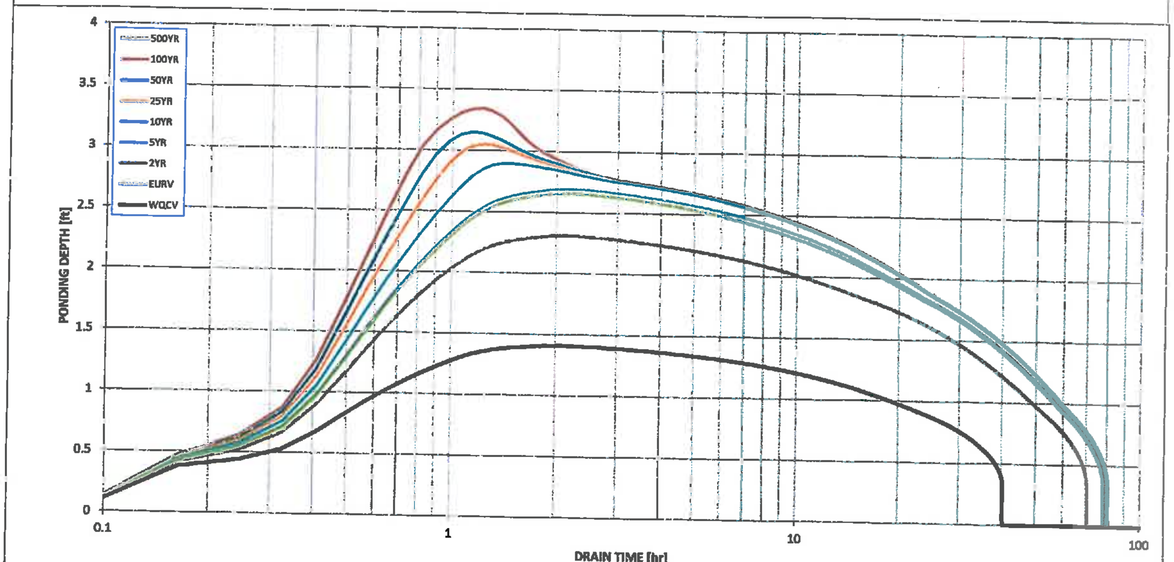
Routed Hydrograph Results

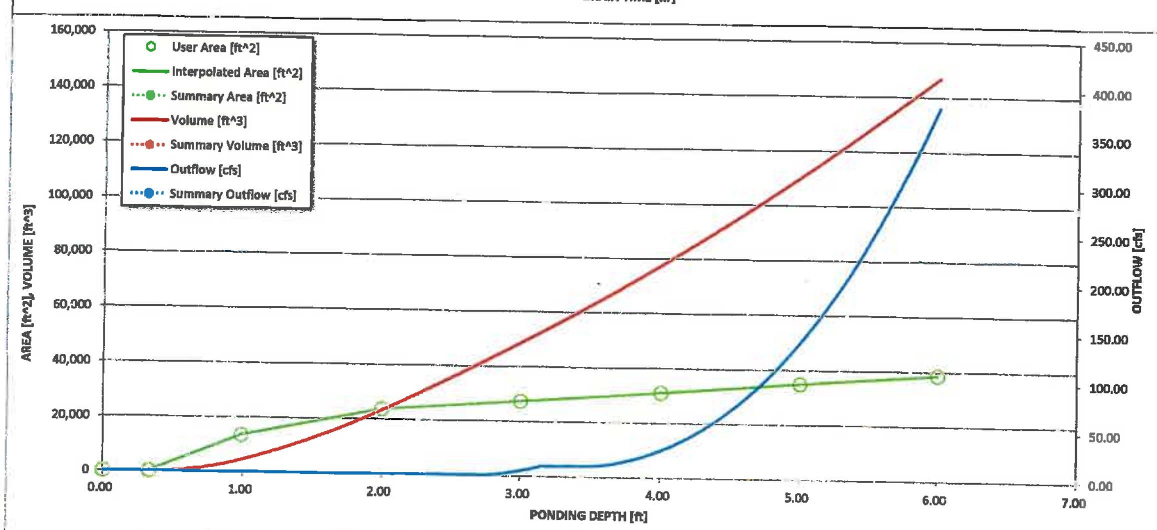
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.270	0.949	0.742	0.974	1.203	1.467	1.687	1.965	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.270	0.949	0.742	0.974	1.203	1.467	1.687	1.965	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.14	0.45	0.68	0.99	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.1	0.2	1.5	4.7	7.2	10.5	0.0
Peak Inflow Q (cfs) =	4.6	16.0	12.5	16.4	20.2	24.6	28.2	32.8	#N/A
Peak Outflow Q (cfs) =	0.1	0.3	0.3	0.3	2.7	6.8	10.1	10.5	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.1	1.8	1.4	1.4	1.0	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.2	0.6	0.8	0.9	#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	71	65	72	72	71	69	68	#N/A
Time to Drain 99% of Inflow Volume (hours) =	40	76	68	76	78	77	77	76	#N/A
Maximum Ponding Depth (ft) =	1.41	2.65	2.31	2.69	2.90	3.05	3.15	3.34	#N/A
Area at Maximum Ponding Depth (acres) =	0.40	0.59	0.57	0.60	0.61	0.63	0.64	0.65	#N/A
Maximum Volume Stored (acre-ft) =	0.248	0.899	0.697	0.923	1.045	1.138	1.201	1.329	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







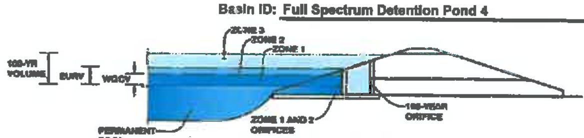
S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: The Sands

Basin ID: Full Spectrum Detention Pond 4



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB			
Watershed Area =	4.61	acres		
Watershed Length =	249	ft		
Watershed Slope =	0.030	ft/ft		
Watershed Imperviousness =	95.00%	percent		
Percentage Hydrologic Soil Group A =	100.0%	percent		
Percentage Hydrologic Soil Group B =	0.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.172	acre-feet		
Excess Urban Runoff Volume (EURV) =	0.604	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.421	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.544	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.651	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.757	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.848	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.966	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet		inches
Approximate 2-yr Detention Volume =	0.400	acre-feet		
Approximate 5-yr Detention Volume =	0.518	acre-feet		
Approximate 10-yr Detention Volume =	0.613	acre-feet		
Approximate 25-yr Detention Volume =	0.720	acre-feet		
Approximate 50-yr Detention Volume =	0.782	acre-feet		
Approximate 100-yr Detention Volume =	0.834	acre-feet		

Note: L / W Ratio < 1
L / W Ratio = 0.3

Optional User Override
1-hr Precipitation

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.172	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.433	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.230	acre-feet
Total Detention Basin Volume =	0.834	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Depth Increment = 0.1 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	0	0.000		
	--	0.33	--	--	--	10	0.000	2	0.000
	--	0.50	--	--	--	525	0.012	42	0.001
	--	1.50	--	--	--	6,463	0.149	3,466	0.080
	--	2.50	--	--	--	8,248	0.189	10,917	0.251
	--	3.50	--	--	--	10,140	0.233	20,111	0.462
	--	4.50	--	--	--	12,160	0.279	31,261	0.718
	--	5.50	--	--	--	14,307	0.328	44,494	1.021
	--	6.50	--	--	--	16,454	0.378	59,875	1.375
	--	7.50	--	--	--	18,601	0.427	77,402	1.777
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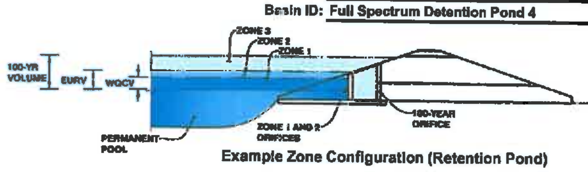
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: The Sands

Basin ID: Full Spectrum Detention Pond 4



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.07	0.172	Orifice Plate
Zone 2 (EURV)	4.08	0.433	Orifice Plate
Zone 3 (100-year)	4.91	0.230	Weir&Pipe (Restrict)
		0.834	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 =	4.08	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	16.30	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	1.36	2.72					
Orifice Area (sq. inches)	0.85	3.00	5.00					

	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 =	4.08	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.90	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.90	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 =	4.08	N/A	feet
Over Flow Weir Slope Length =	2.90	N/A	feet
Grate Open Area / 100-yr Orifice Area =	19.78	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	5.89	N/A	ft^2
Overflow Grate Open Area w/ Debris =	2.94	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 =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	4.05		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.30	N/A	ft^2
Outlet Orifice Centroid =	0.20	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	0.99	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.92	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	8.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

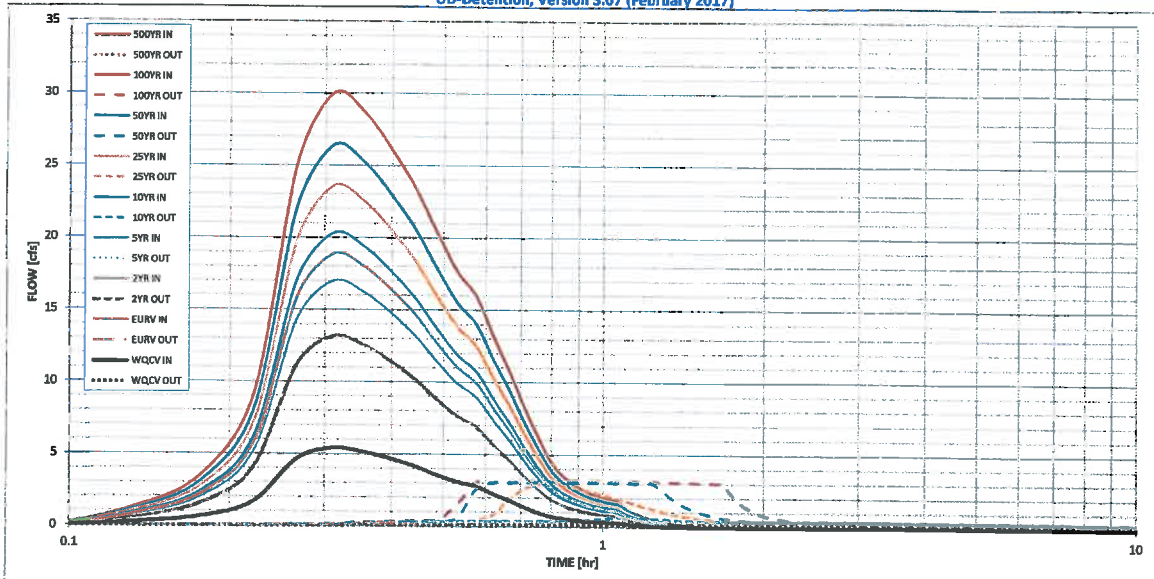
Spillway Design Flow Depth=	0.63	feet
Stage at Top of Freeboard =	6.55	feet
Basin Area at Top of Freeboard =	0.38	acres

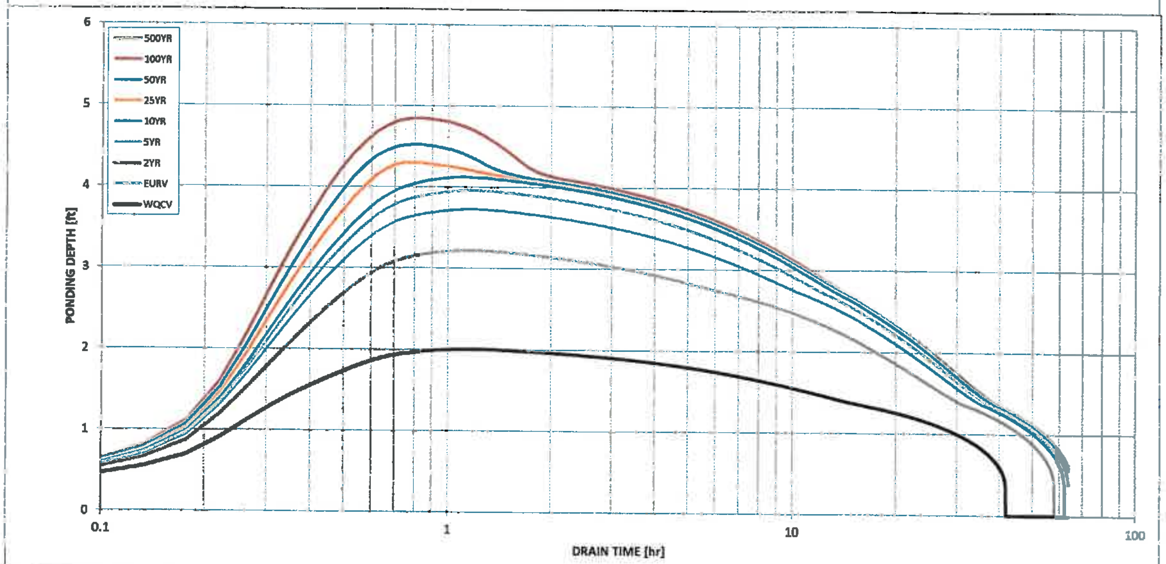
Routed Hydrograph Results

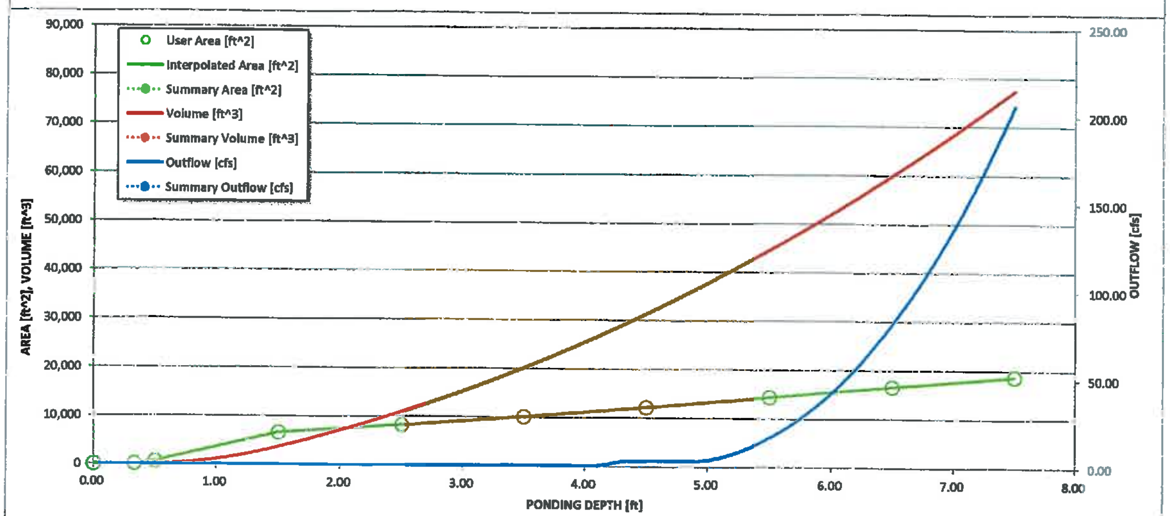
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.172	0.604	0.421	0.544	0.651	0.757	0.848	0.966	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.171	0.603	0.419	0.543	0.651	0.756	0.848	0.965	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.00	0.01	0.02	0.04	0.29	0.70	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.0	0.1	0.2	1.3	3.2	0.0
Peak Inflow Q (cfs) =	5.4	18.8	13.2	17.0	20.3	23.5	26.4	30.0	#N/A
Peak Outflow Q (cfs) =	0.1	0.4	0.3	0.4	0.7	2.9	3.1	3.2	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	10.8	8.1	16.0	2.3	1.0	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.4	0.4	0.5	#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) =	39	55	52	54	55	54	53	52	#N/A
Time to Drain 99% of Inflow Volume (hours) =	41	61	56	59	62	61	61	61	#N/A
Maximum Ponding Depth (ft) =	2.00	3.96	3.22	3.73	4.12	4.30	4.52	4.84	#N/A
Area at Maximum Ponding Depth (acres) =	0.17	0.25	0.22	0.24	0.26	0.27	0.28	0.30	#N/A
Maximum Volume Stored (acre-ft) =	0.161	0.571	0.398	0.514	0.615	0.660	0.723	0.815	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







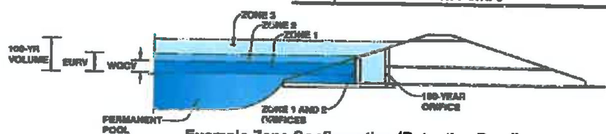
S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: The Sands

Basin ID: Full Spectrum Detention Pond 5



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	27.53	acres
Watershed Length =	1,108	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	65.00%	percent
Percentage Hydrologic Soil Group A =	28.0%	percent
Percentage Hydrologic Soil Group B =	72.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.583	acre-feet
Excess Urban Runoff Volume (EURV) =	2.028	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.592	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	2.115	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	2.679	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	3.398	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	3.974	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	4.708	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	1.495	acre-feet
Approximate 5-yr Detention Volume =	1.991	acre-feet
Approximate 10-yr Detention Volume =	2.501	acre-feet
Approximate 25-yr Detention Volume =	2.775	acre-feet
Approximate 50-yr Detention Volume =	2.936	acre-feet
Approximate 100-yr Detention Volume =	3.187	acre-feet

Optional User Override 1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.583	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.445	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.159	acre-feet
Total Detention Basin Volume =	3.187	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Depth Increment = ft

	Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
6446.5	Top of Micropool	--	0.00	--	--	--	0	0.000		
6446.83		--	0.33	--	--	--	10	0.000	2	0.000
6448		--	1.17	--	--	--	7,724	0.177	3,173	0.073
6449.00		--	2.00	--	--	--	9,663	0.222	10,369	0.238
6450.00		--	3.00	--	--	--	11,965	0.275	21,279	0.489
6451.00		--	4.00	--	--	--	15,225	0.350	34,874	0.801
6452.00		--	5.00	--	--	--	18,189	0.418	51,581	1.184
6453.00		--	6.00	--	--	--	21,381	0.491	71,366	1.638
6454.00		--	7.00	--	--	--	24,658	0.566	94,386	2.167
6455		--	8.00	--	--	--	27,967	0.642	120,698	2.771
		--	9.00	--	--	--	31,423	0.721	150,393	3.453
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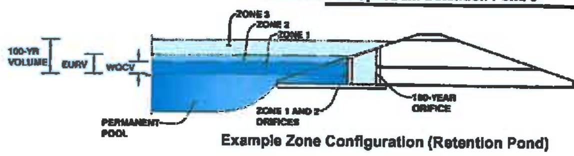
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: The Sands

Basin ID: Full Spectrum Detention Pond 5



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.33	0.583	Orifice Plate
Zone 2 (EURV)	6.76	1.445	Orifice Plate
Zone 3 (100-year)	8.63	1.159	Weir&Pipe (Restrict)
		3.187	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 =	6.76	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	15.30	inches
Orifice Plate: Orifice Area per Row =	3.36	sq. inches (use rectangular openings)

Calculated Parameters for Plate

WQ Orifice Area per Row =	2.333E-02	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	2.25	4.51					
Orifice Area (sq. inches)	3.36	3.36	3.36					

	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 =	6.76	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	8.00	N/A	feet
Overflow Weir Slope =	4.00	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 =	7.49	N/A	feet
Over Flow Weir Slope Length =	3.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	5.83	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	16.80	N/A	ft^2
Overflow Grate Open Area w/ Debris =	8.40	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 =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	20.70		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	2.88	N/A	ft^2
Outlet Orifice Centroid =	0.92	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.38	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.63	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	31.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

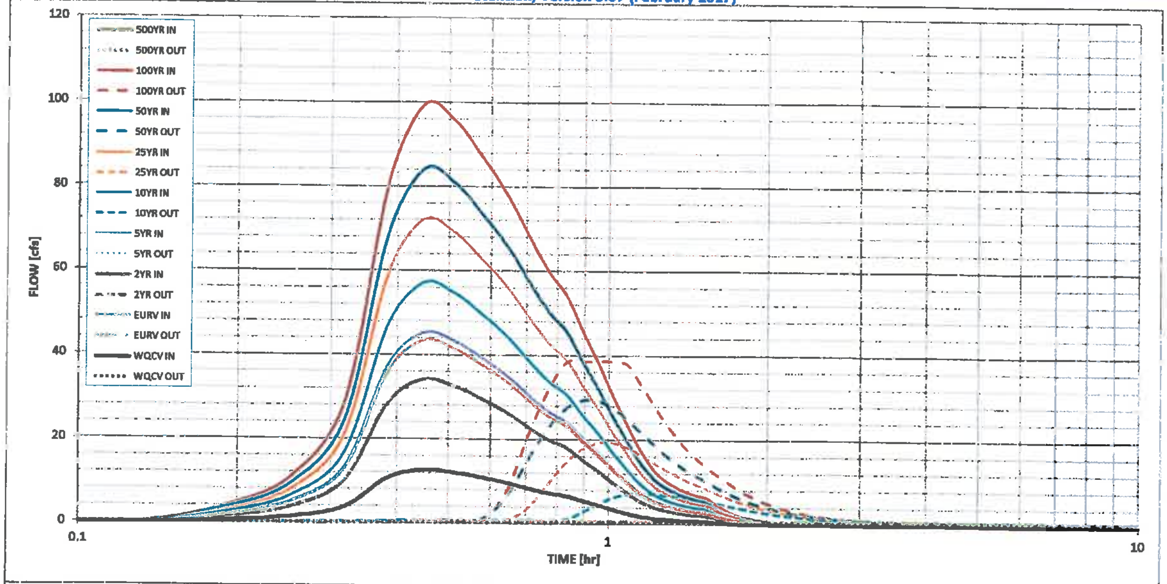
Spillway Design Flow Depth=	0.94	feet
Stage at Top of Freeboard =	10.57	feet
Basin Area at Top of Freeboard =	0.72	acres

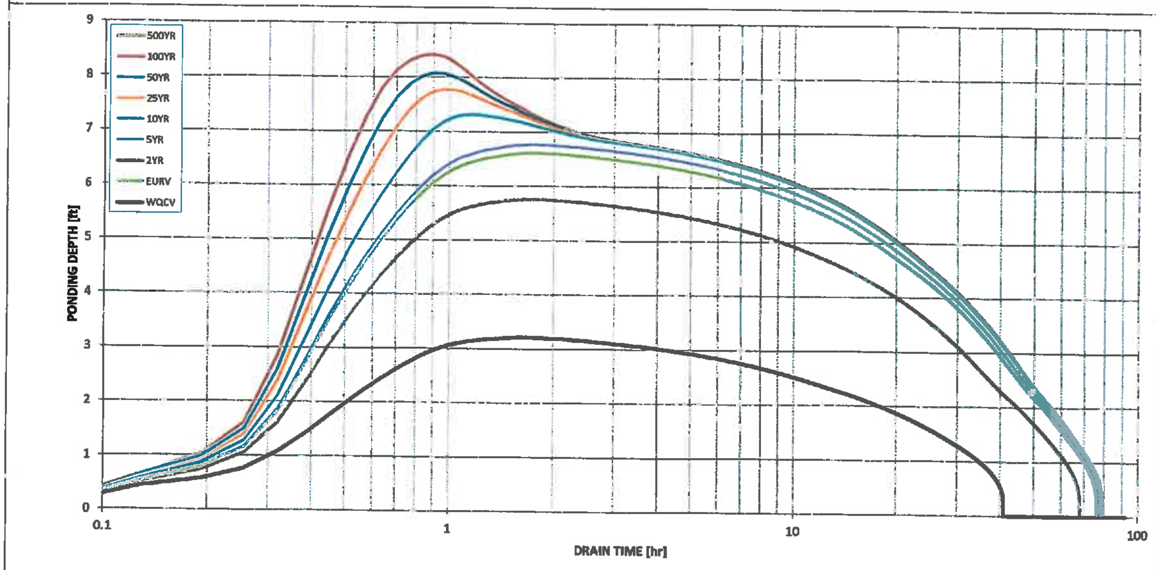
Routed Hydrograph Results

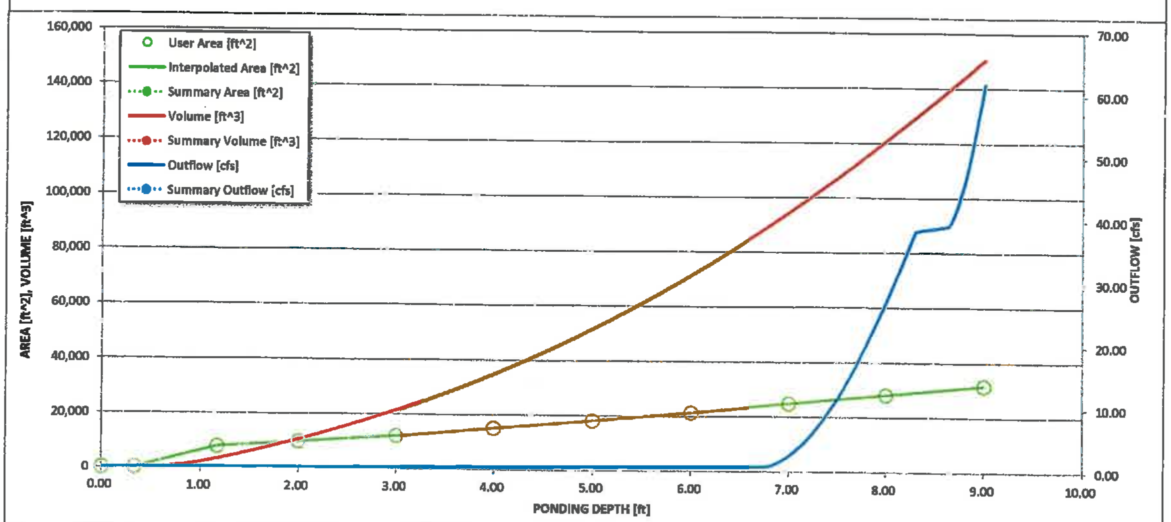
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.583	2.028	1.592	2.115	2.679	3.398	3.974	4.708	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.583	2.030	1.592	2.117	2.682	3.402	3.978	4.713	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.22	0.67	0.99	1.40	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.3	0.6	6.0	18.5	27.3	38.6	0.0
Peak Inflow Q (cfs) =	12.6	43.3	34.1	45.1	57.0	72.0	84.0	99.2	#N/A
Peak Outflow Q (cfs) =	0.3	0.7	0.6	0.7	7.2	19.3	29.2	38.6	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.1	1.2	1.0	1.1	1.0	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.4	1.1	1.7	2.2	#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	69	62	70	70	68	66	64	#N/A
Time to Drain 99% of Inflow Volume (hours) =	40	73	66	75	75	75	74	73	#N/A
Maximum Ponding Depth (ft) =	3.21	6.60	5.76	6.76	7.30	7.77	8.06	8.41	#N/A
Area at Maximum Ponding Depth (acres) =	0.29	0.54	0.47	0.55	0.59	0.62	0.65	0.67	#N/A
Maximum Volume Stored (acre-ft) =	0.548	1.946	1.523	2.033	2.340	2.625	2.810	3.041	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







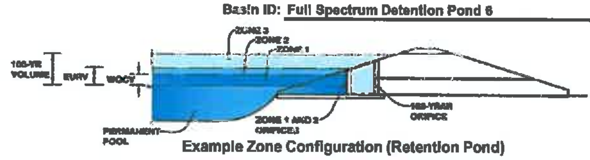
S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: The Sands

Basin ID: Full Spectrum Detention Pond 6



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	1.77	acres
Watershed Length =	124	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	95.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.068	acre-feet
Excess Urban Runoff Volume (EURV) =	0.232	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.161	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.209	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.250	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	0.291	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	0.326	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	0.371	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	0.154	acre-feet
Approximate 5-yr Detention Volume =	0.199	acre-feet
Approximate 10-yr Detention Volume =	0.235	acre-feet
Approximate 25-yr Detention Volume =	0.276	acre-feet
Approximate 50-yr Detention Volume =	0.300	acre-feet
Approximate 100-yr Detention Volume =	0.320	acre-feet

Note: L / W Ratio < 1
L / W Ratio = 0.2

Optional User Override
1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.068	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.166	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.088	acre-feet
Total Detention Basin Volume =	0.320	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Depth Increment = 0.1 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	0	0.000		
	--	0.33	--	--	--	60	0.001	9	0.000
	--	1.50	--	--	--	4,192	0.096	2,456	0.056
	--	2.50	--	--	--	5,600	0.129	7,393	0.170
	--	3.50	--	--	--	7,070	0.162	13,728	0.315
	--	4.50	--	--	--	8,604	0.198	21,565	0.495
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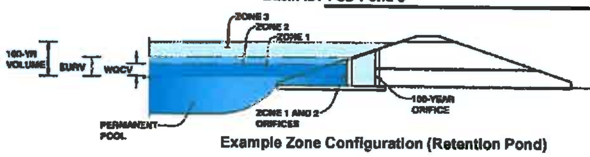
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: The Sands

Basin ID: FSD Pond 6



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.59	0.066	Orifice Plate
Zone 2 (EURV)	2.96	0.166	Orifice Plate
'one 3 (100-year)	3.54	0.088	Weir&Pipe (Restrict)
		0.320	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 =	2.96	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	11.80	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.99	1.97					
Orifice Area (sq. inches)	0.30	1.65	5.00					

	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 =	2.96	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.91	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 =	2.96	N/A	feet
Over Flow Weir Slope Length =	2.91	N/A	feet
Grate Open Area / 100-yr Orifice Area =	45.03	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	5.93	N/A	ft^2
Overflow Grate Open Area w/ Debris =	2.96	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 =	0.25	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 =	2.30		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.13	N/A	ft^2
Outlet Orifice Centroid =	0.11	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	0.73	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.55	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	8.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

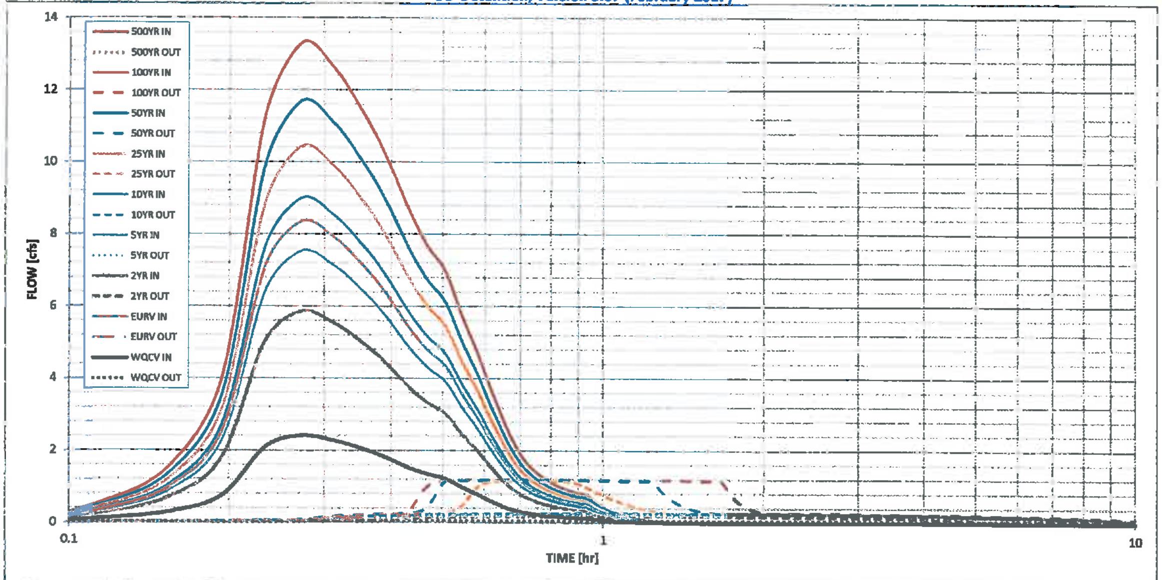
Spillway Design Flow Depth=	0.58	feet
Stage at Top of Freeboard =	5.13	feet
Basin Area at Top of Freeboard =	0.20	acres

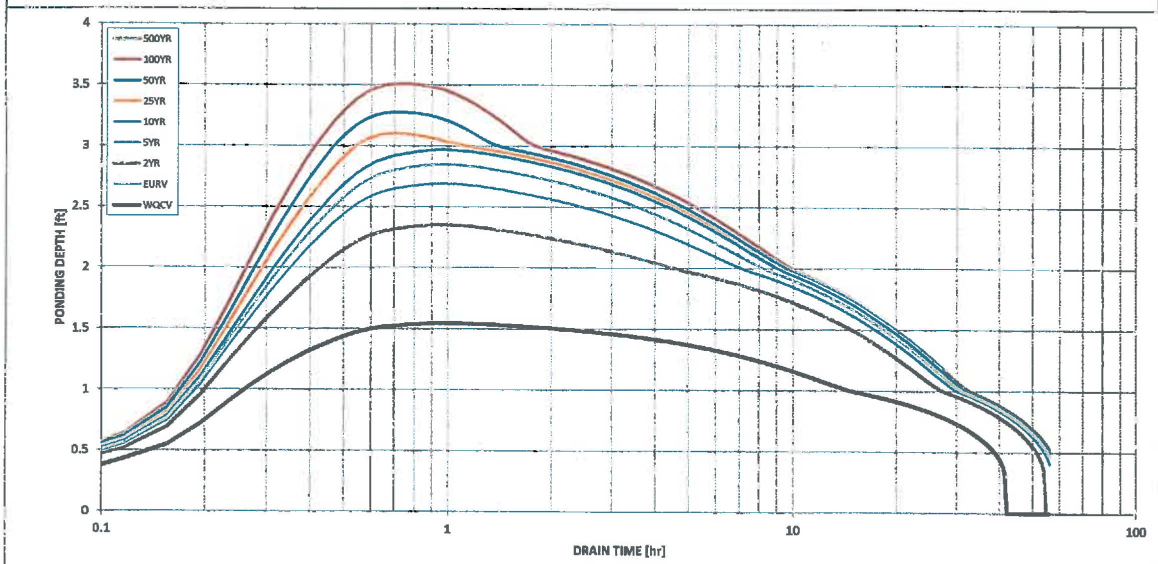
Routed Hydrograph Results

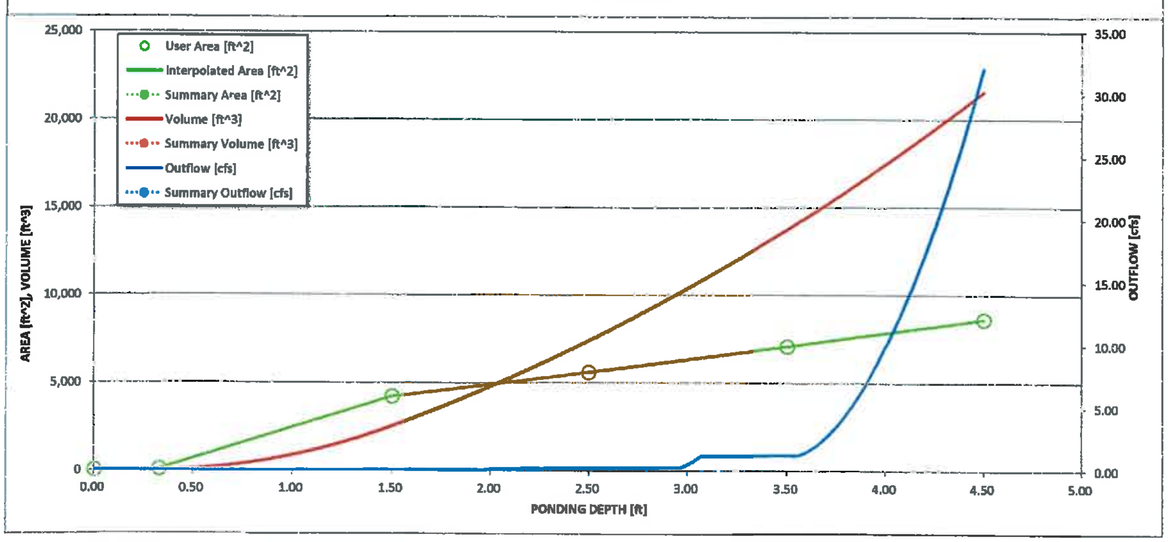
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.066	0.232	0.161	0.209	0.250	0.291	0.326	0.371	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.065	0.231	0.161	0.208	0.249	0.290	0.325	0.371	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.00	0.01	0.02	0.04	0.29	0.70	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.1	0.5	1.2	0.0
Peak Inflow Q (cfs) =	2.4	8.3	5.9	7.5	9.0	10.4	11.7	13.3	#N/A
Peak Outflow Q (cfs) =	0.1	0.2	0.2	0.2	0.3	1.1	1.2	1.2	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	17.2	9.0	16.1	2.3	1.0	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.1	0.1	0.2	#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	47	46	47	47	46	44	43	#N/A
Time to Drain 99% of Inflow Volume (hours) =	41	54	52	53	55	54	54	53	#N/A
Maximum Ponding Depth (ft) =	1.55	2.85	2.35	2.69	2.97	3.10	3.27	3.51	#N/A
Area at Maximum Ponding Depth (acres) =	0.10	0.14	0.12	0.13	0.14	0.15	0.15	0.16	#N/A
Maximum Volume Stored (acre-ft) =	0.061	0.215	0.151	0.195	0.232	0.251	0.279	0.315	#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			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: The Sands

Basin ID: Full Spectrum Detention Pond 7

Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	16.07	acres
Watershed Length =	1,130	ft
Watershed Slope =	0.015	ft/ft
Watershed Imperviousness =	65.00%	percent
Percentage Hydrologic Soil Group A =	28.0%	percent
Percentage Hydrologic Soil Group B =	72.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.340	acre-feet
Excess Urban Runoff Volume (EURV) =	1.184	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.929	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	1.234	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	1.564	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	1.984	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	2.320	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	2.748	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	0.873	acre-feet
Approximate 5-yr Detention Volume =	1.162	acre-feet
Approximate 10-yr Detention Volume =	1.460	acre-feet
Approximate 25-yr Detention Volume =	1.620	acre-feet
Approximate 50-yr Detention Volume =	1.714	acre-feet
Approximate 100-yr Detention Volume =	1.860	acre-feet

Optional User Override 1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.340	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.844	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.676	acre-feet
Total Detention Basin Volume =	1.860	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Depth Increment = ft

	Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
6447.2	Top of Micropool	--	0.00	--	--	--	0	0.000		
6447.53		--	0.33	--	--	--	10	0.000	2	0.000
6448		--	0.47	--	--	--	5,427	0.125	329	0.008
6449.00		--	1.00	--	--	--	12,627	0.290	5,040	0.116
6450.00		--	2.00	--	--	--	15,600	0.358	19,123	0.439
6451.00		--	3.00	--	--	--	18,683	0.429	36,421	0.836
6452.00		--	4.00	--	--	--	21,883	0.502	56,704	1.302
6453.00		--	5.00	--	--	--	25,202	0.579	80,246	1.842
6454.00		--	6.00	--	--	--	28,638	0.657	107,166	2.460
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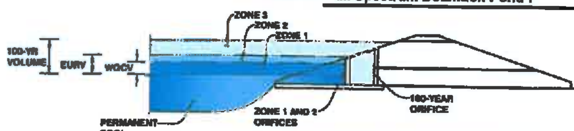
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: The Sands

Basin ID: Full Spectrum Detention Pond 7



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.71	0.340	Orifice Plate
Zone 2 (EURV)	3.77	0.844	Orifice Plate
Zone 3 (100-year)	5.04	0.676	Weir&Pipe (Restrict)
		1.860	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 =	3.77	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	15.30	inches
Orifice Plate: Orifice Area per Row =	2.73	sq. inches (diameter = 1-7/8 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.896E-02	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	1.26	2.51					
Orifice Area (sq. inches)	2.73	2.73	2.73					

	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 =	3.77	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	5.70	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.90	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.77	N/A	feet
Over Flow Weir Slope Length =	2.90	N/A	feet
Grate Open Area / 100-yr Orifice Area =	7.15	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	11.57	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.79	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 =	0.25	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 =	15.50		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.62	N/A	ft^2
Outlet Orifice Centroid =	0.69	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.38	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.05	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	35.00	feet
Spillway End Slopes =	10.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

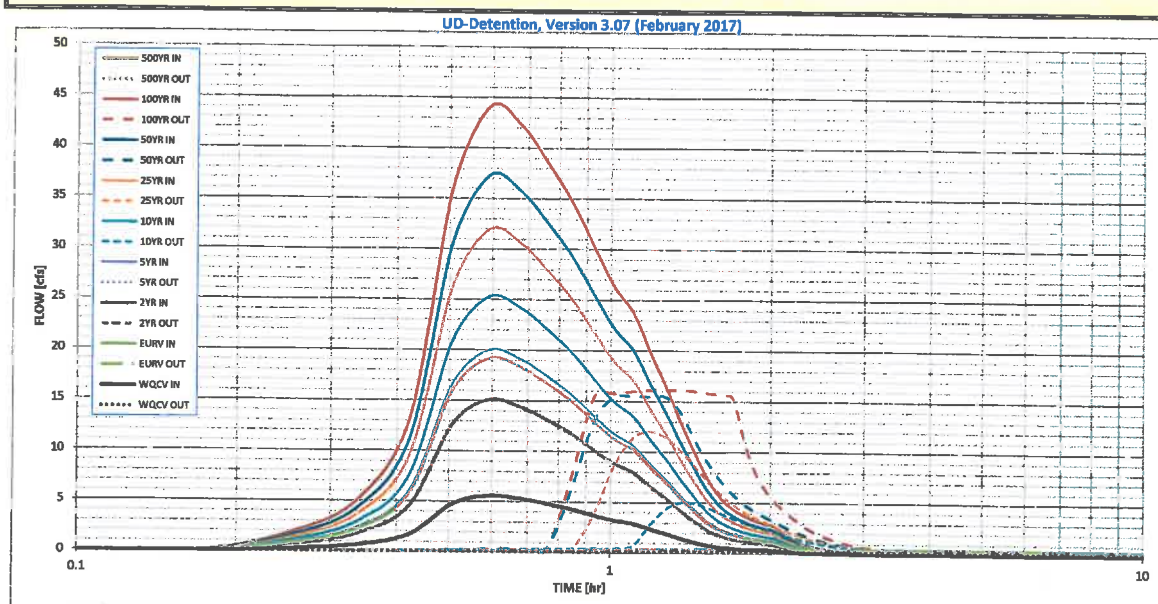
Spillway Design Flow Depth=	0.60	feet
Stage at Top of Freeboard =	6.65	feet
Basin Area at Top of Freeboard =	0.66	acres

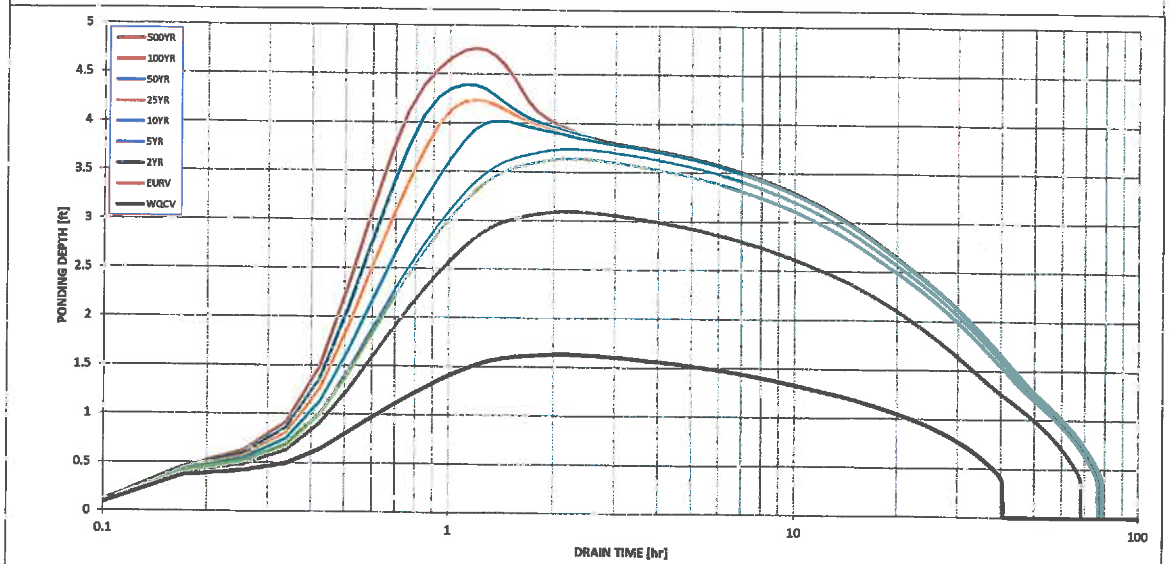
Routed Hydrograph Results

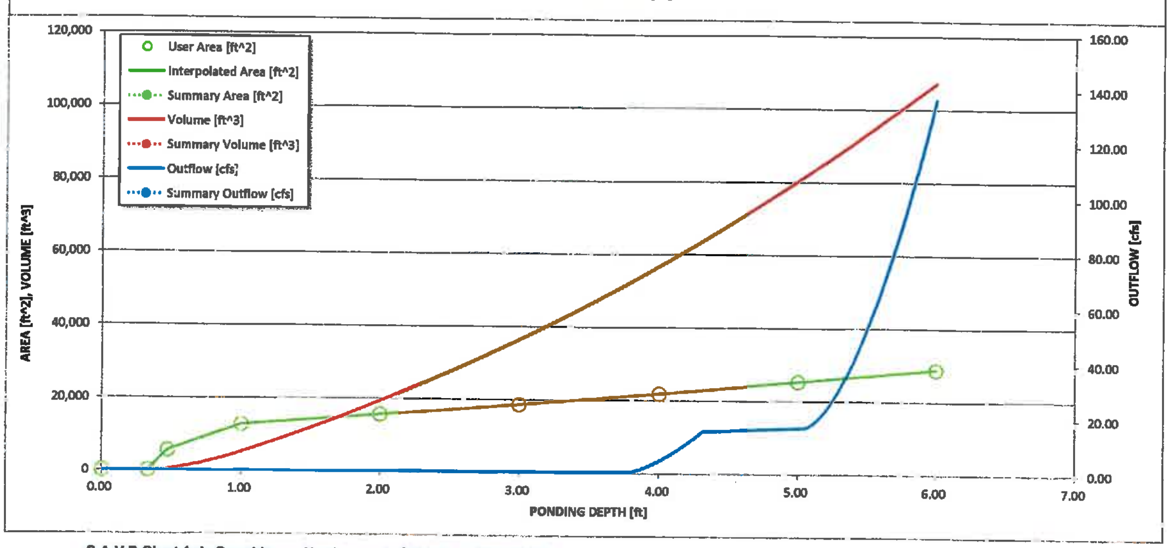
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.340	1.184	0.929	1.234	1.564	1.984	2.320	2.748	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.340	1.183	0.928	1.233	1.563	1.983	2.318	2.747	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.15	0.48	0.71	1.01	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.1	0.3	2.3	7.7	11.3	16.2	0.0
Peak Inflow Q (cfs) =	5.6	19.2	15.1	20.0	25.3	32.0	37.3	44.1	#N/A
Peak Outflow Q (cfs) =	0.2	0.4	0.4	0.4	5.0	12.1	15.5	16.2	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.6	2.1	1.6	1.4	1.0	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.4	1.0	1.3	1.4	#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) =	39	70	63	71	70	69	67	65	#N/A
Time to Drain 99% of Inflow Volume (hours) =	40	74	67	75	76	75	75	74	#N/A
Maximum Ponding Depth (ft) =	1.63	3.63	3.09	3.73	4.02	4.23	4.39	4.76	#N/A
Area at Maximum Ponding Depth (acres) =	0.33	0.48	0.44	0.48	0.50	0.52	0.53	0.56	#N/A
Maximum Volume Stored (acre-ft) =	0.311	1.121	0.875	1.169	1.307	1.419	1.498	1.706	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

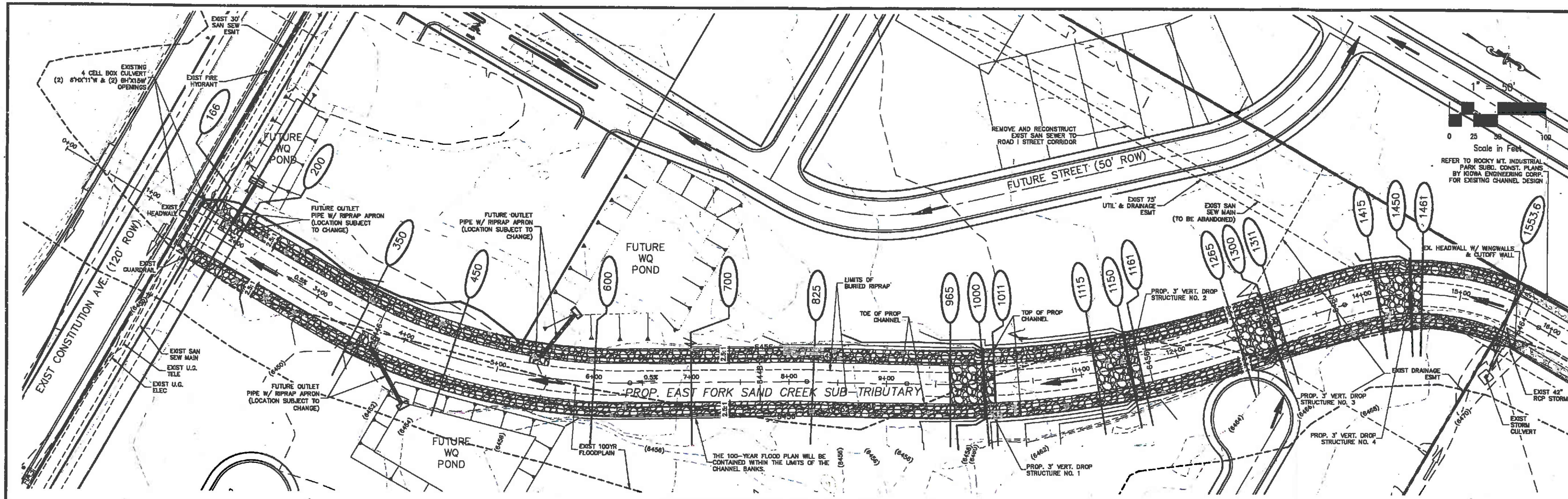




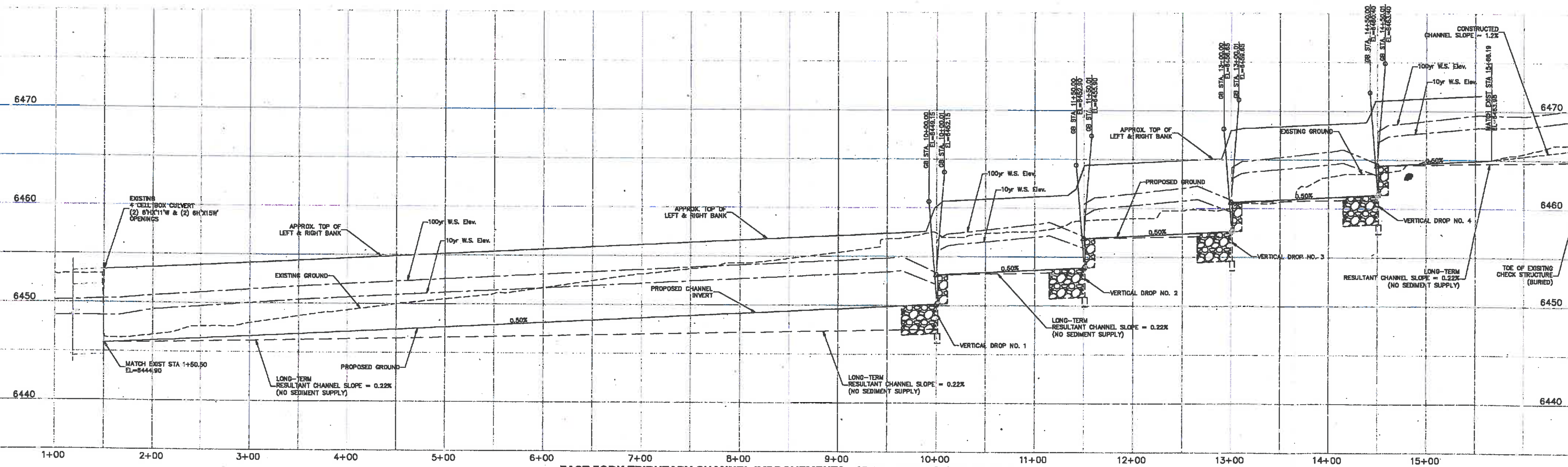


S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

HEC RAS MODEL WORK MAPS



EAST FORK TRIBUTARY CHANNEL IMPROVEMENTS
STA 1+50.50 TO STA 15+66.19



EAST FORK TRIBUTARY CHANNEL IMPROVEMENTS - STA 1+50.50 TO STA 15+66.19

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

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: ____

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

CAUTION: 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.

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

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

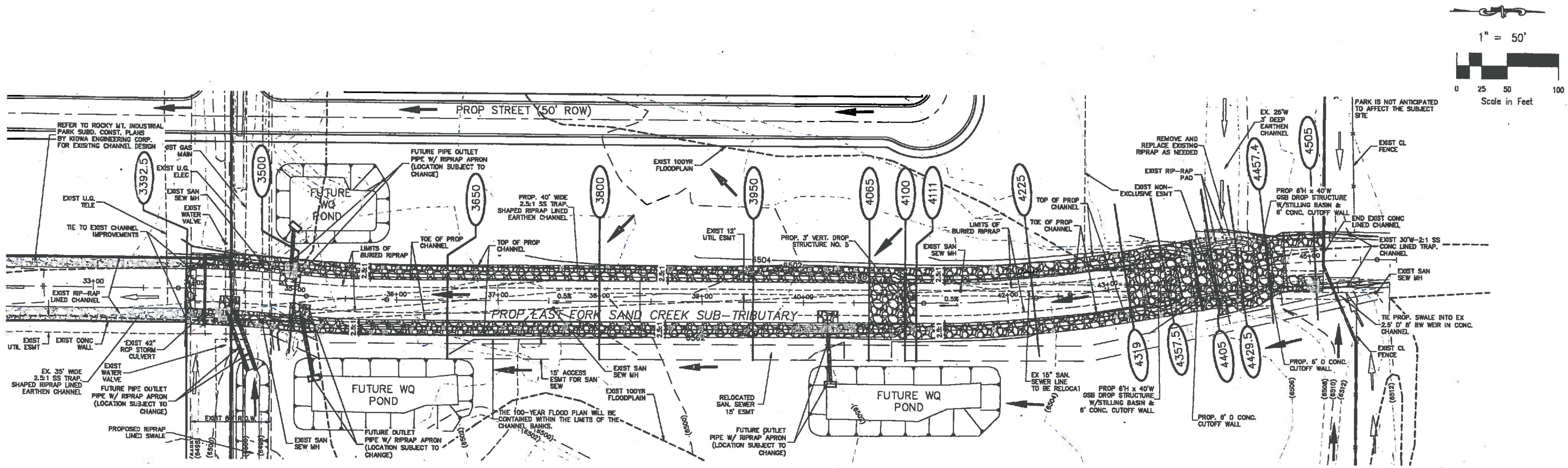
M&S CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485

THE SANDS
HYDRAULIC ANALYSIS WORK MAP

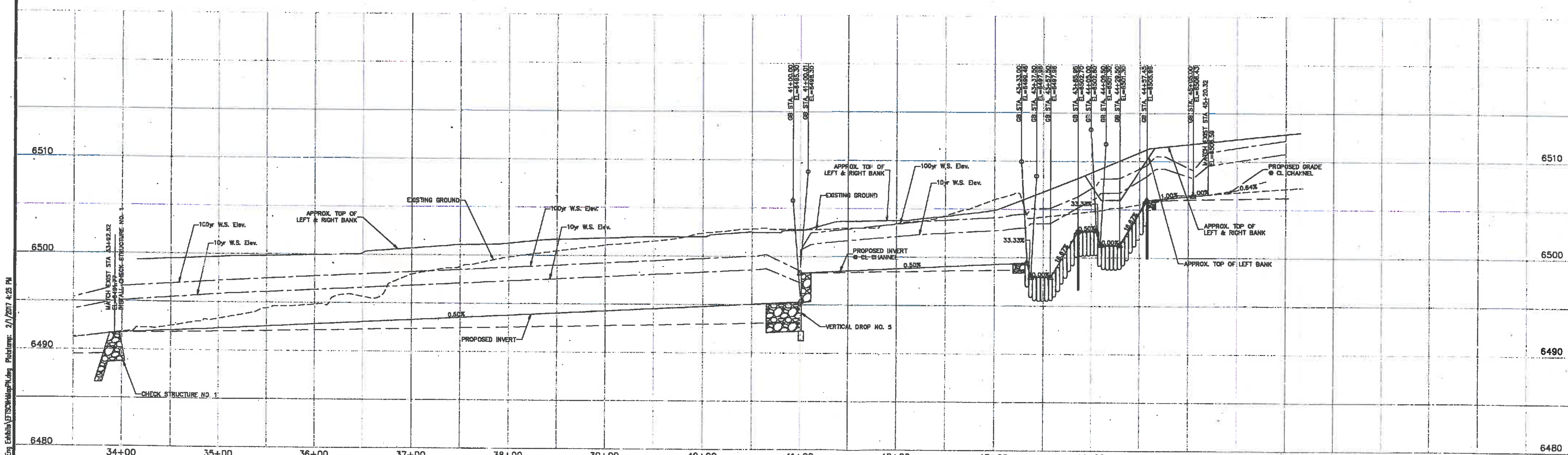
PROJECT NO. 43-069	
DESIGNED BY: DLM	SCALE HORIZ: 1"=50'
DRAWN BY: JNP	VERT: 1"=5'
CHECKED BY: VAS	
DATE: 09/30/2016	SHEET 4 OF 9

WM01

File: 0:\43069\MS Rd-Const Dwg\Street & Storm Plans\EFTSCWMdwg\FS.dwg Plotstamp: 2/1/2017 4:32 PM



EAST FORK TRIBUTARY CHANNEL IMPROVEMENTS
STA 33+92.52 TO STA 45+20.32



EAST FORK TRIBUTARY CHANNEL IMPROVEMENTS STA 33+92.52 TO STA 45+20.32

STATEMENT:
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FOR THE CITY ENGINEER:

DRAINAGE REVIEW: ____________ DATE: ________

THE SANDS
HYDRAULIC ANALYSIS WORK MAP

PROJECT NO. 43-089	FILE:
DESIGNED BY: DLM	SCALE HORIZ: 1"=50'
DRAWN BY: JWP	VERT: 1"=5'
CHECKED BY: VAS	DATE: 05/30/2016
	SHEET 5 OF 9

WM02

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

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

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: Plotdate: 2/1/2017 4:25 PM

HEC-RAS MODEL INPUT/OUTPUT

DEPTH/WATER SURFACE ELEVATION

Please include diagram of plan view.

TheSandsChannelImprovements.rep

HEC-RAS HEC-RAS 5.0.3 September 2016
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX   XXXX        XXXX     XX    XXXX
X     X  X       X    X       X   X   X  X  X
X     X  X       X            X   X  X    X X
XXXXXXX  XXXX    X      XXX   XXXX   XXXXXX  XXXX
X     X  X       X            X X    X    X      X
X     X  X       X    X       X  X   X    X      X
X     X  XXXXXX   XXXX        X   X  X    X XXXXX
```

PROJECT DATA
Project Title: The Sands Channel Improvements
Project File : TheSandsChannelImprovements.prj
Run Date and Time: 2/1/2017 8:33:38 AM

Project in English units

PLAN DATA

Plan Title: Concept Design Analysis - Depth,WSE
Plan File : o:\43089A\MS Rd-Const Ave\HEC-RAS\TheSandsChannelImprovements.p03

Geometry Title: Proposed and Existing - Depth, WSE
Geometry File : o:\43089A\MS Rd-Const Ave\HEC-RAS\TheSandsChannelImprovements.g03

Flow Title : FIS,100,10,5
Flow File : o:\43089A\MS Rd-Const Ave\HEC-RAS\TheSandsChannelImprovements.f08

Plan Description:
Concept Plan Analysis - To evaluate Depth and Water Surface Elevations

Plan Summary Information:

Number of:	Cross Sections =	84	Multiple Openings	=	0
	Culverts =	1	Inline Structures	=	0
	Bridges =	0	Lateral Structures	=	0

Computational Information

Water surface calculation tolerance	=	0.01
Critical depth calculation tolerance	=	0.01
Maximum number of iterations	=	20
Maximum difference tolerance	=	0.3
Flow tolerance factor	=	0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Mixed Flow

FLOW DATA

Flow Title: FIS,100,10,5
Flow File : o:\43089A\MS Rd-Const Ave\HEC-RAS\TheSandsChannelImprovements.f08

Flow Data (cfs)

River	Reach	RS	FIS	100 YR
10 YR	5 YR			
East Fork Sand C	Reach 1	4800	1920	1720
950	475			

Boundary Conditions

River	Reach	Profile	Upstream
Downstream			
East Fork Sand C	Reach 1	FIS	Normal S = 0.0064
Critical			
East Fork Sand C	Reach 1	100 YR	Normal S = 0.0064
Critical			
East Fork Sand C	Reach 1	10 YR	Normal S = 0.0064
Critical			

GEOMETRY DATA

Geometry Title: Proposed and Existing - Depth, WSE
Geometry File : o:\43089A\MS Rd-Const Ave\HEC-RAS\TheSandsChannelImprovements.g03

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4800

INPUT
Description: Sta 48+00 - Existing Channel
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6515.98	2.9	6515.08	12.95	6508.38	42.95	6508.38	53	6515.08
53.5	6515.58								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.017	12.95	.04	42.95	.017

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.95	42.95	100	100	100	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4700

INPUT
Description: Sta 47+00 - Existing Channel
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6515.34	2.9	6514.44	12.95	6507.74	42.95	6507.74	53	6514.44
53.5	6514.94								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.017	12.95	.04	42.95	.017

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.95	42.95	100	100	100	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4600

INPUT
Description: Sta 46+00 - Existing Channel
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6514.7	2.9	6513.8	12.95	6507.1	42.95	6507.1	53	6513.8
53.5	6514.3								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.017	12.95	.04	42.95	.017

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.95	42.95	79.68	79.68	79.68	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4520.32

INPUT
Description: Sta 45+20.32 - Proposed Channel/Tie to Existing
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6514.19	2.9	6513.29	12.95	6506.59	42.95	6506.59	53	6513.29
53.5	6513.79								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.017	12.95	.04	42.95	.017

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.95	42.95	15.32	15.32	15.32	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4505.00

INPUT
Description: Sta 45+05 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6512.43	15	6506.43	55	6506.43	70	6512.43

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.04	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	28.55	28.55	28.55	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4476.45

INPUT
Description: Sta 44+76.45 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6512.15	15	6506.15	55	6506.15	70	6512.15

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.04	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	10	10	10	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4466.45

INPUT
Description: Sta 44+66.45 - U/S edge of Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6512.05	15	6506.05	55	6506.05	70	6512.05

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.06	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	9	9	9	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4457.45

INPUT
Description: Sta 44+57.45 - Crest of Upper GSB Drop Structure
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6511.96	15	6505.96	55	6505.96	70	6511.96

```
Manning's n Values          num=        3
     Sta    n Val       Sta   n Val       Sta    n Val
       0      .07        15     .06        55      .07

Bank Sta: Left    Right     Lengths: Left Channel    Right       Coeff Contr.     Expan.
            15       55               54.3    54.3     54.3                .1          .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                   RS: 4429.50

INPUT
Description: Sta 44+29.5 -  U/S toe of Dissapator Pool/Bttm of Drop Struct
Station Elevation Data      num=        6
     Sta     Elev       Sta    Elev       Sta      Elev       Sta      Elev       Sta      Elev
      -5   6509.3         0  6507.3        15    6501.3        55    6501.3        70    6507.3
      75   6509.3

Manning's n Values          num=        3
     Sta    n Val       Sta   n Val       Sta    n Val
      -5      .07        15     .06        55      .07

Bank Sta: Left    Right     Lengths: Left Channel    Right       Coeff Contr.     Expan.
            15       55                 20      20       20                .1          .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                   RS: 4409.50

INPUT
Description: Sta 44+09.5 -  D/S toe of Dissapator Pool
Station Elevation Data      num=        6
     Sta     Elev       Sta    Elev       Sta      Elev       Sta      Elev       Sta      Elev
      -5   6509.3         0  6507.3        15    6501.3        55    6501.3        70    6507.3
      75   6509.3

Manning's n Values          num=        3
     Sta    n Val       Sta   n Val       Sta    n Val
      -5      .07        15     .06        55      .07

Bank Sta: Left    Right     Lengths: Left Channel    Right       Coeff Contr.     Expan.
            15       55               15.6    15.6     15.6                .1          .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                   RS: 4405.00

INPUT
Description: Sta 44+05 - U/S edge of Apron/Sill of Stilling Basin Pool
Station Elevation Data      num=        4
     Sta     Elev       Sta    Elev       Sta      Elev       Sta      Elev
       0   6508.8        15  6502.8        55    6502.8        70    6508.8

Manning's n Values          num=        3
     Sta    n Val       Sta   n Val       Sta    n Val
       0      .07        15     .06        55      .07
```

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	19	19	19	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4385.95

INPUT
Description: Sta 43+85.95 - Crest of Lower GSB Drop Structure
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6508.7	15	6502.7	55	6502.7	70	6508.7

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	15	.06	55	.07

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	55.3	55.3	55.3	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4357.50

INPUT
Description: Sta 43+57.5 - U/S toe of Dissapator Pool/Bttm of Drop Struct
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-5	6505.96	0	6503.96	15	6497.96	55	6497.96	70	6503.96
75	6505.96								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-5	.07	15	.06	55	.07

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	20	20	20	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4337.50

INPUT
Description: Sta 43+37.5 - D/S toe of Dissapator Pool
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-5	6505.96	0	6503.96	15	6497.96	55	6497.96	70	6503.96
75	6505.96								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-5	.07	15	.06	55	.07

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	15.7	15.7	15.7	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4333.00

INPUT
Description: Sta 43+33 - U/S edge of Apron/Sill of Stilling Basin Pool
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6505.46	15	6499.46	55	6499.46	70	6505.46

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.07	15	.06	55	.07

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	14	14	14	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4319.00

INPUT
Description: Sta 43+19 - D/S of Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6505.39	15	6499.39	55	6499.39	70	6505.39

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.06	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	10	10	10	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4309.00

INPUT
Description: Sta 43+09 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6505.34	15	6499.34	55	6499.34	70	6505.34

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.04	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	84	84	84	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4225.00

INPUT
Description: Sta 42+25 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6504.92	15	6498.92	55	6498.92	70	6504.92

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.04	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	104	104	104	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4121.00

INPUT
Description: Sta 41+21 - Proposed Channel
Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6504.41	15	6498.41	55	6498.41	70	6504.41

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.04	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	10	10	10	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4111.00

INPUT
Description: Sta 41+11 - U/S edge of Exist Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6504.36	15	6498.36	55	6498.36	70	6504.36

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.05	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	11	11	11	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4100.10

INPUT
Description: Sta 41+00.1 - Crest of DStruct. No. 4 (3' Vert.)
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6504.3	15	6498.3	30	6498.3	30	6497.8	40	6497.8

```
      40  6498.3        55  6498.3        70  6504.3

 Manning's n Values           num=         3
      Sta    n Val       Sta   n Val       Sta    n Val
       0      .055        15     .05        55     .055

 Bank Sta: Left    Right     Lengths: Left Channel    Right       Coeff Contr.    Expan.
             15      55                  .1       .1       .1                .1       .3

 CROSS SECTION


 RIVER: East Fork Sand C
 REACH: Reach 1                RS: 4100.00

 INPUT
 Description: Sta 41+00 - Bttm of DStruct. No. 5 (3' Vert.)
 Station Elevation Data      num=         4
      Sta     Elev       Sta     Elev       Sta     Elev       Sta     Elev
        0  6504.3       22.5  6495.3       47.5  6495.3         70  6504.3

 Manning's n Values           num=         3
      Sta    n Val       Sta   n Val       Sta    n Val
       0      .055       22.5    .05       47.5    .055

 Bank Sta: Left    Right     Lengths: Left Channel    Right       Coeff Contr.    Expan.
           22.5     47.5                 35       35       35                .1       .3

 CROSS SECTION


 RIVER: East Fork Sand C
 REACH: Reach 1                RS: 4065.00

 INPUT
 Description: Sta 40+65 - D/S edge of Exist Riprap Apron
 Station Elevation Data      num=         4
      Sta     Elev       Sta     Elev       Sta     Elev       Sta     Elev
        0 6501.13         15 6495.13         55 6495.13         70 6501.13

 Manning's n Values           num=         3
      Sta    n Val       Sta   n Val       Sta    n Val
       0      .055        15     .05        55     .055

 Bank Sta: Left    Right     Lengths: Left Channel    Right       Coeff Contr.    Expan.
             15      55                  10       10       10                .1       .3

 CROSS SECTION


 RIVER: East Fork Sand C
 REACH: Reach 1                RS: 4055.00

 INPUT
 Description: Sta 40+55 - Proposed Channel
 Station Elevation Data      num=         4
      Sta     Elev       Sta     Elev       Sta     Elev       Sta     Elev
        0 6501.08         15 6495.08         55 6495.08         70 6501.08

 Manning's n Values           num=         3
      Sta    n Val       Sta   n Val       Sta    n Val
       0      .055        15     .04        55     .055
```

```
Bank Sta: Left    Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
            15       55               105     105    105               .1       .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1               RS: 3950.00

INPUT
Description: Sta 39+50 - Proposed Channel
Station Elevation Data     num=        4
     Sta    Elev       Sta    Elev       Sta    Elev       Sta    Elev
       0 6500.55        15 6494.55        55 6494.55        70 6500.55

Manning's n Values            num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0     .055       15      .04       55     .055

Bank Sta: Left    Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
            15       55               150     150    150               .1       .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1               RS: 3800.00

INPUT
Description: Sta 38+00 - Proposed Channel
Proposed North
Station Elevation Data     num=        4
     Sta    Elev       Sta    Elev       Sta    Elev       Sta    Elev
       0 6499.81        15 6493.81        55 6493.81        70 6499.81

Manning's n Values            num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0     .055       15      .04       55     .055

Bank Sta: Left    Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
            15       55               150     150    150               .1       .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1               RS: 3650.00

INPUT
Description: Sta 36+50 - Proposed Channel
Station Elevation Data     num=        4
     Sta    Elev       Sta    Elev       Sta    Elev       Sta    Elev
       0 6499.05        15 6493.05        55 6493.05        70 6499.05

Manning's n Values            num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0     .055       15      .04       55     .055

Bank Sta: Left    Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
            15       55               150     150    150               .1       .3

CROSS SECTION
```

```
RIVER: East Fork Sand C
REACH: Reach 1                 RS: 3500.00

INPUT
Description: Sta 35+00 - Proposed Channel
Station Elevation Data      num=        4
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   6498.3       15   6492.3       55   6492.3       70   6498.3

Manning's n Values          num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0     .055       15      .04       55     .055

Bank Sta: Left    Right     Lengths: Left Channel   Right      Coeff Contr.    Expan.
            15       55             107.48  107.48  107.48                .1        .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                 RS: 3392.52

INPUT
Description: Sta 33+92.52 - Tie to Existing Channel
Proposed North
                (Beginning STA of plans Sheet CH05)
Station Elevation Data      num=        4
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0  6497.77       15  6491.77       55  6491.77       70  6497.77

Manning's n Values          num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0     .055       15      .05       55     .055

Bank Sta: Left    Right     Lengths: Left Channel   Right      Coeff Contr.    Expan.
            15       55                 50      50      50                .1        .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                 RS: 3342.52

INPUT
Description: Sta 33+42.52 - Existing Channel
Trasition from Kiow Existing to
                Ms Civil Proposed North
Station Elevation Data      num=        4
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   6496.1     12.5   6491.1     47.5   6491.1       60   6496.1

Manning's n Values          num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0     .055     12.5      .04     47.5     .055

Bank Sta: Left    Right     Lengths: Left Channel   Right      Coeff Contr.    Expan.
          12.5     47.5              90.52   90.52   90.52                .1        .3

CROSS SECTION


RIVER: East Fork Sand C
```

```
REACH: Reach 1                RS: 3252.00

INPUT
Description: Sta 32+52 - Existing Channel
Existing Channel Kiowa
Station Elevation Data    num=       4
     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev
       0     6495    12.5     6490    47.5     6490      60     6495

Manning's n Values        num=       3
     Sta    n Val     Sta    n Val     Sta    n Val
       0     .055    12.5      .04    47.5     .055

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
          12.5    47.5              150     150     150                .1       .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                RS: 3102.00

INPUT
Description: Sta 31+02 - Existing Channel
Existing Channel KiowaExisting
             Channel Kiowa
Station Elevation Data    num=       4
     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev
       0   6493.2    12.5   6488.2    47.5   6488.2      60   6493.2

Manning's n Values        num=       3
     Sta    n Val     Sta    n Val     Sta    n Val
       0     .055    12.5      .04    47.5     .055

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
          12.5    47.5              150     150     150                .1       .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                RS: 2952.00

INPUT
Description: Sta 29+52 - Existing Channel
Sta 29+52 - Existing Channel Kiowa
Station Elevation Data    num=       4
     Sta     Elev     Sta     Elev     Sta     Elev     Sta     Elev
       0   6491.4    12.5   6486.4    47.5   6486.4      60   6491.4

Manning's n Values        num=       3
     Sta    n Val     Sta    n Val     Sta    n Val
       0     .055    12.5      .04    47.5     .055

Bank Sta: Left   Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
          12.5    47.5              150     150     150                .1       .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                RS: 2802.00
```

INPUT
Description: Sta 28+02 - Existing Channel
Existing Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6489.6	12.5	6484.6	47.5	6484.6	60	6489.6

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	12.5	.04	47.5	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	14	14	14	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 2788.00

INPUT
Description: Sta 27+88 - U/S edge of Exist Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
06489.432		12.56484.432		47.56484.432		606489.432	

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	12.5	.04	47.5	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	11	11	11	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 2777.10

INPUT
Description: Sta 27+77.1 - Crest of Exist. 3' Drop Structure
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6489.3	12.5	6484.3	25	6484.3	25	6483.8	35	6483.8
35	6484.3	47.5	6484.3	60	6489.3				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	12.5	.04	47.5	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	.1	.1	.1	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 2777.00

INPUT
Description: Sta 27+77 - Bttm of Exist. 3' Drop Structure
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

```
       0  6489.3        20  6481.3        40  6481.3        60  6489.3

Manning's n Values          num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
      0     .055        20     .04        40     .055

Bank Sta: Left    Right     Lengths: Left Channel   Right      Coeff Contr.    Expan.
            20      40                   35      35      35                .1        .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                 RS: 2742.00

INPUT
Description: Sta 27+42 - D/S edge of Exist Riprap Apron
Station Elevation Data      num=        4
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0 6485.88      12.5 6480.88      47.5 6480.88       60 6485.88

Manning's n Values          num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
      0     .055      12.5     .04      47.5     .055

Bank Sta: Left    Right     Lengths: Left Channel   Right      Coeff Contr.    Expan.
          12.5     47.5                 140     140     140                .1        .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                 RS: 2602.00

INPUT
Description: Sta 26+02 - Existing Channel
Station Elevation Data      num=        4
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0  6484.2      12.5  6479.2      47.5  6479.2       60  6484.2

Manning's n Values          num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
      0     .055      12.5     .04      47.5     .055

Bank Sta: Left    Right     Lengths: Left Channel   Right      Coeff Contr.    Expan.
          12.5     47.5                 150     150     150                .1        .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                 RS: 2452.00

INPUT
Description: Sta 24+52 - Existing Channel
Station Elevation Data      num=        4
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0  6482.4      12.5  6477.4      47.5  6477.4       60  6482.4

Manning's n Values          num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
      0     .055      12.5     .04      47.5     .055
```

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	150	150	150	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 2302.00

INPUT
Description: Sta 23+02 - Existing Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6480.6	12.5	6475.6	47.5	6475.6	60	6480.6

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	12.5	.04	47.5	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	150	150	150	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 2152.00

INPUT
Description: Sta 21+52 - Existing Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6477.17	12.5	6473.8	47.5	6473.8	60	6477.17

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	12.5	.04	47.5	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	150	150	150	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 2002.00

INPUT
Description: Sta 20+02 - Existing Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6477.17	12.5	6472.17	47.5	6472.17	60	6477.17

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	12.5	.04	47.5	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	14	14	14	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1988.00

INPUT
Description: Sta 19+88 - U/S edge of Exist Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6477	12.5	6472	47.5	6472	60	6477

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	12.5	.04	47.5	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	11	11	11	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1977.10

INPUT
Description: Sta 19+77.1 - Crest of Exist. 3' Drop Structure
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6477	12.5	6472	25	6472	25	6471.5	35	6471.5
35	6472	47.5	6472	60	6477				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	12.5	.04	47.5	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	.1	.1	.1	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1977.00

INPUT
Description: Sta 19+77 - Bttm of Exist. 3' Drop Structure
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6477	20	6469	40	6469	60	6477

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	20	.04	40	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
20	40	35	35	35	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1942.00

INPUT
Description: Sta 19+42 - D/S edge of Exist Riprap Apron

```
Station Elevation Data    num=        4
     Sta     Elev       Sta     Elev       Sta     Elev       Sta     Elev
       0  6473.58      12.5  6468.58      47.5  6468.58        60  6473.58

Manning's n Values        num=        3
     Sta    n Val       Sta    n Val       Sta    n Val
       0     .055      12.5      .04      47.5     .055

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
          12.5     47.5               40      40       40                .1        .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1               RS: 1902.00

INPUT
Description: Sta 19+02 - Existing Channel
Station Elevation Data    num=        4
     Sta     Elev       Sta     Elev       Sta     Elev       Sta     Elev
       0   6473.1      12.5   6468.1      47.5   6468.1        60   6473.1

Manning's n Values        num=        3
     Sta    n Val       Sta    n Val       Sta    n Val
       0     .055      12.5      .04      47.5     .055

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
          12.5     47.5              150     150      150                .1        .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1               RS: 1752.00

INPUT
Description: Sta 17+52 - Existing Channel
Station Elevation Data    num=        4
     Sta     Elev       Sta     Elev       Sta     Elev       Sta     Elev
       0   6471.3      12.5   6466.3      47.5   6466.3        60   6471.3

Manning's n Values        num=        3
     Sta    n Val       Sta    n Val       Sta    n Val
       0     .055      12.5      .04      47.5     .055

Bank Sta: Left    Right    Lengths: Left Channel    Right      Coeff Contr.    Expan.
          12.5     47.5              150     150      150                .1        .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1               RS: 1602.00

INPUT
Description: Sta 16+02 - Existing Channel
Station Elevation Data    num=        4
     Sta     Elev       Sta     Elev       Sta     Elev       Sta     Elev
       0   6469.5      12.5   6464.5      47.5   6464.5        60   6469.5

Manning's n Values        num=        3
     Sta    n Val       Sta    n Val       Sta    n Val
```

0	.055	12.5	.04	47.5	.055

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
12.5 47.5 48 48.34 48.37 .1 .3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1553.66

INPUT
Description: Sta 15+53.66 - Tie to Existing Channel Section
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6469.92	15	6463.92	55	6463.92	70	6469.92

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.04	55	.055

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
15 55 73 82.66 94 .1 .3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1471.00

INPUT
Description: Sta 14+71 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6469.5	15	6463.5	55	6463.5	70	6469.5

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.04	55	.055

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
15 55 10 10 10 .1 .3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1461.00

INPUT
Description: Sta 14+61 - U/S edge of Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6469.45	15	6463.45	55	6463.45	70	6469.45

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.05	55	.055

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
15 55 11 11 11 .1 .3

CROSS SECTION

```
RIVER: East Fork Sand C
REACH: Reach 1                 RS: 1450.10

INPUT
Description: Sta 14+50.1 - Crest of DStruct. No. 4 (3' Vert.)
Station Elevation Data    num=        8
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   6469.4       15   6463.4       30   6463.4       30   6462.9       40   6462.9
      40   6463.4       55   6463.4       70   6469.4

Manning's n Values         num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0     .055       15      .05       55     .055

Bank Sta: Left    Right     Lengths: Left Channel    Right       Coeff Contr.    Expan.
            15       55                  .1       .1       .1               .1        .3
CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                 RS: 1450.00

INPUT
Description: Sta 14+50 - Bttm of Wall DStruct. No. 4 (3' Vert.)
Station Elevation Data    num=        4
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0   6469.4     22.5   6460.4     47.5   6460.4       70   6469.4

Manning's n Values         num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0     .055     22.5      .05     47.5     .055

Bank Sta: Left    Right     Lengths: Left Channel    Right       Coeff Contr.    Expan.
          22.5     47.5                  32       35       36               .1        .3
CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                 RS: 1415.00

INPUT
Description: Sta 14+15 - D/S edge of Riprap Apron
Station Elevation Data    num=        4
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0  6466.22       15  6460.22       55  6460.22       70  6466.22

Manning's n Values         num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0     .055       15      .05       55     .055

Bank Sta: Left    Right     Lengths: Left Channel    Right       Coeff Contr.    Expan.
            15       55                  10       10       10               .1        .3
CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                 RS: 1405.00
```

INPUT
Description: Sta 14+05 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6466.17	15	6460.17	55	6460.17	70	6466.17

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.04	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	84	84	84	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1321.00

INPUT
Description: Sta 13+21 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6465.75	15	6459.75	55	6459.75	70	6465.75

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.04	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	10	10	10	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1311.00

INPUT
Description: Sta 13+11 - U/S edge of Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6465.7	15	6459.7	55	6459.7	70	6465.7

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.05	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	11	11	11	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1300.10

INPUT
Description: Sta 13+00.1 - Crest of DStruct. No. 3 (3' Vert.)
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6465.65	15	6459.65	30	6459.65	30	6459.15	40	6459.15
40	6459.65	55	6459.65	70	6465.65				

```
Manning's n Values          num=        3
     Sta    n Val       Sta   n Val      Sta    n Val
      0     .055         15     .05       55    .055

Bank Sta: Left   Right     Lengths: Left Channel   Right      Coeff Contr.   Expan.
           15      55                   .1       .1      .1                .1       .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                 RS: 1300.00

INPUT
Description: Sta 13+00 - Bttm of Wall DStruct. No. 3 (3' Vert.)
Station Elevation Data      num=        4
     Sta     Elev       Sta    Elev      Sta    Elev      Sta    Elev
       0  6465.65      22.5 6456.65     47.5 6456.65       70 6465.65

Manning's n Values          num=        3
     Sta    n Val       Sta   n Val      Sta    n Val
      0     .055       22.5     .05     47.5    .055

Bank Sta: Left   Right     Lengths: Left Channel   Right      Coeff Contr.   Expan.
         22.5     47.5                  35       35      35                .1       .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                 RS: 1265.00

INPUT
Description: Sta 12+65 - D/S edge of Riprap Apron
Station Elevation Data      num=        4
     Sta     Elev       Sta    Elev      Sta    Elev      Sta    Elev
       0  6462.47        15 6456.47       55 6456.47       70 6462.47

Manning's n Values          num=        3
     Sta    n Val       Sta   n Val      Sta    n Val
      0     .055         15     .05       55    .055

Bank Sta: Left   Right     Lengths: Left Channel   Right      Coeff Contr.   Expan.
           15      55                   10       10      10                .1       .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                 RS: 1255.00

INPUT
Description: Sta 12+55 - Proposed Channel
Station Elevation Data      num=        4
     Sta     Elev       Sta    Elev      Sta    Elev      Sta    Elev
       0  6462.42        15 6456.42       55 6456.42       70 6462.42

Manning's n Values          num=        3
     Sta    n Val       Sta   n Val      Sta    n Val
      0     .055         15     .04       55    .055

Bank Sta: Left   Right     Lengths: Left Channel   Right      Coeff Contr.   Expan.
```

15	55	86	84	82		.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1171.00

INPUT
Description: Sta 11+71 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6462	15	6456	55	6456	70	6462

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.04	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	10	10	10	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1161.00

INPUT
Description: Sta 11+61 - U/S edge of Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6461.95	15	6455.95	55	6455.95	70	6461.95

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.05	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	11	11	11	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1150.10

INPUT
Description: Sta 1150.10 - Crest of DStruct. No. 2 (3' Vert.)
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6461.9	15	6455.9	30	6455.9	30	6455.4	40	6455.4
40	6455.9	55	6455.9	70	6461.9				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.05	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	.1	.1	.1	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1150.00

INPUT
Description: Sta 11+50 - Bttm of Wall DStruct. No. 2 (3' Vert.)
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6461.9	22.5	6452.9	47.5	6452.9	70	6461.9

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	22.5	.05	47.5	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
22.5	47.5	35	35	35	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1115.00

INPUT
Description: Sta 11+15 - D/S edge of Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6458.72	15	6452.72	55	6452.72	70	6458.72

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.05	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	10	10	10	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1105.00

INPUT
Description: Sta 11+05 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6458.67	15	6452.67	55	6452.67	70	6458.67

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.04	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	88	84	82	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1021.00

INPUT
Description: Sta 10+21 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6458.25	15	6452.25	55	6452.25	70	6458.25

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.04	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	10	10	10	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1011.00

INPUT
Description: Sta 10+11 - U/S edge of Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6458.2	15	6452.2	55	6452.2	70	6458.2

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.05	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	11	11	11	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1000.10

INPUT
Description: Sta 10+00.1 - Crest of DStruct. No. 1 (3' Vert.)
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6458.15	15	6452.15	30	6452.15	30	6451.65	40	6451.65
40	6452.15	55	6452.15	70	6458.15				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.05	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	.1	.1	.1	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1000.00

INPUT
Description: Sta 10+00 - Bttm of Wall DStruct. No. 1 (3' Vert.)
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6458.15	22.5	6449.15	47.5	6449.15	70	6458.15

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val

```
        0     .055    22.5      .05     47.5     .055

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
          22.5    47.5                  35       35     35                .1        .3
```

CROSS SECTION

```
RIVER: East Fork Sand C
REACH: Reach 1              RS: 965.00

INPUT
Description: Sta 9+65 - D/S edge of Riprap Apron
Station Elevation Data     num=        4
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0  6454.97       15  6448.97       55  6448.97       70  6454.97

Manning's n Values         num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0     .055       15      .05       55     .055

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
            15       55                  10       10     10                .1        .3
```

CROSS SECTION

```
RIVER: East Fork Sand C
REACH: Reach 1              RS: 955.00

INPUT
Description: Sta 9+55 - Proposed Channel
Station Elevation Data     num=        4
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0  6454.92       15  6448.92       55  6448.92       70  6454.92

Manning's n Values         num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0     .055       15      .04       55     .055

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
            15       55                 130      130    130                .1        .3
```

CROSS SECTION

```
RIVER: East Fork Sand C
REACH: Reach 1              RS: 825.00

INPUT
Description: Sta 8+25 - Proposed Channel
Station Elevation Data     num=        4
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0  6454.27       15  6448.27       55  6448.27       70  6454.27

Manning's n Values         num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0     .055       15      .04       55     .055

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
            15       55                 125      125    125                .1        .3
```

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 700.00

INPUT
Description: Sta 7+00 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6453.65	15	6447.65	55	6447.65	70	6453.65

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.04	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	101	100	99	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 600.00

INPUT
Description: Sta 6+00 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6453.15	15	6447.15	55	6447.15	70	6453.15

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.04	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	155	150	145	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 450.00

INPUT
Description: Sta 4+50 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6452.4	15	6446.4	55	6446.4	70	6452.4

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.04	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	103	100	96	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 350.00

INPUT

Description: Sta 3+50 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6451.9	15	6445.9	55	6445.9	70	6451.9

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.04	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	151	150	149	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 200.00

INPUT
Description: Sta 2+00 -50' U/S of Box Culvert
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6451.15	15	6445.15	55	6445.15	70	6451.15

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.04	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	34	34	34	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 166.00

INPUT
Description: Sta 1+66 - 16' U/S of Box Culvert
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6450.98	15	6444.98	55	6444.98	70	6450.98

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.04	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	145	145	145	.1	.3

CULVERT

RIVER: East Fork Sand C
REACH: Reach 1 RS: 150.00

INPUT
Description: Box Culvert at Constitution Ave
Distance from Upstream XS = 16
Deck/Roadway Width = 115
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	6453.98		9	6453.98		9	6453.98	
61	6453.98		61	6453.98		70	6453.98	

Upstream Bridge Cross Section Data
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6450.98	9	6444.9	61	6444.9	70	6450.98

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	9	.03	61	.045

Bank Sta: Left	Right	Coeff Contr.	Expan.
9	61	.1	.3

Downstream Deck/Roadway Coordinates
num= 6

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	6453.33		9	6453.33		9	6453.33	
61	6453.33		61	6453.33		70	6453.33	

Downstream Bridge Cross Section Data
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
06450.255		96444.255		616444.255		706450.255	

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	9	.04	61	.045

Bank Sta: Left	Right	Coeff Contr.	Expan.
9	61	.1	.3

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
Downstream Embankment side slope = 0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .98
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =
Weir crest shape = Broad Crested

Number of Culverts = 1

Culvert Name	Shape	Rise	Span
Constitution	Box	6	12.5

FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG

Culvert Upstrm Dist	Length	Top n	Bottom n	Depth Blocked	Entrance Loss Coef	Exit Loss Coef
16	115	.013	.013	0	.4	1

Number of Barrels = 4
Upstream Elevation = 6444.9
Centerline Stations

Sta.	Sta.	Sta.	Sta.
15.25	28.42	41.58	54.75

Downstream Elevation = 6444.325
Centerline Stations

Sta.	Sta.	Sta.	Sta.
15.25	28.42	41.58	54.75

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 21.00

INPUT
Description: Sta 0+21 -35' D/S of Box Culvert
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6450.255	15	6444.255	55	6444.255	70	6450.255

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.05	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	35	35	35	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: -14.00

INPUT
Description: Sta -0+14 - 69' D/S of Box Culvert
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6450.08	15	6444.08	55	6444.08	70	6450.08

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.055	15	.05	55	.055

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	-14	-14	-14	.1	.3

SUMMARY OF MANNING'S N VALUES

River:East Fork Sand C

Reach	River Sta.	n1	n2	n3
Reach 1	4800	.017	.04	.017
Reach 1	4700	.017	.04	.017
Reach 1	4600	.017	.04	.017
Reach 1	4520.32	.017	.04	.017
Reach 1	4505.00	.055	.04	.055
Reach 1	4476.45	.055	.04	.055
Reach 1	4466.45	.055	.06	.055
Reach 1	4457.45	.07	.06	.07
Reach 1	4429.50	.07	.06	.07
Reach 1	4409.50	.07	.06	.07
Reach 1	4405.00	.07	.06	.07
Reach 1	4385.95	.07	.06	.07
Reach 1	4357.50	.07	.06	.07
Reach 1	4337.50	.07	.06	.07
Reach 1	4333.00	.07	.06	.07
Reach 1	4319.00	.055	.06	.055
Reach 1	4309.00	.055	.04	.055

Reach 1	4225.00	.055	.04	.055
Reach 1	4121.00	.055	.04	.055
Reach 1	4111.00	.055	.05	.055
Reach 1	4100.10	.055	.05	.055
Reach 1	4100.00	.055	.05	.055
Reach 1	4065.00	.055	.05	.055
Reach 1	4055.00	.055	.04	.055
Reach 1	3950.00	.055	.04	.055
Reach 1	3800.00	.055	.04	.055
Reach 1	3650.00	.055	.04	.055
Reach 1	3500.00	.055	.04	.055
Reach 1	3392.52	.055	.05	.055
Reach 1	3342.52	.055	.04	.055
Reach 1	3252.00	.055	.04	.055
Reach 1	3102.00	.055	.04	.055
Reach 1	2952.00	.055	.04	.055
Reach 1	2802.00	.055	.04	.055
Reach 1	2788.00	.055	.04	.055
Reach 1	2777.10	.055	.04	.055
Reach 1	2777.00	.055	.04	.055
Reach 1	2742.00	.055	.04	.055
Reach 1	2602.00	.055	.04	.055
Reach 1	2452.00	.055	.04	.055
Reach 1	2302.00	.055	.04	.055
Reach 1	2152.00	.055	.04	.055
Reach 1	2002.00	.055	.04	.055
Reach 1	1988.00	.055	.04	.055
Reach 1	1977.10	.055	.04	.055
Reach 1	1977.00	.055	.04	.055
Reach 1	1942.00	.055	.04	.055
Reach 1	1902.00	.055	.04	.055
Reach 1	1752.00	.055	.04	.055
Reach 1	1602.00	.055	.04	.055
Reach 1	1553.66	.055	.04	.055
Reach 1	1471.00	.055	.04	.055
Reach 1	1461.00	.055	.05	.055
Reach 1	1450.10	.055	.05	.055
Reach 1	1450.00	.055	.05	.055
Reach 1	1415.00	.055	.05	.055
Reach 1	1405.00	.055	.04	.055
Reach 1	1321.00	.055	.04	.055
Reach 1	1311.00	.055	.05	.055
Reach 1	1300.10	.055	.05	.055
Reach 1	1300.00	.055	.05	.055
Reach 1	1265.00	.055	.05	.055
Reach 1	1255.00	.055	.04	.055
Reach 1	1171.00	.055	.04	.055
Reach 1	1161.00	.055	.05	.055
Reach 1	1150.10	.055	.05	.055
Reach 1	1150.00	.055	.05	.055
Reach 1	1115.00	.055	.05	.055
Reach 1	1105.00	.055	.04	.055
Reach 1	1021.00	.055	.04	.055
Reach 1	1011.00	.055	.05	.055
Reach 1	1000.10	.055	.05	.055
Reach 1	1000.00	.055	.05	.055
Reach 1	965.00	.055	.05	.055
Reach 1	955.00	.055	.04	.055
Reach 1	825.00	.055	.04	.055
Reach 1	700.00	.055	.04	.055
Reach 1	600.00	.055	.04	.055
Reach 1	450.00	.055	.04	.055
Reach 1	350.00	.055	.04	.055

Reach 1	200.00	.055	.04	.055
Reach 1	166.00	.055	.04	.055
Reach 1	150.00	Culvert		
Reach 1	21.00	.055	.05	.055
Reach 1	-14.00	.055	.05	.055

SUMMARY OF REACH LENGTHS

River: East Fork Sand C

Reach	River Sta.	Left	Channel	Right
Reach 1	4800	100	100	100
Reach 1	4700	100	100	100
Reach 1	4600	79.68	79.68	79.68
Reach 1	4520.32	15.32	15.32	15.32
Reach 1	4505.00	28.55	28.55	28.55
Reach 1	4476.45	10	10	10
Reach 1	4466.45	9	9	9
Reach 1	4457.45	54.3	54.3	54.3
Reach 1	4429.50	20	20	20
Reach 1	4409.50	15.6	15.6	15.6
Reach 1	4405.00	19	19	19
Reach 1	4385.95	55.3	55.3	55.3
Reach 1	4357.50	20	20	20
Reach 1	4337.50	15.7	15.7	15.7
Reach 1	4333.00	14	14	14
Reach 1	4319.00	10	10	10
Reach 1	4309.00	84	84	84
Reach 1	4225.00	104	104	104
Reach 1	4121.00	10	10	10
Reach 1	4111.00	11	11	11
Reach 1	4100.10	.1	.1	.1
Reach 1	4100.00	35	35	35
Reach 1	4065.00	10	10	10
Reach 1	4055.00	105	105	105
Reach 1	3950.00	150	150	150
Reach 1	3800.00	150	150	150
Reach 1	3650.00	150	150	150
Reach 1	3500.00	107.48	107.48	107.48
Reach 1	3392.52	50	50	50
Reach 1	3342.52	90.52	90.52	90.52
Reach 1	3252.00	150	150	150
Reach 1	3102.00	150	150	150
Reach 1	2952.00	150	150	150
Reach 1	2802.00	14	14	14
Reach 1	2788.00	11	11	11
Reach 1	2777.10	.1	.1	.1
Reach 1	2777.00	35	35	35
Reach 1	2742.00	140	140	140
Reach 1	2602.00	150	150	150
Reach 1	2452.00	150	150	150
Reach 1	2302.00	150	150	150
Reach 1	2152.00	150	150	150
Reach 1	2002.00	14	14	14
Reach 1	1988.00	11	11	11
Reach 1	1977.10	.1	.1	.1
Reach 1	1977.00	35	35	35
Reach 1	1942.00	40	40	40
Reach 1	1902.00	150	150	150

Reach 1	1752.00	150	150	150
Reach 1	1602.00	48	48.34	48.37
Reach 1	1553.66	73	82.66	94
Reach 1	1471.00	10	10	10
Reach 1	1461.00	11	11	11
Reach 1	1450.10	.1	.1	.1
Reach 1	1450.00	32	35	36
Reach 1	1415.00	10	10	10
Reach 1	1405.00	84	84	84
Reach 1	1321.00	10	10	10
Reach 1	1311.00	11	11	11
Reach 1	1300.10	.1	.1	.1
Reach 1	1300.00	35	35	35
Reach 1	1265.00	10	10	10
Reach 1	1255.00	86	84	82
Reach 1	1171.00	10	10	10
Reach 1	1161.00	11	11	11
Reach 1	1150.10	.1	.1	.1
Reach 1	1150.00	35	35	35
Reach 1	1115.00	10	10	10
Reach 1	1105.00	88	84	82
Reach 1	1021.00	10	10	10
Reach 1	1011.00	11	11	11
Reach 1	1000.10	.1	.1	.1
Reach 1	1000.00	35	35	35
Reach 1	965.00	10	10	10
Reach 1	955.00	130	130	130
Reach 1	825.00	125	125	125
Reach 1	700.00	101	100	99
Reach 1	600.00	155	150	145
Reach 1	450.00	103	100	96
Reach 1	350.00	151	150	149
Reach 1	200.00	34	34	34
Reach 1	166.00	145	145	145
Reach 1	150.00	Culvert		
Reach 1	21.00	35	35	35
Reach 1	-14.00	-14	-14	-14

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: East Fork Sand C

Reach	River Sta.	Contr.	Expan.
Reach 1	4800	.1	.3
Reach 1	4700	.1	.3
Reach 1	4600	.1	.3
Reach 1	4520.32	.1	.3
Reach 1	4505.00	.1	.3
Reach 1	4476.45	.1	.3
Reach 1	4466.45	.1	.3
Reach 1	4457.45	.1	.3
Reach 1	4429.50	.1	.3
Reach 1	4409.50	.1	.3
Reach 1	4405.00	.1	.3
Reach 1	4385.95	.1	.3
Reach 1	4357.50	.1	.3
Reach 1	4337.50	.1	.3
Reach 1	4333.00	.1	.3
Reach 1	4319.00	.1	.3

Reach 1	4309.00	.1	.3
Reach 1	4225.00	.1	.3
Reach 1	4121.00	.1	.3
Reach 1	4111.00	.1	.3
Reach 1	4100.10	.1	.3
Reach 1	4100.00	.1	.3
Reach 1	4065.00	.1	.3
Reach 1	4055.00	.1	.3
Reach 1	3950.00	.1	.3
Reach 1	3800.00	.1	.3
Reach 1	3650.00	.1	.3
Reach 1	3500.00	.1	.3
Reach 1	3392.52	.1	.3
Reach 1	3342.52	.1	.3
Reach 1	3252.00	.1	.3
Reach 1	3102.00	.1	.3
Reach 1	2952.00	.1	.3
Reach 1	2802.00	.1	.3
Reach 1	2788.00	.1	.3
Reach 1	2777.10	.1	.3
Reach 1	2777.00	.1	.3
Reach 1	2742.00	.1	.3
Reach 1	2602.00	.1	.3
Reach 1	2452.00	.1	.3
Reach 1	2302.00	.1	.3
Reach 1	2152.00	.1	.3
Reach 1	2002.00	.1	.3
Reach 1	1988.00	.1	.3
Reach 1	1977.10	.1	.3
Reach 1	1977.00	.1	.3
Reach 1	1942.00	.1	.3
Reach 1	1902.00	.1	.3
Reach 1	1752.00	.1	.3
Reach 1	1602.00	.1	.3
Reach 1	1553.66	.1	.3
Reach 1	1471.00	.1	.3
Reach 1	1461.00	.1	.3
Reach 1	1450.10	.1	.3
Reach 1	1450.00	.1	.3
Reach 1	1415.00	.1	.3
Reach 1	1405.00	.1	.3
Reach 1	1321.00	.1	.3
Reach 1	1311.00	.1	.3
Reach 1	1300.10	.1	.3
Reach 1	1300.00	.1	.3
Reach 1	1265.00	.1	.3
Reach 1	1255.00	.1	.3
Reach 1	1171.00	.1	.3
Reach 1	1161.00	.1	.3
Reach 1	1150.10	.1	.3
Reach 1	1150.00	.1	.3
Reach 1	1115.00	.1	.3
Reach 1	1105.00	.1	.3
Reach 1	1021.00	.1	.3
Reach 1	1011.00	.1	.3
Reach 1	1000.10	.1	.3
Reach 1	1000.00	.1	.3
Reach 1	965.00	.1	.3
Reach 1	955.00	.1	.3
Reach 1	825.00	.1	.3
Reach 1	700.00	.1	.3
Reach 1	600.00	.1	.3
Reach 1	450.00	.1	.3

Reach 1	350.00	.1	.3
Reach 1	200.00	.1	.3
Reach 1	166.00	.1	.3
Reach 1	150.00	Culvert	
Reach 1	21.00	.1	.3
Reach 1	-14.00	.1	.3

HEC-RAS Plan: EFSCST-WSE River: East Fork Sand C Reach: Reach 1

EXIST

PROP

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	E.G. Elev	E.G. Slope	Flow Area	Top Width
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(sq ft)	(ft)
Reach 1	4800	FIS	1920.00	6508.38	6513.68	5.30	6515.16	0.006297	201.15	45.90
Reach 1	4800	100 YR	1720.00	6508.38	6513.38	5.00	6514.75	0.006302	187.67	45.01
Reach 1	4800	10 YR	950.00	6508.38	6512.03	3.65	6512.90	0.006326	129.44	40.95
Reach 1	4800	5 YR	475.00	6508.38	6510.88	2.50	6511.39	0.006355	84.25	37.49
Reach 1	4700	FIS	1920.00	6507.74	6513.07	5.33	6514.53	0.006149	202.65	46.00
Reach 1	4700	100 YR	1720.00	6507.74	6512.77	5.03	6514.12	0.006158	189.04	45.10
Reach 1	4700	10 YR	950.00	6507.74	6511.41	3.67	6512.27	0.006180	130.38	41.02
Reach 1	4700	5 YR	475.00	6507.74	6510.26	2.51	6510.76	0.006191	84.93	37.54
Reach 1	4600	FIS	1920.00	6507.10	6512.51	5.41	6513.92	0.005822	206.17	46.23
Reach 1	4600	100 YR	1720.00	6507.10	6512.21	5.11	6513.50	0.005831	192.31	45.32
Reach 1	4600	10 YR	950.00	6507.10	6510.84	3.74	6511.66	0.005776	133.15	41.22
Reach 1	4600	5 YR	475.00	6507.10	6509.69	2.59	6510.16	0.005554	87.81	37.77
Reach 1	4520.32	FIS	1920.00	6506.59	6511.26	4.67	6513.26	0.010212	172.85	44.01
Reach 1	4520.32	100 YR	1720.00	6506.59	6510.95	4.36	6512.84	0.010610	159.45	43.09
Reach 1	4520.32	10 YR	950.00	6506.59	6509.59	3.00	6510.94	0.013085	103.37	38.99
Reach 1	4520.32	5 YR	475.00	6506.59	6508.51	1.92	6509.41	0.016308	63.11	35.76
Reach 1	4505.00	FIS	1920.00	6506.43	6509.30	2.87	6512.83	0.042921	135.21	54.33
Reach 1	4505.00	100 YR	1720.00	6506.43	6509.11	2.67	6512.40	0.043817	124.88	53.37
Reach 1	4505.00	10 YR	950.00	6506.43	6508.28	1.85	6510.51	0.047609	82.59	49.25
Reach 1	4505.00	5 YR	475.00	6506.43	6508.46	2.03	6508.92	0.008608	91.69	50.17
Reach 1	4476.45	FIS	1920.00	6506.15	6510.80	4.65	6511.99	0.007829	240.14	63.26
Reach 1	4476.45	100 YR	1720.00	6506.15	6510.52	4.37	6511.62	0.007862	222.34	61.83
Reach 1	4476.45	10 YR	950.00	6506.15	6509.26	3.11	6509.98	0.007904	148.63	55.55
Reach 1	4476.45	5 YR	475.00	6506.15	6508.26	2.11	6508.68	0.007628	95.35	50.53
Reach 1	4466.45	FIS	1920.00	6506.05	6510.83	4.78	6511.82	0.014286	248.34	63.90
Reach 1	4466.45	100 YR	1720.00	6506.05	6510.53	4.48	6511.46	0.014559	229.22	62.39
Reach 1	4466.45	10 YR	950.00	6506.05	6509.21	3.16	6509.85	0.015643	151.15	55.78
Reach 1	4466.45	5 YR	475.00	6506.05	6508.17	2.12	6508.57	0.015841	96.17	50.61
Reach 1	4457.45	FIS	1920.00	6505.96	6509.86	3.90	6511.57	0.031876	193.82	59.48
Reach 1	4457.45	100 YR	1720.00	6505.96	6509.60	3.64	6511.21	0.032663	178.56	58.19
Reach 1	4457.45	10 YR	950.00	6505.96	6508.46	2.50	6509.60	0.037364	115.42	52.48
Reach 1	4457.45	5 YR	475.00	6505.96	6507.55	1.59	6508.31	0.044003	70.10	47.97
Reach 1	4429.50	FIS	1920.00	6501.30	6508.59	7.29	6508.97	0.003286	424.31	76.44
Reach 1	4429.50	100 YR	1720.00	6501.30	6508.25	6.95	6508.60	0.003138	399.06	74.77
Reach 1	4429.50	10 YR	950.00	6501.30	6506.74	5.44	6506.94	0.002348	291.84	67.22
Reach 1	4429.50	5 YR	475.00	6501.30	6505.49	4.19	6505.58	0.001504	211.58	60.96
Reach 1	4409.50	FIS	1920.00	6501.30	6508.51	7.21	6508.90	0.003421	418.36	76.05
Reach 1	4409.50	100 YR	1720.00	6501.30	6508.18	6.88	6508.53	0.003265	393.53	74.40
Reach 1	4409.50	10 YR	950.00	6501.30	6506.69	5.39	6506.89	0.002432	288.30	66.96
Reach 1	4409.50	5 YR	475.00	6501.30	6505.46	4.16	6505.55	0.001546	209.61	60.80
Reach 1	4405.00	FIS	1920.00	6502.80	6507.79	4.99	6508.75	0.013122	261.99	64.96
Reach 1	4405.00	100 YR	1720.00	6502.80	6507.50	4.70	6508.39	0.013060	243.39	63.51
Reach 1	4405.00	10 YR	950.00	6502.80	6506.21	3.41	6506.78	0.012560	165.28	57.03
Reach 1	4405.00	5 YR	475.00	6502.80	6505.15	2.35	6505.47	0.011552	107.71	51.74
Reach 1	4385.95	FIS	1920.00	6502.70	6506.60	3.90	6508.31	0.031876	193.82	59.48
Reach 1	4385.95	100 YR	1720.00	6502.70	6506.34	3.64	6507.95	0.032663	178.56	58.19
Reach 1	4385.95	10 YR	950.00	6502.70	6505.20	2.50	6506.34	0.037364	115.42	52.48
Reach 1	4385.95	5 YR	475.00	6502.70	6504.29	1.59	6505.05	0.044003	70.10	47.97
Reach 1	4357.50	FIS	1920.00	6497.96	6505.50	7.54	6505.85	0.002902	443.43	77.68
Reach 1	4357.50	100 YR	1720.00	6497.96	6505.14	7.18	6505.46	0.002782	416.39	75.92
Reach 1	4357.50	10 YR	950.00	6497.96	6503.57	5.61	6503.74	0.002110	302.84	68.03
Reach 1	4357.50	5 YR	475.00	6497.96	6502.26	4.29	6502.34	0.001379	217.91	61.47
Reach 1	4337.50	FIS	1920.00	6497.96	6505.43	7.47	6505.79	0.003002	438.13	77.34
Reach 1	4337.50	100 YR	1720.00	6497.96	6505.08	7.12	6505.40	0.002876	411.51	75.60
Reach 1	4337.50	10 YR	950.00	6497.96	6503.52	5.56	6503.70	0.002174	299.69	67.80

HEC-RAS Plan: EFSCST-WSE River: East Fork Sand C Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Max Chl Dpth (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Flow Area (sq ft)	Top Width (ft)
Reach 1	4337.50	5 YR	475.00	6497.96	6502.23	4.27	6502.31	0.001413	216.08	61.33
Reach 1	4333.00	FIS	1920.00	6499.46	6504.88	5.42	6505.67	0.009776	289.91	67.08
Reach 1	4333.00	100 YR	1720.00	6499.46	6504.55	5.09	6505.29	0.009795	268.58	65.47
Reach 1	4333.00	10 YR	950.00	6499.46	6503.13	3.67	6503.61	0.009680	180.30	58.33
Reach 1	4333.00	5 YR	475.00	6499.46	6501.96	2.50	6502.24	0.009290	115.63	52.50
Reach 1	4319.00	FIS	1920.00	6499.39	6504.77	5.38	6505.52	0.009224	287.85	66.92
Reach 1	4319.00	100 YR	1720.00	6499.39	6504.45	5.06	6505.14	0.009329	266.19	65.28
Reach 1	4319.00	10 YR	950.00	6499.39	6503.00	3.61	6503.47	0.009720	176.72	58.03
Reach 1	4319.00	5 YR	475.00	6499.39	6501.82	2.43	6502.11	0.009908	111.79	52.13
Reach 1	4309.00	FIS	1920.00	6499.34	6504.50	5.16	6505.43	0.005414	272.81	65.79
Reach 1	4309.00	100 YR	1720.00	6499.34	6504.20	4.86	6505.06	0.005389	253.19	64.28
Reach 1	4309.00	10 YR	950.00	6499.34	6502.84	3.50	6503.39	0.005251	170.43	57.48
Reach 1	4309.00	5 YR	475.00	6499.34	6501.71	2.37	6502.04	0.005090	108.77	51.84
Reach 1	4225.00	FIS	1920.00	6498.92	6503.98	5.06	6504.96	0.005791	266.51	65.31
Reach 1	4225.00	100 YR	1720.00	6498.92	6503.69	4.77	6504.58	0.005762	247.40	63.83
Reach 1	4225.00	10 YR	950.00	6498.92	6502.36	3.44	6502.94	0.005561	167.18	57.20
Reach 1	4225.00	5 YR	475.00	6498.92	6501.27	2.35	6501.60	0.005264	107.58	51.73
Reach 1	4121.00	FIS	1920.00	6498.41	6502.81	4.40	6504.16	0.009511	224.61	62.02
Reach 1	4121.00	100 YR	1720.00	6498.41	6502.56	4.15	6503.79	0.009448	208.81	60.73
Reach 1	4121.00	10 YR	950.00	6498.41	6501.41	3.00	6502.19	0.008950	142.61	55.01
Reach 1	4121.00	5 YR	475.00	6498.41	6500.46	2.05	6500.91	0.008323	92.69	50.27
Reach 1	4111.00	FIS	1920.00	6498.36	6502.75	4.39	6504.03	0.014306	223.49	61.93
Reach 1	4111.00	100 YR	1720.00	6498.36	6502.47	4.11	6503.67	0.014475	206.68	60.55
Reach 1	4111.00	10 YR	950.00	6498.36	6501.27	2.91	6502.07	0.015104	137.34	54.53
Reach 1	4111.00	5 YR	475.00	6498.36	6500.32	1.96	6500.80	0.015007	87.78	49.78
Reach 1	4100.10	FIS	1920.00	6497.80	6502.09	4.29	6503.79	0.022570	192.46	58.95
Reach 1	4100.10	100 YR	1720.00	6497.80	6501.83	4.03	6503.43	0.023107	177.40	57.65
Reach 1	4100.10	10 YR	950.00	6497.80	6500.69	2.89	6501.83	0.026490	114.68	51.93
Reach 1	4100.10	5 YR	475.00	6497.80	6499.78	1.98	6500.54	0.031493	69.49	47.38
Reach 1	4100.00	FIS	1920.00	6495.30	6498.80	3.50	6503.49	0.072649	117.96	42.48
Reach 1	4100.00	100 YR	1720.00	6495.30	6498.52	3.22	6503.12	0.079001	106.27	41.08
Reach 1	4100.00	10 YR	950.00	6495.30	6497.31	2.01	6501.52	0.130087	60.27	35.04
Reach 1	4100.00	5 YR	475.00	6495.30	6496.42	1.12	6500.23	0.248009	31.17	30.61
Reach 1	4065.00	FIS	1920.00	6495.13	6500.52	5.39	6501.31	0.006771	288.40	66.96
Reach 1	4065.00	100 YR	1720.00	6495.13	6500.19	5.06	6500.93	0.006827	266.70	65.32
Reach 1	4065.00	10 YR	950.00	6495.13	6498.73	3.60	6499.23	0.007062	176.60	58.02
Reach 1	4065.00	5 YR	475.00	6495.13	6497.54	2.41	6497.85	0.007254	110.98	52.06
Reach 1	4055.00	FIS	1920.00	6495.08	6500.35	5.27	6501.24	0.005004	280.40	66.36
Reach 1	4055.00	100 YR	1720.00	6495.08	6500.04	4.96	6500.86	0.005004	259.77	64.79
Reach 1	4055.00	10 YR	950.00	6495.08	6498.63	3.54	6499.16	0.005007	173.18	57.72
Reach 1	4055.00	5 YR	475.00	6495.08	6497.46	2.38	6497.78	0.005008	109.35	51.90
Reach 1	3950.00	FIS	1920.00	6494.55	6499.83	5.28	6500.71	0.004977	280.91	66.40
Reach 1	3950.00	100 YR	1720.00	6494.55	6499.52	4.97	6500.33	0.004976	260.28	64.83
Reach 1	3950.00	10 YR	950.00	6494.55	6498.10	3.55	6498.64	0.004958	173.75	57.77
Reach 1	3950.00	5 YR	475.00	6494.55	6496.94	2.39	6497.26	0.004930	109.91	51.95
Reach 1	3800.00	FIS	1920.00	6493.81	6499.07	5.26	6499.96	0.005044	279.62	66.30
Reach 1	3800.00	100 YR	1720.00	6493.81	6498.76	4.95	6499.58	0.005043	259.08	64.74
Reach 1	3800.00	10 YR	950.00	6493.81	6497.35	3.54	6497.89	0.005033	172.87	57.70
Reach 1	3800.00	5 YR	475.00	6493.81	6496.19	2.38	6496.51	0.005040	109.13	51.88
Reach 1	3650.00	FIS	1920.00	6493.05	6498.32	5.27	6499.21	0.005017	280.14	66.34
Reach 1	3650.00	100 YR	1720.00	6493.05	6498.01	4.96	6498.83	0.005011	259.65	64.78
Reach 1	3650.00	10 YR	950.00	6493.05	6496.60	3.55	6497.14	0.004966	173.66	57.76
Reach 1	3650.00	5 YR	475.00	6493.05	6495.44	2.39	6495.76	0.004906	110.09	51.97
Reach 1	3500.00	FIS	1920.00	6492.30	6497.56	5.26	6498.45	0.005045	279.59	66.30

HEC-RAS Plan: EFSCST-WSE River: East Fork Sand C Reach: Reach 1 (Continued)

PROP

EXIST

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	E.G. Elev	E.G. Slope	Flow Area	Top Width
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(sq ft)	(ft)
Reach 1	3500.00	100 YR	1720.00	6492.30	6497.25	4.95	6498.07	0.005036	259.21	64.75
Reach 1	3500.00	10 YR	950.00	6492.30	6495.87	3.57	6496.40	0.004904	174.40	57.83
Reach 1	3500.00	5 YR	475.00	6492.30	6494.74	2.44	6495.05	0.004607	112.38	52.19
Reach 1	3392.52	FIS	1920.00	6491.77	6496.87	5.09	6497.76	0.008324	268.68	65.47
Reach 1	3392.52	100 YR	1720.00	6491.77	6496.53	4.76	6497.38	0.008562	246.87	63.79
Reach 1	3392.52	10 YR	950.00	6491.77	6495.06	3.29	6495.67	0.009796	158.41	56.43
Reach 1	3392.52	5 YR	475.00	6491.77	6493.90	2.13	6494.30	0.011138	96.61	50.66
Reach 1	3342.52	FIS	1920.00	6491.10	6495.49	4.39	6497.19	0.012147	202.03	56.97
Reach 1	3342.52	100 YR	1720.00	6491.10	6495.23	4.13	6496.80	0.012152	187.21	55.65
Reach 1	3342.52	10 YR	950.00	6491.10	6494.05	2.95	6495.08	0.012181	124.94	49.74
Reach 1	3342.52	5 YR	475.00	6491.10	6493.08	1.98	6493.70	0.012169	79.06	44.90
Reach 1	3252.00	FIS	1920.00	6490.00	6494.40	4.40	6496.09	0.012109	202.26	56.99
Reach 1	3252.00	100 YR	1720.00	6490.00	6494.13	4.13	6495.70	0.012116	187.40	55.67
Reach 1	3252.00	10 YR	950.00	6490.00	6492.96	2.96	6493.98	0.012061	125.36	49.79
Reach 1	3252.00	5 YR	475.00	6490.00	6491.98	1.98	6492.60	0.012138	79.12	44.90
Reach 1	3102.00	FIS	1920.00	6488.20	6492.65	4.44	6494.29	0.011658	204.93	57.22
Reach 1	3102.00	100 YR	1720.00	6488.20	6492.38	4.18	6493.91	0.011639	190.02	55.90
Reach 1	3102.00	10 YR	950.00	6488.20	6491.17	2.97	6492.18	0.011841	126.13	49.86
Reach 1	3102.00	5 YR	475.00	6488.20	6490.20	2.00	6490.80	0.011734	80.00	45.00
Reach 1	2952.00	FIS	1920.00	6486.40	6490.77	4.37	6492.48	0.012382	200.70	56.85
Reach 1	2952.00	100 YR	1720.00	6486.40	6490.51	4.10	6492.10	0.012422	185.80	55.52
Reach 1	2952.00	10 YR	950.00	6486.40	6489.35	2.95	6490.38	0.012209	124.85	49.73
Reach 1	2952.00	5 YR	475.00	6486.40	6488.37	1.97	6488.99	0.012390	78.60	44.84
Reach 1	2802.00	FIS	1920.00	6484.60	6489.14	4.54	6490.71	0.010777	210.60	57.71
Reach 1	2802.00	100 YR	1720.00	6484.60	6488.88	4.28	6490.32	0.010706	195.58	56.40
Reach 1	2802.00	10 YR	950.00	6484.60	6487.61	3.01	6488.59	0.011369	127.87	50.04
Reach 1	2802.00	5 YR	475.00	6484.60	6486.62	2.02	6487.21	0.011319	80.95	45.10
Reach 1	2788.00	FIS	1920.00	6484.43	6488.67	4.24	6490.51	0.013835	193.14	56.18
Reach 1	2788.00	100 YR	1720.00	6484.43	6488.39	3.95	6490.12	0.014185	177.51	54.77
Reach 1	2788.00	10 YR	950.00	6484.43	6487.15	2.71	6488.38	0.016291	113.37	48.57
Reach 1	2788.00	5 YR	475.00	6484.43	6486.17	1.74	6486.99	0.019129	68.27	43.68
Reach 1	2777.10	FIS	1920.00	6483.80	6488.15	4.35	6490.31	0.018009	176.89	54.26
Reach 1	2777.10	100 YR	1720.00	6483.80	6487.88	4.08	6489.92	0.018576	162.29	52.90
Reach 1	2777.10	10 YR	950.00	6483.80	6486.71	2.91	6488.17	0.021380	103.76	47.04
Reach 1	2777.10	5 YR	475.00	6483.80	6485.81	2.01	6486.74	0.023857	63.62	42.56
Reach 1	2777.00	FIS	1920.00	6481.30	6485.50	4.20	6490.07	0.037003	128.09	41.00
Reach 1	2777.00	100 YR	1720.00	6481.30	6485.17	3.87	6489.67	0.040235	114.77	39.34
Reach 1	2777.00	10 YR	950.00	6481.30	6483.74	2.44	6487.88	0.084855	63.78	32.21
Reach 1	2777.00	5 YR	475.00	6481.30	6482.68	1.38	6486.45	0.121919	32.27	26.88
Reach 1	2742.00	FIS	1920.00	6480.88	6483.67	2.79	6488.42	0.060116	117.28	48.97
Reach 1	2742.00	100 YR	1720.00	6480.88	6483.48	2.60	6487.94	0.061799	108.00	48.01
Reach 1	2742.00	10 YR	950.00	6480.88	6482.83	1.94	6485.39	0.051692	77.52	44.72
Reach 1	2742.00	5 YR	475.00	6480.88	6482.31	1.43	6483.55	0.036729	55.35	42.17
Reach 1	2602.00	FIS	1920.00	6479.20	6483.56	4.36	6485.28	0.012461	200.25	56.81
Reach 1	2602.00	100 YR	1720.00	6479.20	6483.30	4.09	6484.90	0.012533	185.23	55.47
Reach 1	2602.00	10 YR	950.00	6479.20	6482.12	2.92	6483.17	0.012681	123.27	49.58
Reach 1	2602.00	5 YR	475.00	6479.20	6481.16	1.96	6481.79	0.012669	78.03	44.78
Reach 1	2452.00	FIS	1920.00	6477.40	6481.97	4.57	6483.51	0.010544	212.21	57.85
Reach 1	2452.00	100 YR	1720.00	6477.40	6481.72	4.31	6483.13	0.010398	197.57	56.57
Reach 1	2452.00	10 YR	950.00	6477.40	6480.48	3.08	6481.42	0.010415	131.69	50.42
Reach 1	2452.00	5 YR	475.00	6477.40	6479.45	2.05	6480.02	0.010824	82.14	45.24
Reach 1	2302.00	FIS	1920.00	6475.60	6479.84	4.24	6481.68	0.013835	193.14	56.18
Reach 1	2302.00	100 YR	1720.00	6475.60	6479.56	3.95	6481.29	0.014185	177.51	54.77
Reach 1	2302.00	10 YR	950.00	6475.60	6478.40	2.80	6479.56	0.014619	117.54	48.99
Reach 1	2302.00	5 YR	475.00	6475.60	6477.50	1.90	6478.18	0.013982	75.56	44.50

HEC-RAS Plan: EFSCST-WSE River: East Fork Sand C Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Max Chl Dpth (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Flow Area (sq ft)	Top Width (ft)
Reach 1	2152.00	FIS	1920.00	6473.80	6478.50	4.69	6479.71	0.008364	239.56	60.00
Reach 1	2152.00	100 YR	1720.00	6473.80	6478.20	4.40	6479.33	0.008484	221.87	60.00
Reach 1	2152.00	10 YR	950.00	6473.80	6476.89	3.08	6477.71	0.009506	143.27	57.88
Reach 1	2152.00	5 YR	475.00	6473.80	6475.87	2.07	6476.38	0.009858	88.14	50.33
Reach 1	2002.00	FIS	1920.00	6472.17	6476.77	4.60	6478.29	0.010290	214.02	58.01
Reach 1	2002.00	100 YR	1720.00	6472.17	6476.49	4.31	6477.90	0.010398	197.57	56.57
Reach 1	2002.00	10 YR	950.00	6472.17	6475.22	3.05	6476.18	0.010781	130.17	50.27
Reach 1	2002.00	5 YR	475.00	6472.17	6474.19	2.01	6474.78	0.011443	80.66	45.07
Reach 1	1988.00	FIS	1920.00	6472.00	6476.66	4.66	6478.14	0.009811	217.60	58.32
Reach 1	1988.00	100 YR	1720.00	6472.00	6476.37	4.37	6477.75	0.009921	200.81	56.86
Reach 1	1988.00	10 YR	950.00	6472.00	6475.09	3.09	6476.02	0.010328	132.06	50.45
Reach 1	1988.00	5 YR	475.00	6472.00	6474.04	2.04	6474.62	0.010913	81.92	45.21
Reach 1	1977.10	FIS	1920.00	6471.50	6476.14	4.64	6477.98	0.014053	192.70	55.70
Reach 1	1977.10	100 YR	1720.00	6471.50	6475.85	4.34	6477.59	0.014541	176.52	54.22
Reach 1	1977.10	10 YR	950.00	6471.50	6474.60	3.09	6475.84	0.016703	112.65	47.97
Reach 1	1977.10	5 YR	475.00	6471.50	6473.60	2.10	6474.44	0.019952	67.40	43.00
Reach 1	1977.00	FIS	1920.00	6469.00	6473.23	4.23	6477.71	0.035954	129.43	41.16
Reach 1	1977.00	100 YR	1720.00	6469.00	6472.90	3.90	6477.31	0.039133	115.92	39.49
Reach 1	1977.00	10 YR	950.00	6469.00	6471.46	2.46	6475.55	0.063711	64.17	32.28
Reach 1	1977.00	5 YR	475.00	6469.00	6470.38	1.38	6474.14	0.120873	32.36	26.90
Reach 1	1942.00	FIS	1920.00	6468.58	6471.38	2.80	6476.09	0.059424	117.73	49.01
Reach 1	1942.00	100 YR	1720.00	6468.58	6471.19	2.61	6475.62	0.061276	108.30	48.04
Reach 1	1942.00	10 YR	950.00	6468.58	6470.53	1.95	6473.09	0.051514	77.61	44.73
Reach 1	1942.00	5 YR	475.00	6468.58	6470.02	1.44	6471.24	0.036601	55.42	42.18
Reach 1	1902.00	FIS	1920.00	6468.10	6472.47	4.37	6474.18	0.012416	200.50	56.83
Reach 1	1902.00	100 YR	1720.00	6468.10	6472.21	4.11	6473.80	0.012401	185.91	55.53
Reach 1	1902.00	10 YR	950.00	6468.10	6471.03	2.93	6472.08	0.012431	124.09	49.66
Reach 1	1902.00	5 YR	475.00	6468.10	6470.06	1.96	6470.69	0.012669	78.03	44.78
Reach 1	1752.00	FIS	1920.00	6466.30	6470.85	4.55	6472.41	0.010703	211.11	57.76
Reach 1	1752.00	100 YR	1720.00	6466.30	6470.57	4.27	6472.02	0.010802	194.98	56.35
Reach 1	1752.00	10 YR	950.00	6466.30	6469.34	3.04	6470.30	0.011002	129.29	50.18
Reach 1	1752.00	5 YR	475.00	6466.30	6468.35	2.05	6468.92	0.010824	82.14	45.24
Reach 1	1602.00	FIS	1920.00	6464.50	6468.76	4.26	6470.58	0.013599	194.29	56.28
Reach 1	1602.00	100 YR	1720.00	6464.50	6468.51	4.01	6470.19	0.013544	180.35	55.03
Reach 1	1602.00	10 YR	950.00	6464.50	6467.36	2.86	6468.46	0.013509	120.69	49.31
Reach 1	1602.00	5 YR	475.00	6464.50	6466.40	1.90	6467.08	0.013982	75.56	44.50
Reach 1	1553.66	FIS	1920.00	6463.92	6468.89	4.97	6469.91	0.006168	260.76	64.87
Reach 1	1553.66	100 YR	1720.00	6463.92	6468.60	4.68	6469.54	0.006135	242.12	63.41
Reach 1	1553.66	10 YR	950.00	6463.92	6467.30	3.38	6467.90	0.005935	163.56	56.88
Reach 1	1553.66	5 YR	475.00	6463.92	6466.22	2.30	6466.57	0.005619	105.32	51.51
Reach 1	1471.00	FIS	1920.00	6463.50	6467.93	4.43	6469.26	0.009323	226.15	62.14
Reach 1	1471.00	100 YR	1720.00	6463.50	6467.67	4.17	6468.89	0.009253	210.30	60.85
Reach 1	1471.00	10 YR	950.00	6463.50	6466.51	3.01	6467.29	0.008879	142.98	55.04
Reach 1	1471.00	5 YR	475.00	6463.50	6465.56	2.06	6466.00	0.008202	93.13	50.31
Reach 1	1461.00	FIS	1920.00	6463.45	6467.86	4.41	6469.13	0.014007	225.09	62.06
Reach 1	1461.00	100 YR	1720.00	6463.45	6467.59	4.14	6468.77	0.014123	208.40	60.70
Reach 1	1461.00	10 YR	950.00	6463.45	6466.38	2.93	6467.17	0.014684	138.62	54.65
Reach 1	1461.00	5 YR	475.00	6463.45	6465.42	1.97	6465.89	0.014650	88.46	49.85
Reach 1	1450.10	FIS	1920.00	6462.90	6467.19	4.29	6468.89	0.022570	192.46	58.95
Reach 1	1450.10	100 YR	1720.00	6462.90	6466.93	4.03	6468.53	0.023107	177.40	57.65
Reach 1	1450.10	10 YR	950.00	6462.90	6465.79	2.89	6466.93	0.026490	114.68	51.93
Reach 1	1450.10	5 YR	475.00	6462.90	6464.88	1.98	6465.64	0.031493	69.49	47.38
Reach 1	1450.00	FIS	1920.00	6460.40	6463.90	3.50	6468.59	0.072649	117.96	42.48
Reach 1	1450.00	100 YR	1720.00	6460.40	6463.62	3.22	6468.22	0.079001	106.27	41.08

EXIST

PROP

HEC-RAS Plan: EFSCST-WSE River: East Fork Sand C Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	E.G. Elev	E.G. Slope	Flow Area	Top Width
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(sq ft)	(ft)
Reach 1	1450.00	10 YR	950.00	6460.40	6462.41	2.01	6466.62	0.130087	60.27	35.04
Reach 1	1450.00	5 YR	475.00	6460.40	6461.52	1.12	6465.33	0.248009	31.17	30.61
Reach 1	1415.00	FIS	1920.00	6460.22	6465.37	5.15	6466.25	0.007994	272.43	65.76
Reach 1	1415.00	100 YR	1720.00	6460.22	6465.07	4.84	6465.88	0.008016	252.47	64.22
Reach 1	1415.00	10 YR	950.00	6460.22	6463.69	3.47	6464.23	0.008089	168.80	57.34
Reach 1	1415.00	5 YR	475.00	6460.22	6462.57	2.35	6462.89	0.007955	107.71	51.74
Reach 1	1405.00	FIS	1920.00	6460.17	6465.15	4.98	6466.16	0.006127	261.36	64.91
Reach 1	1405.00	100 YR	1720.00	6460.17	6464.87	4.70	6465.80	0.006076	242.93	63.48
Reach 1	1405.00	10 YR	950.00	6460.17	6463.56	3.39	6464.15	0.005873	164.14	56.93
Reach 1	1405.00	5 YR	475.00	6460.17	6462.48	2.31	6462.83	0.005554	105.72	51.55
Reach 1	1321.00	FIS	1920.00	6459.75	6464.18	4.43	6465.51	0.009323	226.15	62.14
Reach 1	1321.00	100 YR	1720.00	6459.75	6463.92	4.17	6465.14	0.009253	210.30	60.85
Reach 1	1321.00	10 YR	950.00	6459.75	6462.76	3.01	6463.54	0.008879	142.98	55.04
Reach 1	1321.00	5 YR	475.00	6459.75	6461.81	2.06	6462.25	0.008202	93.13	50.31
Reach 1	1311.00	FIS	1920.00	6459.70	6464.11	4.41	6465.38	0.014007	225.09	62.06
Reach 1	1311.00	100 YR	1720.00	6459.70	6463.84	4.14	6465.02	0.014123	208.40	60.70
Reach 1	1311.00	10 YR	950.00	6459.70	6462.63	2.93	6463.42	0.014684	138.62	54.65
Reach 1	1311.00	5 YR	475.00	6459.70	6461.67	1.97	6462.14	0.014650	88.46	49.85
Reach 1	1300.10	FIS	1920.00	6459.15	6463.44	4.29	6465.14	0.022570	192.46	58.95
Reach 1	1300.10	100 YR	1720.00	6459.15	6463.18	4.03	6464.78	0.023107	177.40	57.65
Reach 1	1300.10	10 YR	950.00	6459.15	6462.04	2.89	6463.18	0.026490	114.68	51.93
Reach 1	1300.10	5 YR	475.00	6459.15	6461.13	1.98	6461.89	0.031493	69.49	47.38
Reach 1	1300.00	FIS	1920.00	6456.65	6460.15	3.50	6464.84	0.072649	117.96	42.48
Reach 1	1300.00	100 YR	1720.00	6456.65	6459.87	3.22	6464.47	0.079001	106.27	41.08
Reach 1	1300.00	10 YR	950.00	6456.65	6458.66	2.01	6462.87	0.130087	60.27	35.04
Reach 1	1300.00	5 YR	475.00	6456.65	6457.77	1.12	6461.58	0.248009	31.17	30.61
Reach 1	1265.00	FIS	1920.00	6456.47	6461.62	5.15	6462.50	0.007994	272.43	65.76
Reach 1	1265.00	100 YR	1720.00	6456.47	6461.32	4.84	6462.13	0.008016	252.47	64.22
Reach 1	1265.00	10 YR	950.00	6456.47	6459.94	3.47	6460.48	0.008089	168.80	57.34
Reach 1	1265.00	5 YR	475.00	6456.47	6458.82	2.35	6459.14	0.007955	107.71	51.74
Reach 1	1255.00	FIS	1920.00	6456.42	6461.40	4.98	6462.41	0.006127	261.36	64.91
Reach 1	1255.00	100 YR	1720.00	6456.42	6461.12	4.70	6462.05	0.006076	242.93	63.48
Reach 1	1255.00	10 YR	950.00	6456.42	6459.81	3.39	6460.40	0.005873	164.14	56.93
Reach 1	1255.00	5 YR	475.00	6456.42	6458.73	2.31	6459.08	0.005554	105.72	51.55
Reach 1	1171.00	FIS	1920.00	6456.00	6460.43	4.43	6461.76	0.009323	226.15	62.14
Reach 1	1171.00	100 YR	1720.00	6456.00	6460.17	4.17	6461.39	0.009253	210.30	60.85
Reach 1	1171.00	10 YR	950.00	6456.00	6459.01	3.01	6459.79	0.008879	142.98	55.04
Reach 1	1171.00	5 YR	475.00	6456.00	6458.06	2.06	6458.50	0.008202	93.13	50.31
Reach 1	1161.00	FIS	1920.00	6455.95	6460.36	4.41	6461.63	0.014007	225.09	62.06
Reach 1	1161.00	100 YR	1720.00	6455.95	6460.09	4.14	6461.27	0.014123	208.40	60.70
Reach 1	1161.00	10 YR	950.00	6455.95	6458.88	2.93	6459.67	0.014684	138.62	54.65
Reach 1	1161.00	5 YR	475.00	6455.95	6457.92	1.97	6458.39	0.014650	88.46	49.85
Reach 1	1150.10	FIS	1920.00	6455.40	6459.69	4.29	6461.39	0.022570	192.46	58.95
Reach 1	1150.10	100 YR	1720.00	6455.40	6459.43	4.03	6461.03	0.023107	177.40	57.65
Reach 1	1150.10	10 YR	950.00	6455.40	6458.29	2.89	6459.43	0.026490	114.68	51.93
Reach 1	1150.10	5 YR	475.00	6455.40	6457.38	1.98	6458.14	0.031493	69.49	47.38
Reach 1	1150.00	FIS	1920.00	6452.90	6456.40	3.50	6461.09	0.072649	117.96	42.48
Reach 1	1150.00	100 YR	1720.00	6452.90	6456.12	3.22	6460.72	0.079001	106.27	41.08
Reach 1	1150.00	10 YR	950.00	6452.90	6454.91	2.01	6459.12	0.130087	60.27	35.04
Reach 1	1150.00	5 YR	475.00	6452.90	6454.02	1.12	6457.83	0.248009	31.17	30.61
Reach 1	1115.00	FIS	1920.00	6452.72	6457.87	5.15	6458.75	0.007991	272.46	65.76
Reach 1	1115.00	100 YR	1720.00	6452.72	6457.57	4.85	6458.38	0.008013	252.50	64.23
Reach 1	1115.00	10 YR	950.00	6452.72	6456.19	3.47	6456.73	0.008085	168.83	57.34
Reach 1	1115.00	5 YR	475.00	6452.72	6455.07	2.35	6455.39	0.007955	107.71	51.74

HEC-RAS Plan: EFSCST-WSE River: East Fork Sand C Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	E.G. Elev	E.G. Slope	Flow Area	Top Width
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(sq ft)	(ft)
Reach 1	1105.00	FIS	1920.00	6452.67	6457.65	4.98	6458.66	0.006122	261.42	64.92
Reach 1	1105.00	100 YR	1720.00	6452.67	6457.37	4.70	6458.30	0.006071	242.99	63.48
Reach 1	1105.00	10 YR	950.00	6452.67	6456.06	3.39	6456.65	0.005870	164.17	56.94
Reach 1	1105.00	5 YR	475.00	6452.67	6454.98	2.31	6455.33	0.005554	105.72	51.55
Reach 1	1021.00	FIS	1920.00	6452.25	6456.68	4.43	6458.01	0.009323	226.15	62.14
Reach 1	1021.00	100 YR	1720.00	6452.25	6456.42	4.17	6457.64	0.009253	210.30	60.85
Reach 1	1021.00	10 YR	950.00	6452.25	6455.26	3.01	6456.04	0.008879	142.98	55.04
Reach 1	1021.00	5 YR	475.00	6452.25	6454.31	2.06	6454.75	0.008202	93.13	50.31
Reach 1	1011.00	FIS	1920.00	6452.20	6456.61	4.41	6457.88	0.014007	225.09	62.06
Reach 1	1011.00	100 YR	1720.00	6452.20	6456.34	4.14	6457.52	0.014123	208.40	60.70
Reach 1	1011.00	10 YR	950.00	6452.20	6455.13	2.93	6455.92	0.014684	138.62	54.65
Reach 1	1011.00	5 YR	475.00	6452.20	6454.17	1.97	6454.64	0.014650	88.46	49.85
Reach 1	1000.10	FIS	1920.00	6451.65	6455.94	4.29	6457.64	0.022570	192.46	58.95
Reach 1	1000.10	100 YR	1720.00	6451.65	6455.68	4.03	6457.28	0.023107	177.40	57.65
Reach 1	1000.10	10 YR	950.00	6451.65	6454.54	2.89	6455.68	0.026490	114.68	51.93
Reach 1	1000.10	5 YR	475.00	6451.65	6453.63	1.98	6454.39	0.031493	69.49	47.38
Reach 1	1000.00	FIS	1920.00	6449.15	6452.65	3.50	6457.34	0.072649	117.96	42.48
Reach 1	1000.00	100 YR	1720.00	6449.15	6452.37	3.22	6456.97	0.079001	106.27	41.08
Reach 1	1000.00	10 YR	950.00	6449.15	6451.16	2.01	6455.37	0.130087	60.27	35.04
Reach 1	1000.00	5 YR	475.00	6449.15	6450.27	1.12	6454.08	0.248009	31.17	30.61
Reach 1	965.00	FIS	1920.00	6448.97	6454.36	5.39	6455.15	0.006764	288.50	66.97
Reach 1	965.00	100 YR	1720.00	6448.97	6454.04	5.07	6454.77	0.006812	266.89	65.34
Reach 1	965.00	10 YR	950.00	6448.97	6452.58	3.60	6453.07	0.007056	176.66	58.02
Reach 1	965.00	5 YR	475.00	6448.97	6451.38	2.41	6451.69	0.007244	111.03	52.06
Reach 1	955.00	FIS	1920.00	6448.92	6454.20	5.27	6455.08	0.004995	280.56	66.37
Reach 1	955.00	100 YR	1720.00	6448.92	6453.88	4.96	6454.70	0.004993	259.96	64.80
Reach 1	955.00	10 YR	950.00	6448.92	6452.47	3.55	6453.01	0.004992	173.35	57.74
Reach 1	955.00	5 YR	475.00	6448.92	6451.30	2.38	6451.63	0.004997	109.43	51.91
Reach 1	825.00	FIS	1920.00	6448.27	6453.55	5.28	6454.43	0.004990	280.65	66.38
Reach 1	825.00	100 YR	1720.00	6448.27	6453.23	4.96	6454.05	0.004988	260.06	64.81
Reach 1	825.00	10 YR	950.00	6448.27	6451.82	3.55	6452.36	0.004978	173.52	57.75
Reach 1	825.00	5 YR	475.00	6448.27	6450.66	2.38	6450.98	0.004972	109.61	51.92
Reach 1	700.00	FIS	1920.00	6447.65	6452.92	5.27	6453.80	0.005024	280.01	66.33
Reach 1	700.00	100 YR	1720.00	6447.65	6452.60	4.95	6453.42	0.005023	259.43	64.76
Reach 1	700.00	10 YR	950.00	6447.65	6451.19	3.54	6451.73	0.005009	173.16	57.72
Reach 1	700.00	5 YR	475.00	6447.65	6450.03	2.38	6450.36	0.005000	109.41	51.90
Reach 1	600.00	FIS	1920.00	6447.15	6452.41	5.26	6453.30	0.005050	279.49	66.29
Reach 1	600.00	100 YR	1720.00	6447.15	6452.09	4.94	6452.92	0.005053	258.89	64.72
Reach 1	600.00	10 YR	950.00	6447.15	6450.69	3.54	6451.23	0.005024	172.99	57.71
Reach 1	600.00	5 YR	475.00	6447.15	6449.53	2.38	6449.85	0.005004	109.38	51.90
Reach 1	450.00	FIS	1920.00	6446.40	6451.63	5.23	6452.53	0.005147	277.65	66.15
Reach 1	450.00	100 YR	1720.00	6446.40	6451.31	4.91	6452.15	0.005167	256.90	64.57
Reach 1	450.00	10 YR	950.00	6446.40	6449.93	3.53	6450.47	0.005100	172.11	57.63
Reach 1	450.00	5 YR	475.00	6446.40	6448.78	2.38	6449.10	0.005015	109.30	51.89
Reach 1	350.00	FIS	1920.00	6445.90	6451.08	5.18	6452.00	0.005316	274.55	65.92
Reach 1	350.00	100 YR	1720.00	6445.90	6450.77	4.87	6451.62	0.005337	254.04	64.35
Reach 1	350.00	10 YR	950.00	6445.90	6449.40	3.50	6449.95	0.005243	170.51	57.49
Reach 1	350.00	5 YR	475.00	6445.90	6448.27	2.37	6448.60	0.005047	109.08	51.87
Reach 1	200.00	FIS	1920.00	6445.15	6450.12	4.97	6451.14	0.006174	260.66	64.86
Reach 1	200.00	100 YR	1720.00	6445.15	6449.76	4.61	6450.73	0.006474	237.68	63.06
Reach 1	200.00	10 YR	950.00	6445.15	6448.33	3.18	6449.02	0.007283	152.74	55.92
Reach 1	200.00	5 YR	475.00	6445.15	6447.35	2.20	6447.74	0.006556	100.16	51.01
Reach 1	166.00	FIS	1920.00	6444.98	6449.84	4.86	6450.91	0.006687	253.57	64.31
Reach 1	166.00	100 YR	1720.00	6444.98	6449.45	4.47	6450.49	0.007255	228.55	62.33
Reach 1	166.00	10 YR	950.00	6444.98	6447.71	2.73	6448.67	0.012476	127.75	53.64

PROP

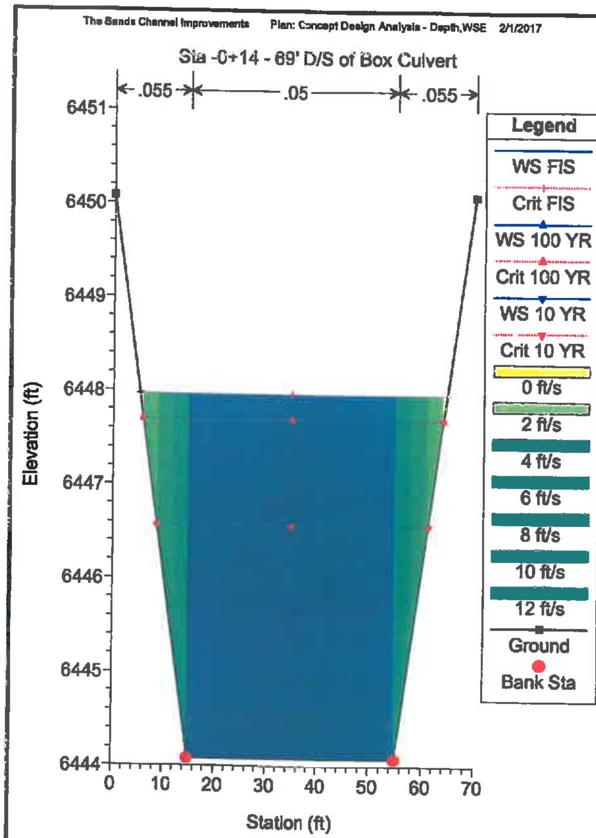
EXIST

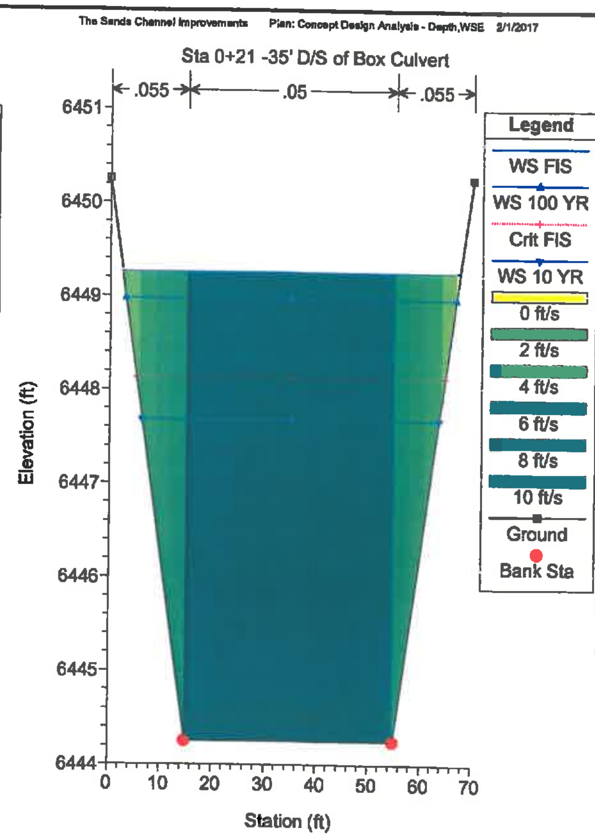
HEC-RAS Plan: EFSCST-WSE River: East Fork Sand C Reach: Reach 1 (Continued)

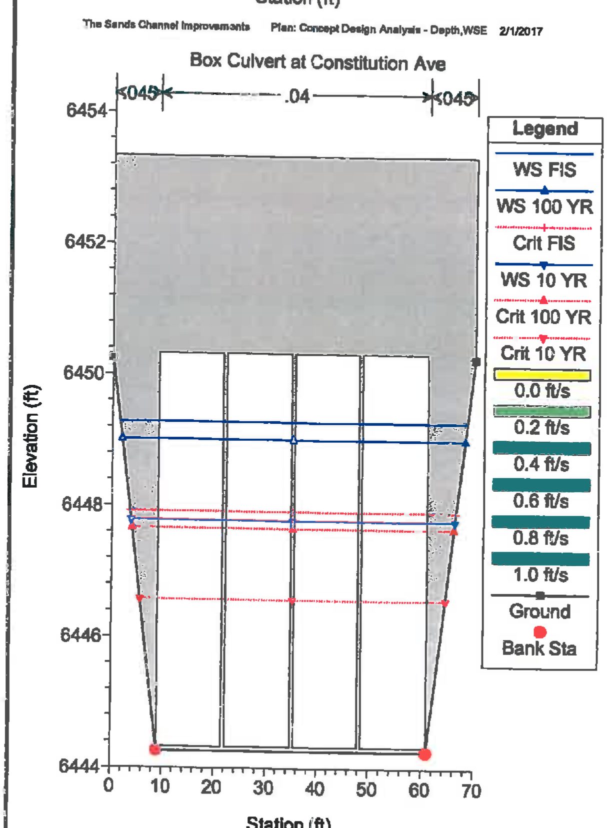
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	E.G. Elev	E.G. Slope	Flow Area	Top Width
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(sq ft)	(ft)
Reach 1	166.00	5 YR	475.00	6444.98	6446.58	1.60	6447.34	0.019601	70.38	48.00
Reach 1	150.00		Culvert							
Reach 1	21.00	FIS	1920.00	6444.26	6449.27	5.01	6450.20	0.008817	263.45	65.07
Reach 1	21.00	100 YR	1720.00	6444.26	6448.98	4.73	6449.84	0.008751	245.04	63.64
Reach 1	21.00	10 YR	950.00	6444.26	6447.69	3.43	6448.24	0.008374	166.87	57.17
Reach 1	21.00	5 YR	475.00	6444.26	6446.63	2.37	6446.94	0.007673	108.97	51.86
Reach 1	-14.00	FIS	1920.00	6444.08	6447.97	3.89	6449.66	0.021988	193.38	59.45
Reach 1	-14.00	100 YR	1720.00	6444.08	6447.70	3.62	6449.30	0.022688	177.79	58.12
Reach 1	-14.00	10 YR	950.00	6444.08	6446.57	2.49	6447.71	0.026034	114.96	52.44
Reach 1	-14.00	5 YR	475.00	6444.08	6445.67	1.59	6446.42	0.030765	69.82	47.94

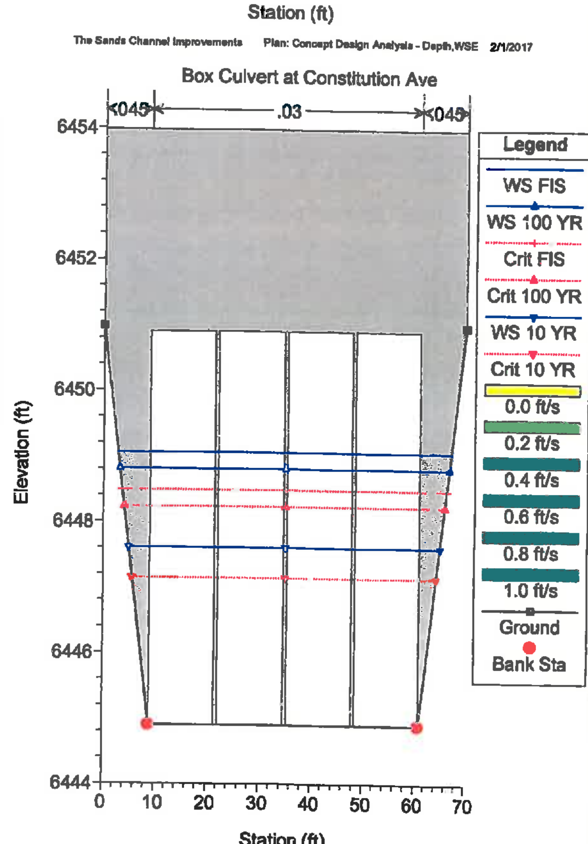
Plan: EFSCST-WSE East Fork Sand C Reach 1 RS: 150.00 Culv Group: Constitution Profile: 100 YR

Q Culv Group (cfs)	1720.00	Culv Full Len (ft)	
# Barrels	4	Culv Vel US (ft/s)	8.82
Q Barrel (cfs)	430.00	Culv Vel DS (ft/s)	7.35
E.G. US. (ft)	6450.49	Culv Inv El Up (ft)	6444.90
W.S. US. (ft)	6449.45	Culv Inv El Dn (ft)	6444.33
E.G. DS (ft)	6449.84	Culv Frctn Ls (ft)	0.00
W.S. DS (ft)	6448.98	Culv Exit Loss (ft)	0.00
Delta EG (ft)	0.65	Culv Entr Loss (ft)	0.48
Delta WS (ft)	0.46	Q Weir (cfs)	
E.G. IC (ft)	6450.24	Weir Sta Lft (ft)	
E.G. OC (ft)	6450.49	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	6448.80	Weir Max Depth (ft)	
Culv WS Outlet (ft)	6449.01	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	2.76	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	3.33	Min El Weir Flow (ft)	6453.99


The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta -0+14 - 69' D/S of Box Culvert
.055
.05
.055
Elevation (ft)
Station (ft)
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta

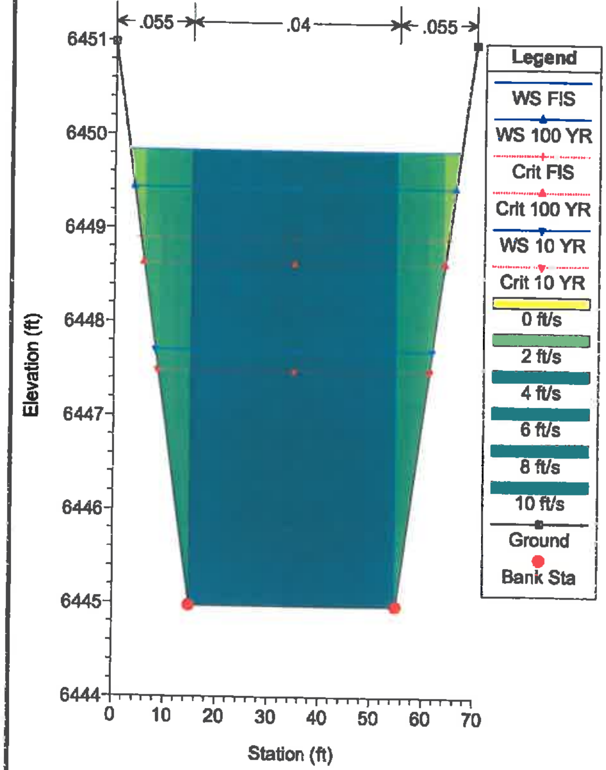

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 0+21 -35' D/S of Box Culvert
.055
.05
.055
Elevation (ft)
Station (ft)
Legend
WS FIS
WS 100 YR
Crit FIS
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta


The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Box Culvert at Constitution Ave
.045
.04
.045
Elevation (ft)
Station (ft)
Legend
WS FIS
WS 100 YR
Crit FIS
WS 10 YR
Crit 100 YR
Crit 10 YR
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta


The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Box Culvert at Constitution Ave
.045
.03
.045
Elevation (ft)
Station (ft)
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
Crit 10 YR
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

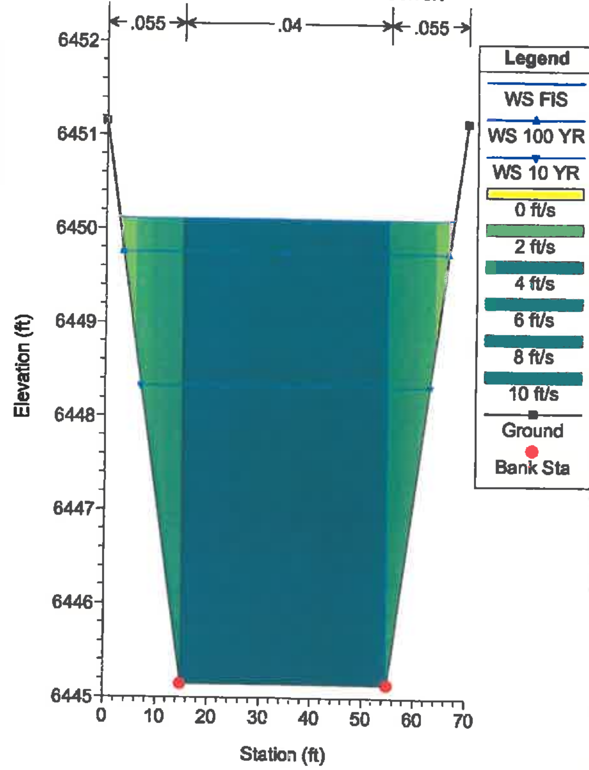
The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017

Sta 1+66 - 16' U/S of Box Culvert



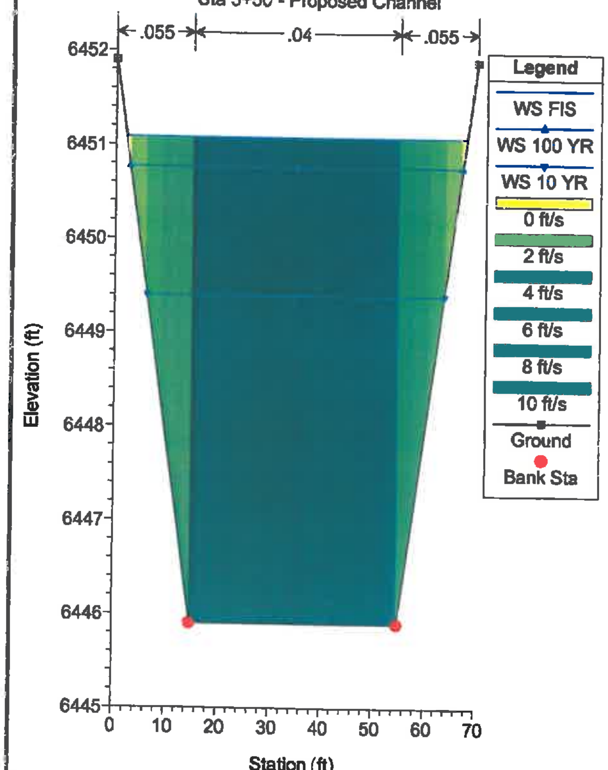
The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017

Sta 2+00 -50' U/S of Box Culvert



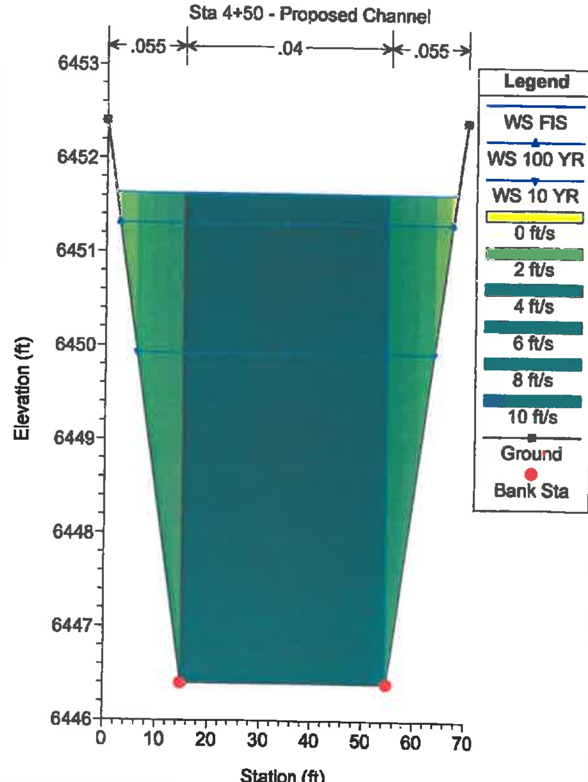
The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017

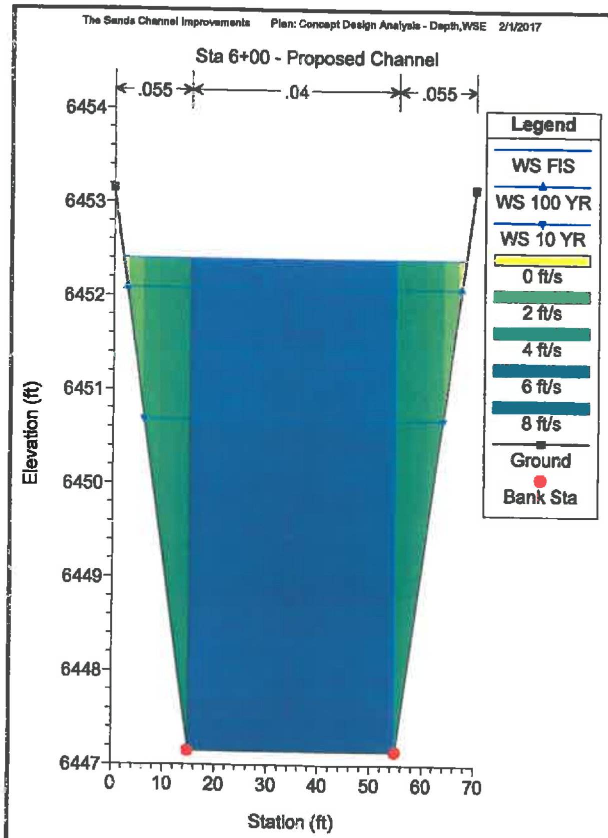
Sta 3+50 - Proposed Channel

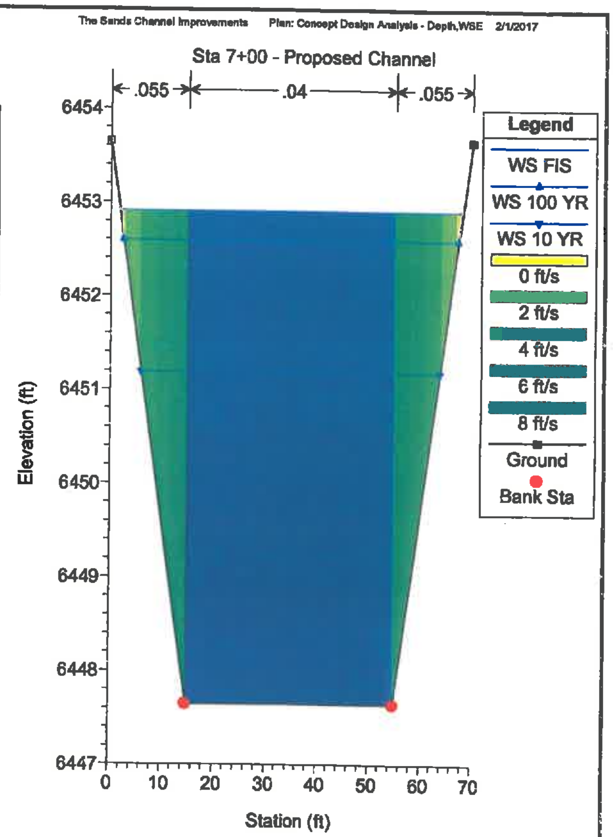


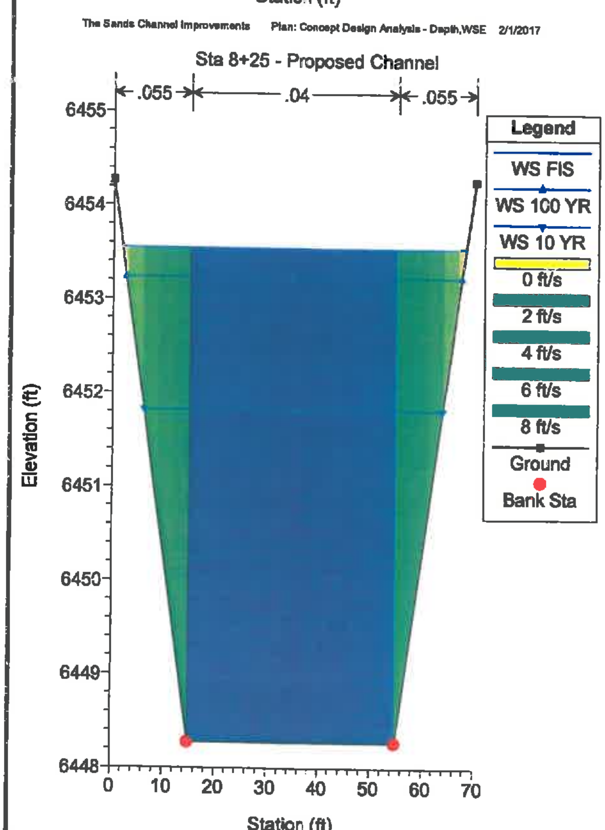
The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017

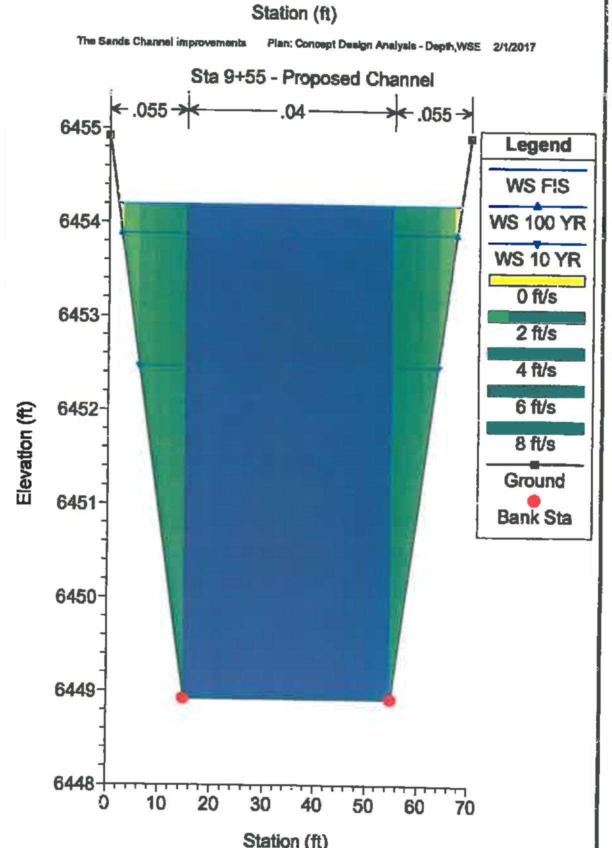
Sta 4+50 - Proposed Channel

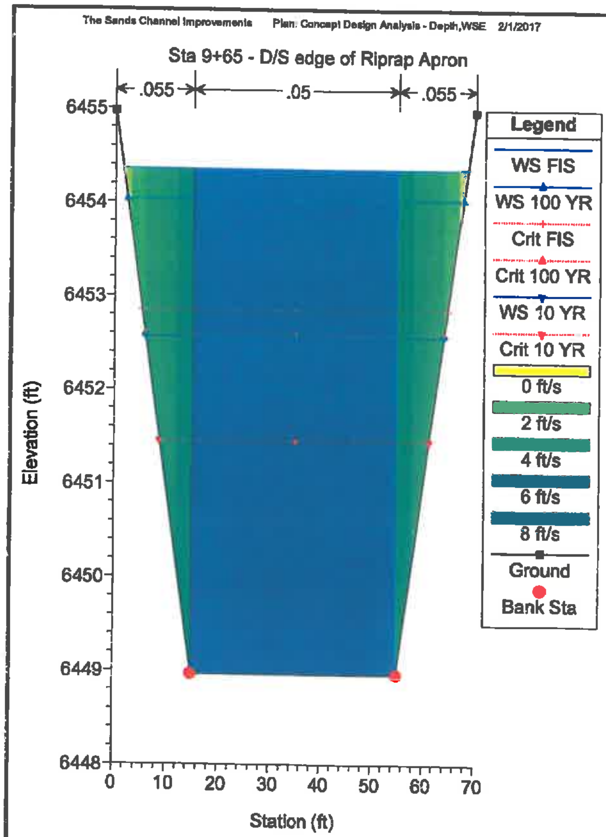


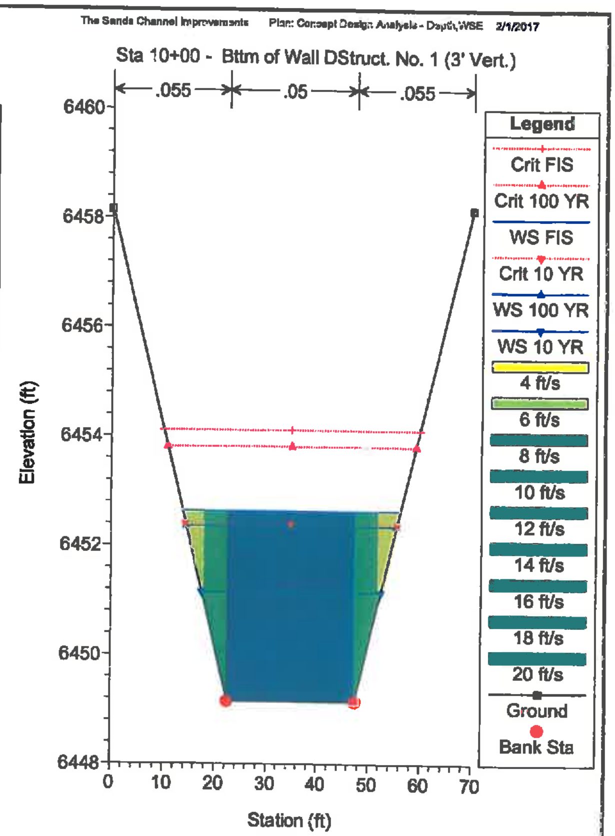

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 6+00 - Proposed Channel
.055
.04
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

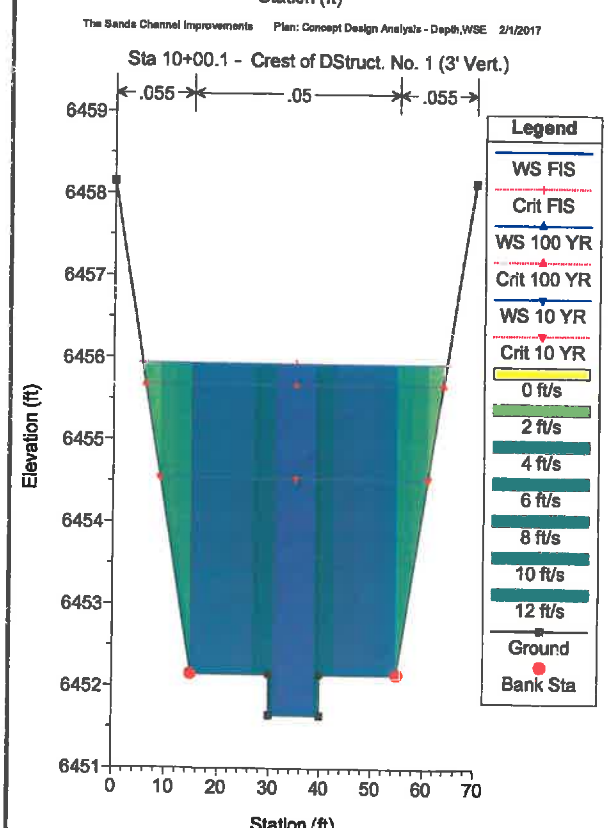

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 7+00 - Proposed Channel
.055
.04
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

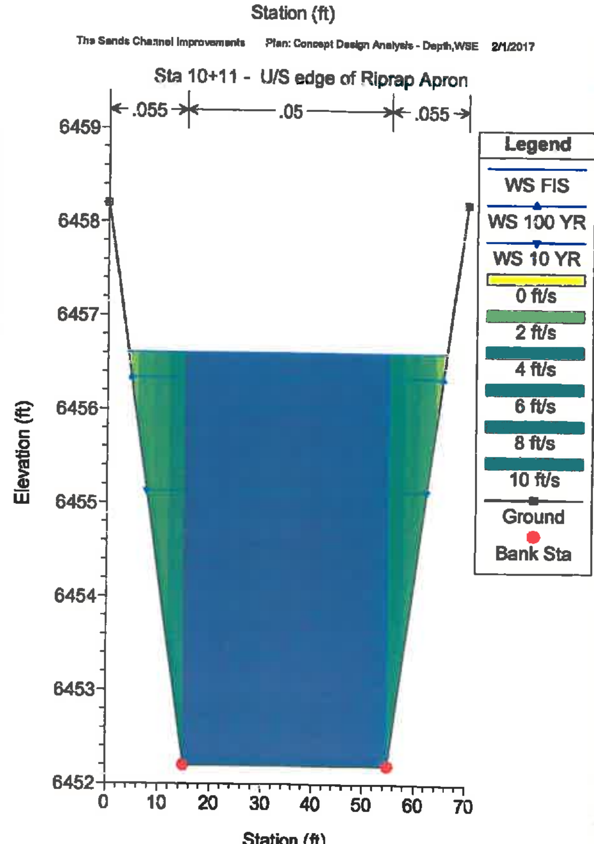

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 8+25 - Proposed Channel
.055
.04
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

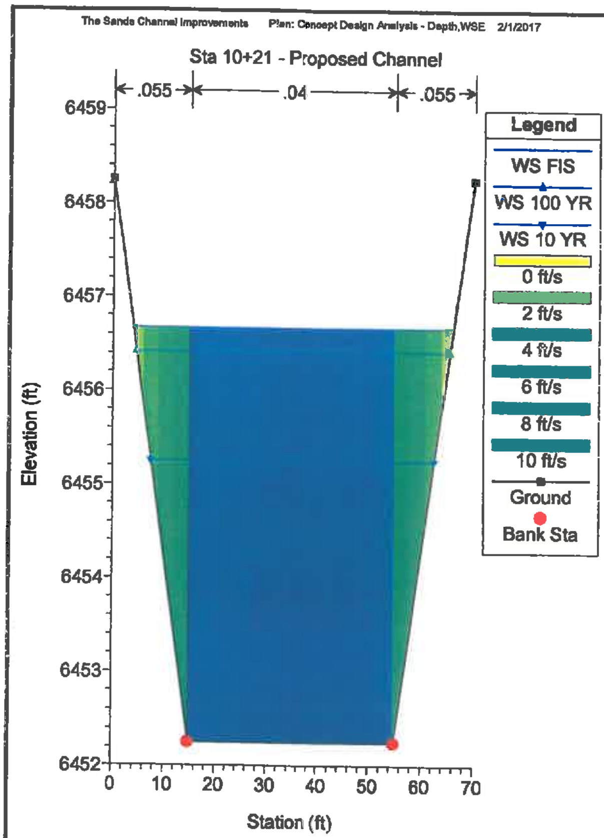

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 9+55 - Proposed Channel
.055
.04
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

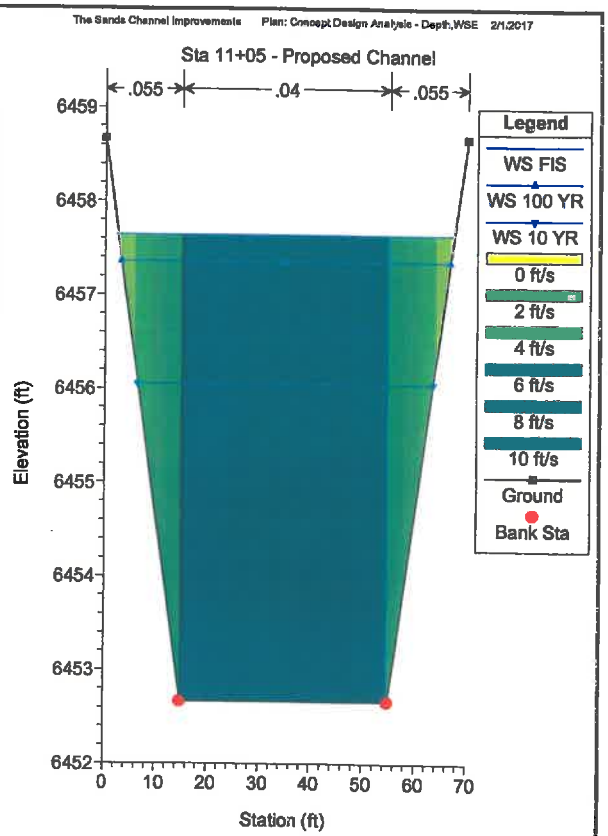

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 9+65 - D/S edge of Riprap Apron
.055
.05
.055
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
Ground
Bank Sta
Elevation (ft)
6455
6454
6453
6452
6451
6450
6449
6448
Station (ft)
0
10
20
30
40
50
60
70

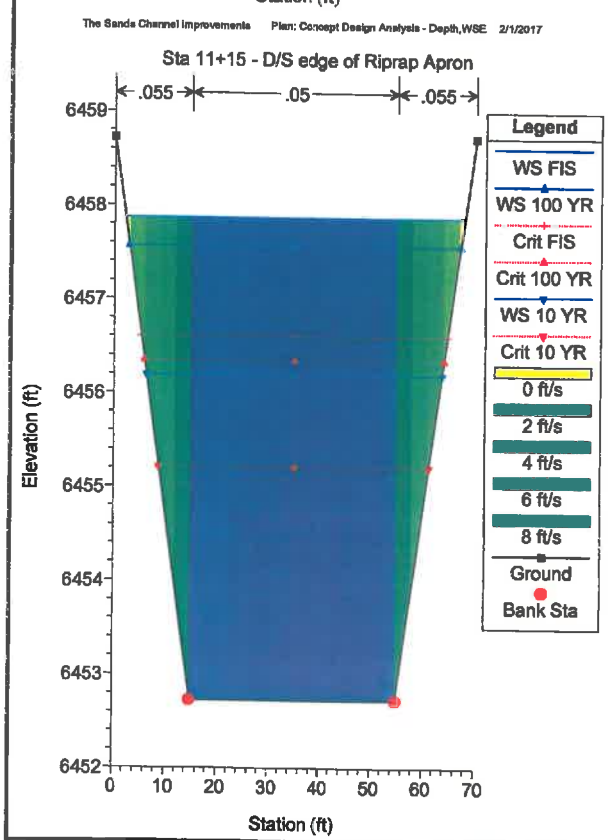

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 10+00 - Bttm of Wall DStruct. No. 1 (3' Vert.)
.055
.05
.055
Legend
Crit FIS
Crit 100 YR
WS FIS
Crit 10 YR
WS 100 YR
WS 10 YR
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
Ground
Bank Sta
Elevation (ft)
6460
6458
6456
6454
6452
6450
6448
Station (ft)
0
10
20
30
40
50
60
70

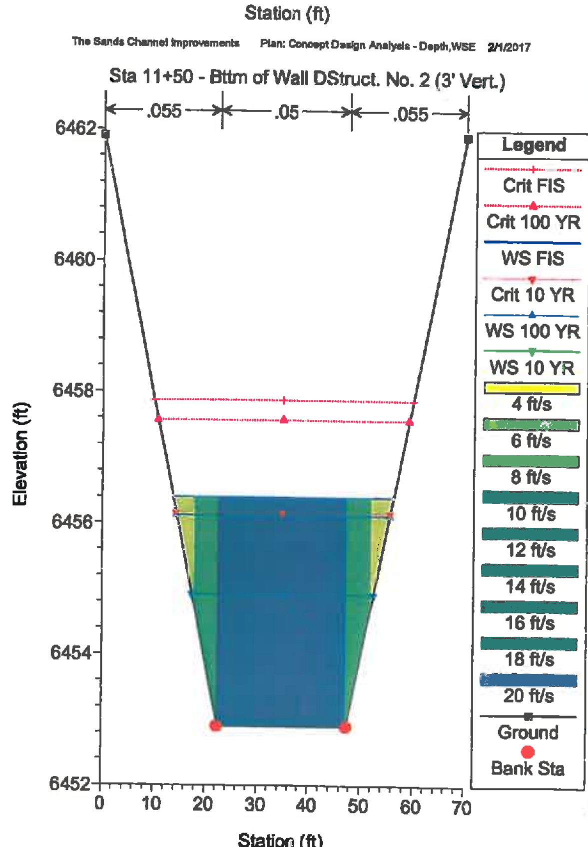

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 10+00.1 - Crest of DStruct. No. 1 (3' Vert.)
.055
.05
.055
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
6459
6458
6457
6456
6455
6454
6453
6452
6451
Station (ft)
0
10
20
30
40
50
60
70

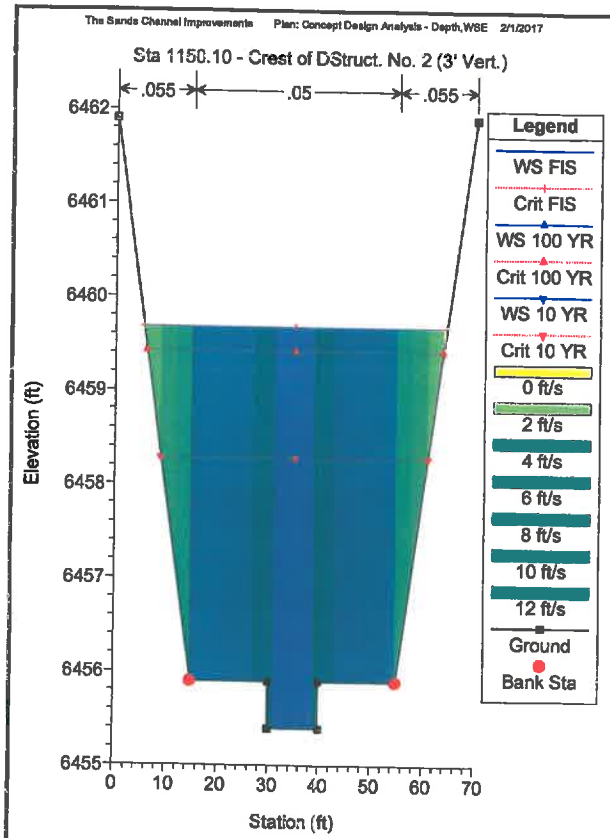

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 10+11 - U/S edge of Riprap Apron
.055
.05
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6459
6458
6457
6456
6455
6454
6453
6452
Station (ft)
0
10
20
30
40
50
60
70

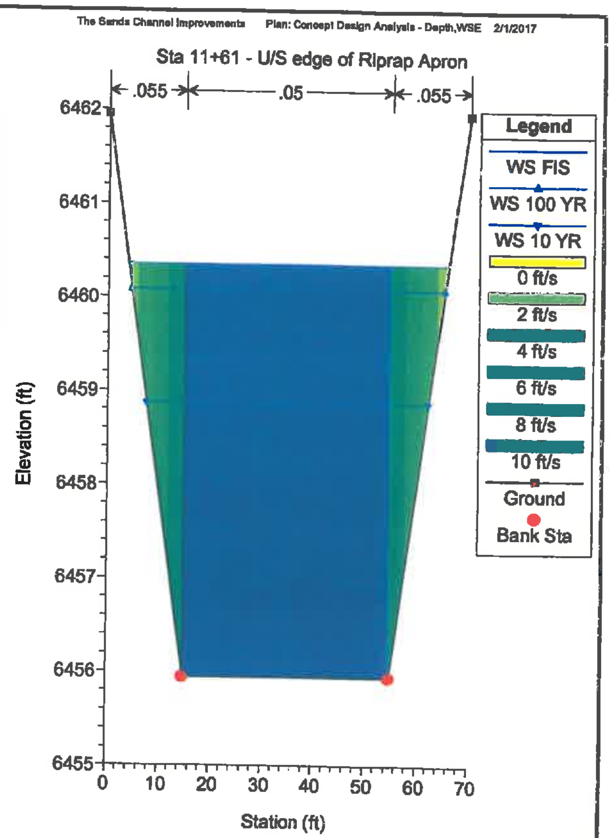

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 10+21 - Proposed Channel
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta

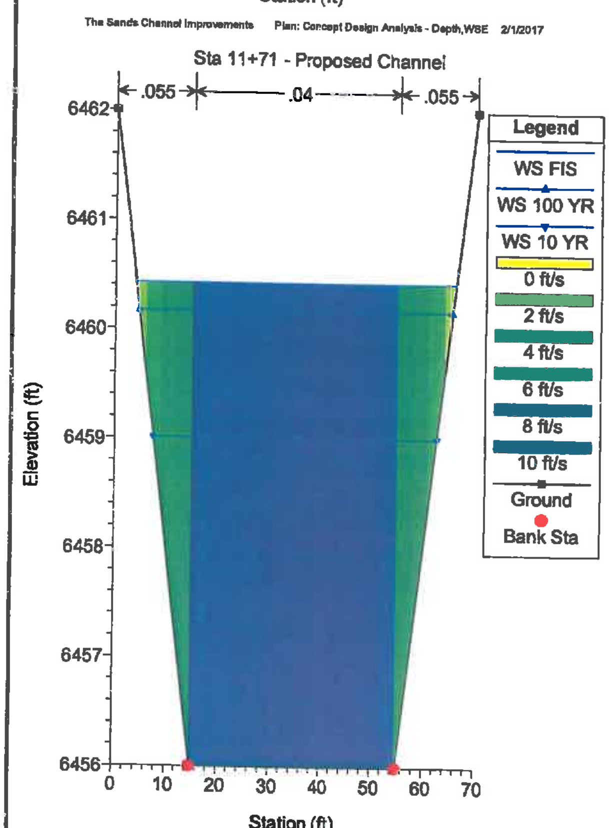

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 11+05 - Proposed Channel
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta

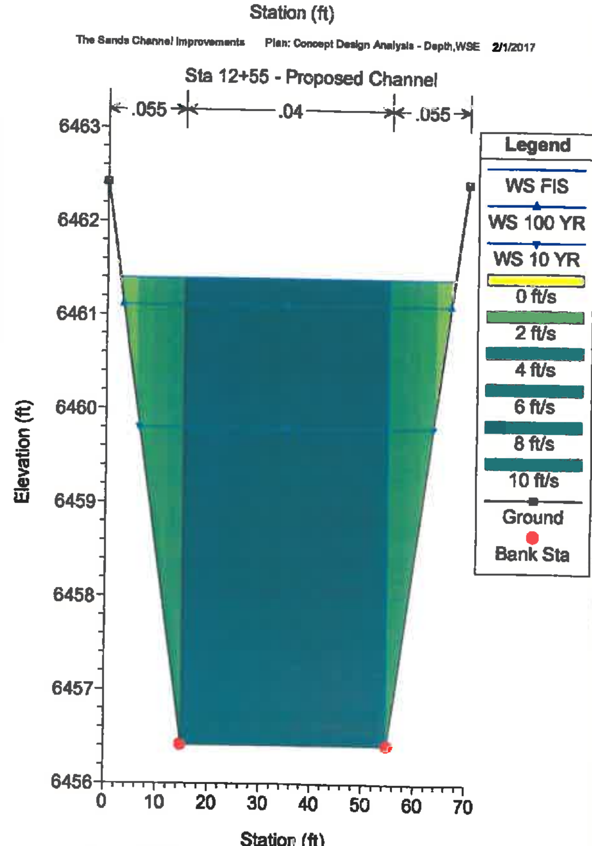

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 11+15 - D/S edge of Riprap Apron
.055
.05
.055
Elevation (ft)
Station (ft)
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
Ground
Bank Sta

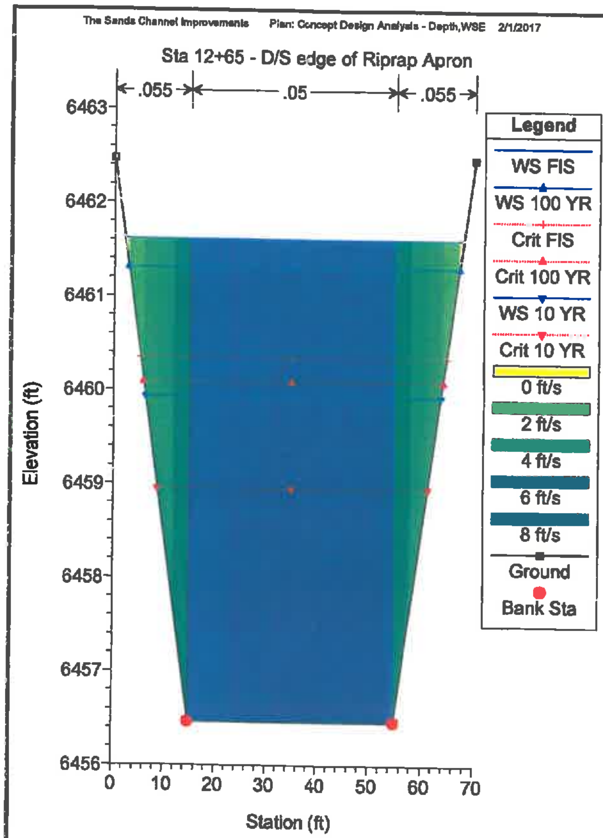

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 11+50 - Bttm of Wall DStruct. No. 2 (3' Vert.)
.055
.05
.055
Elevation (ft)
Station (ft)
Legend
Crit FIS
Crit 100 YR
WS FIS
Crit 10 YR
WS 100 YR
WS 10 YR
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
Ground
Bank Sta

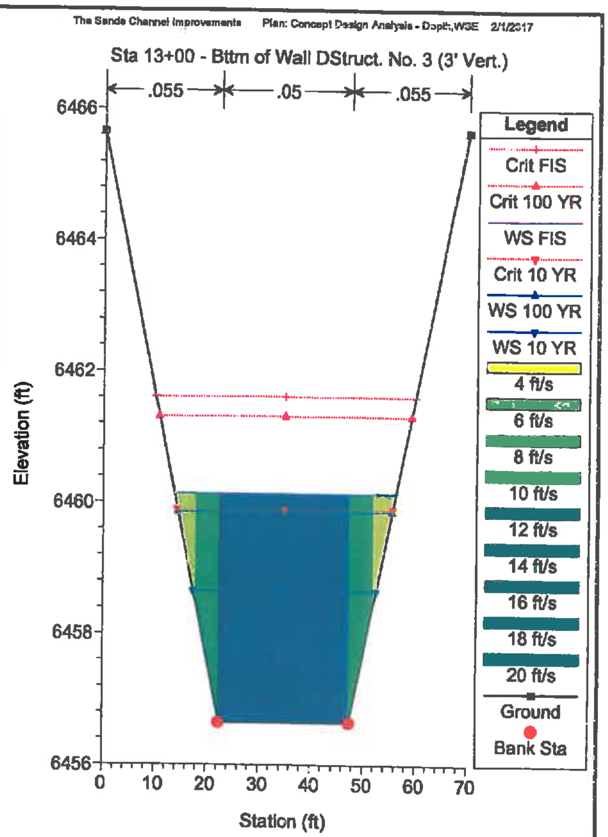

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 1150.10 - Crest of DStruct. No. 2 (3' Vert.)
.055
.05
.055
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
6462
6461
6460
6459
6458
6457
6456
6455
0 10 20 30 40 50 60 70
Station (ft)

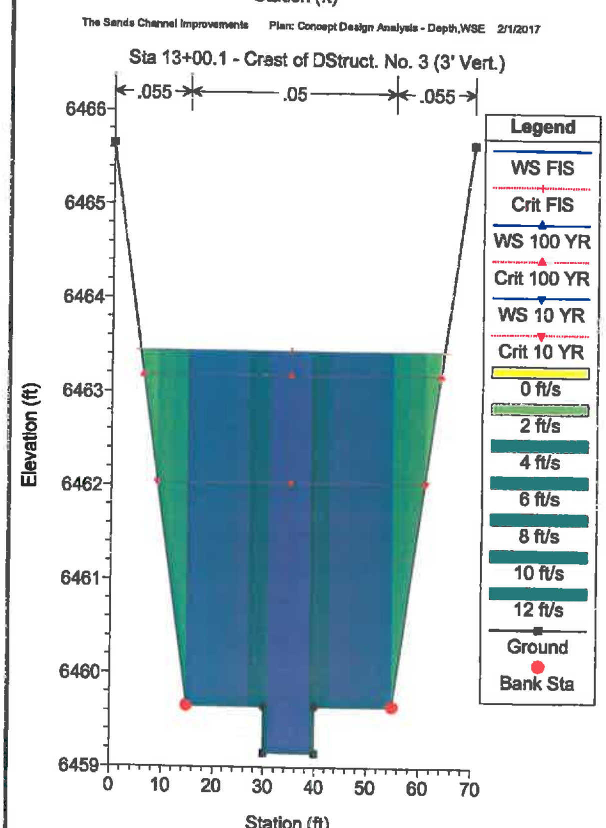

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 11+61 - U/S edge of Riprap Apron
.055
.05
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6462
6461
6460
6459
6458
6457
6456
6455
0 10 20 30 40 50 60 70
Station (ft)

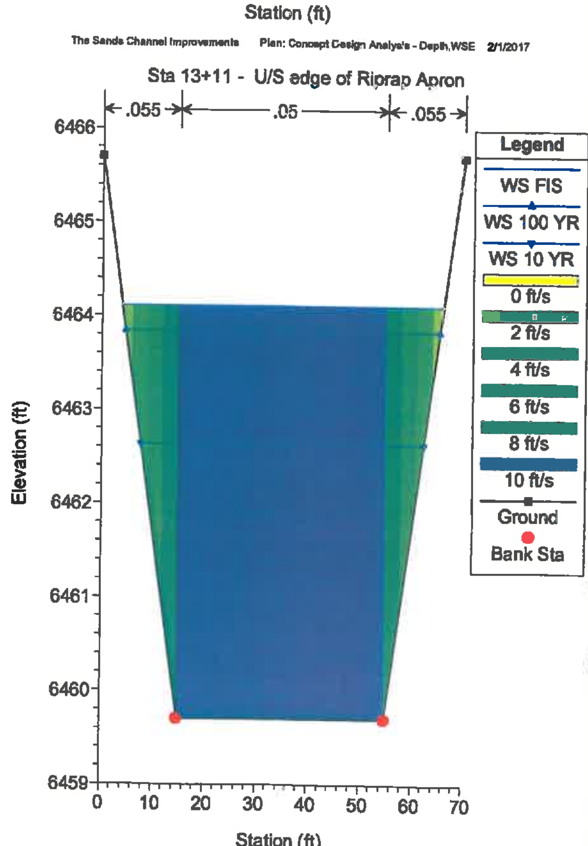

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 11+71 - Proposed Channel
.055
.04
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6462
6461
6460
6459
6458
6457
6456
0 10 20 30 40 50 60 70
Station (ft)

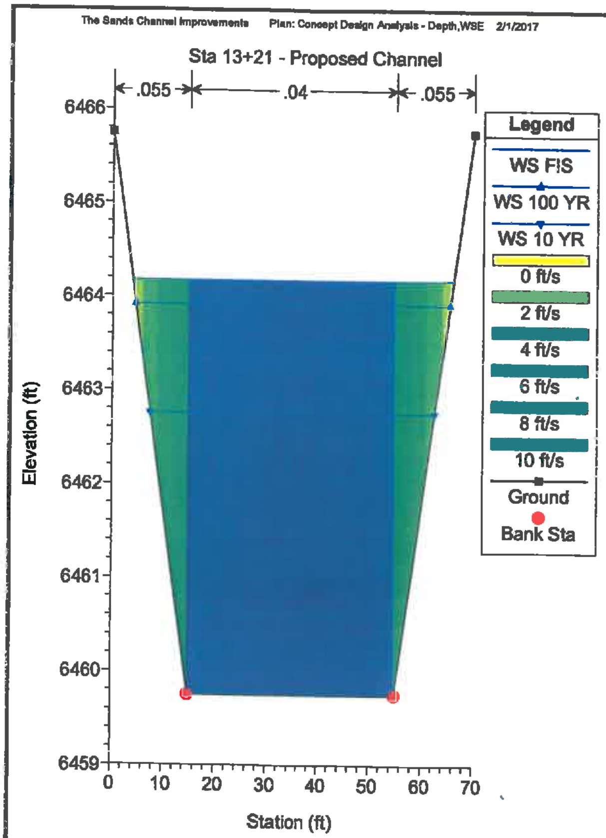

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 12+55 - Proposed Channel
.055
.04
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6463
6462
6461
6460
6459
6458
6457
6456
0 10 20 30 40 50 60 70
Station (ft)

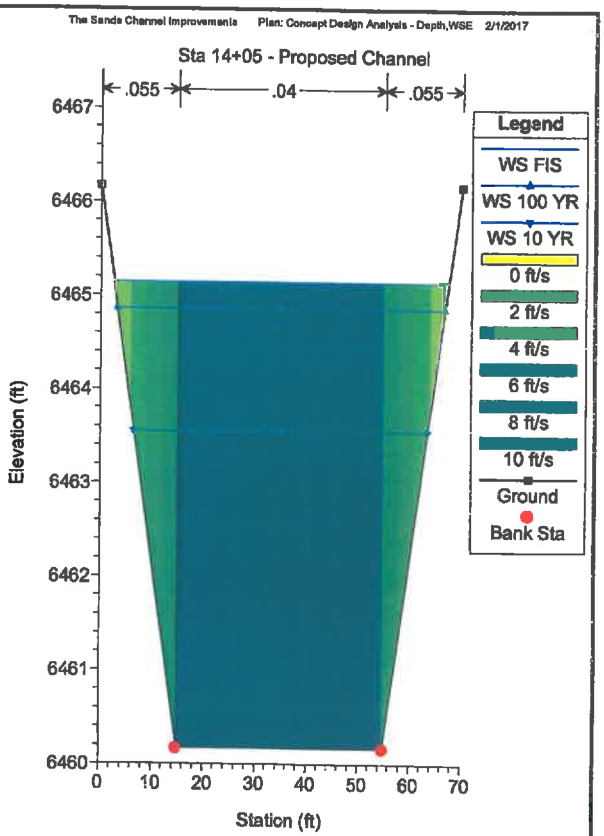

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 12+65 - D/S edge of Riprap Apron
.055
.05
.055
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

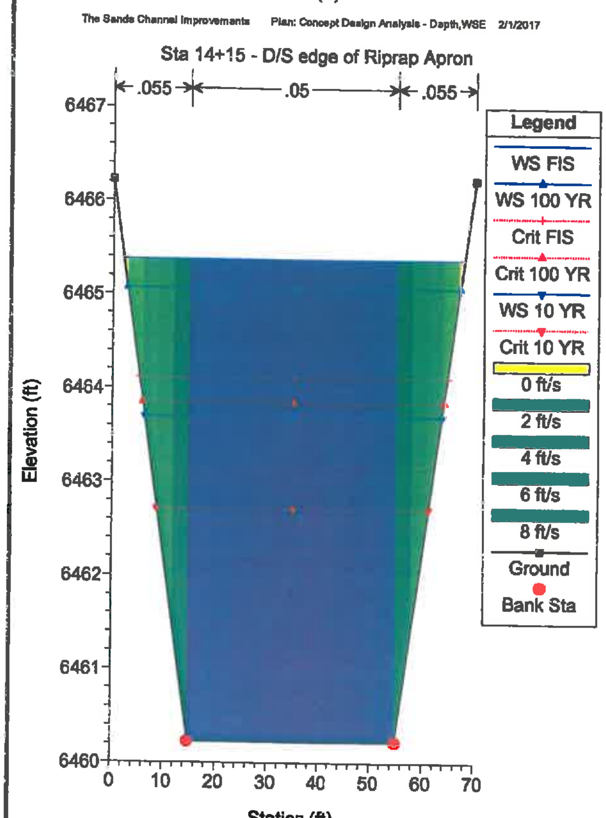

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 13+00 - Bttm of Wall DStruct. No. 3 (3' Vert.)
.055
.05
.055
Legend
Crit FIS
Crit 100 YR
WS FIS
Crit 10 YR
WS 100 YR
WS 10 YR
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

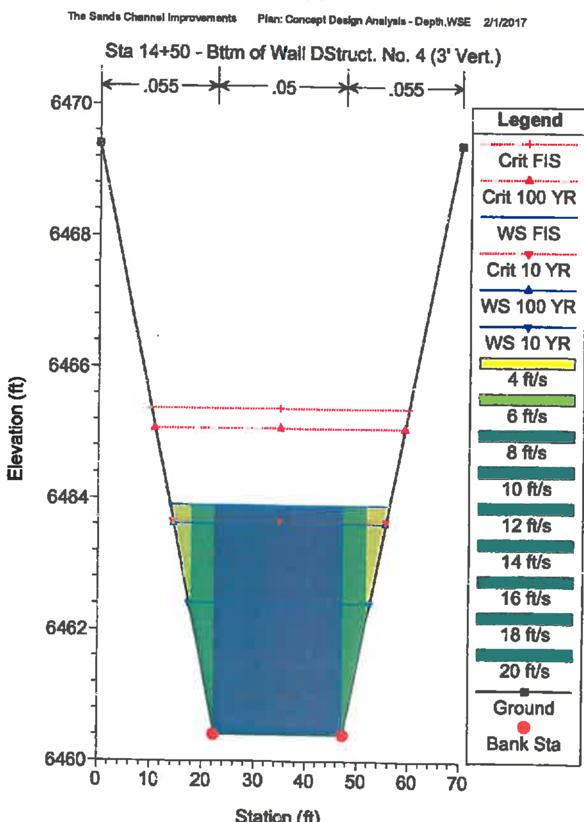

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 13+00.1 - Crest of DStruct. No. 3 (3' Vert.)
.055
.05
.055
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

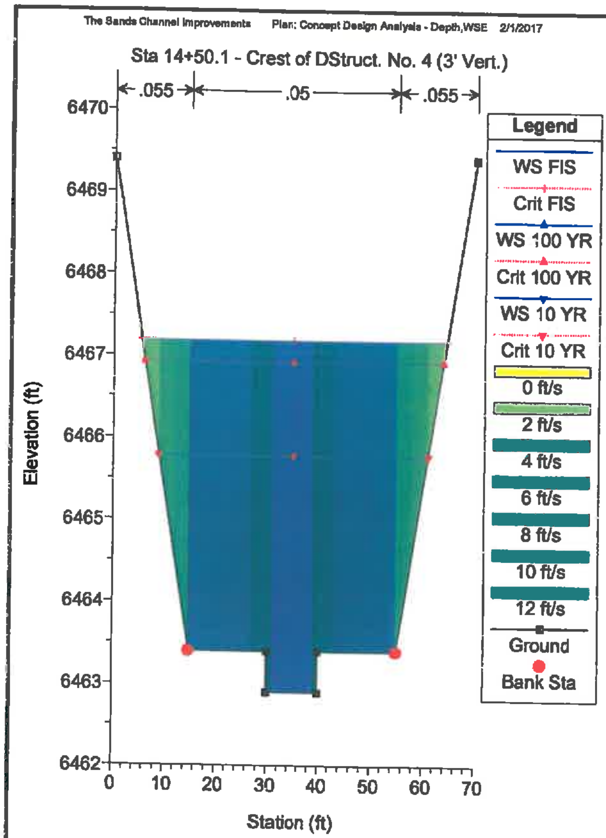

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 13+11 - U/S edge of Riprap Apron
.055
.05
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

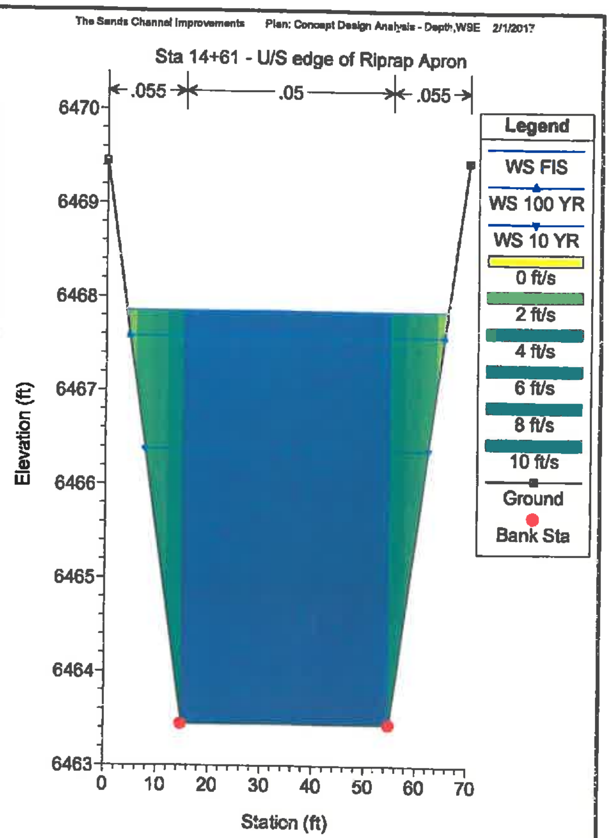

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 13+21 - Proposed Channel
.055
.04
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6466
6465
6464
6463
6462
6461
6460
6459
0 10 20 30 40 50 60 70
Station (ft)

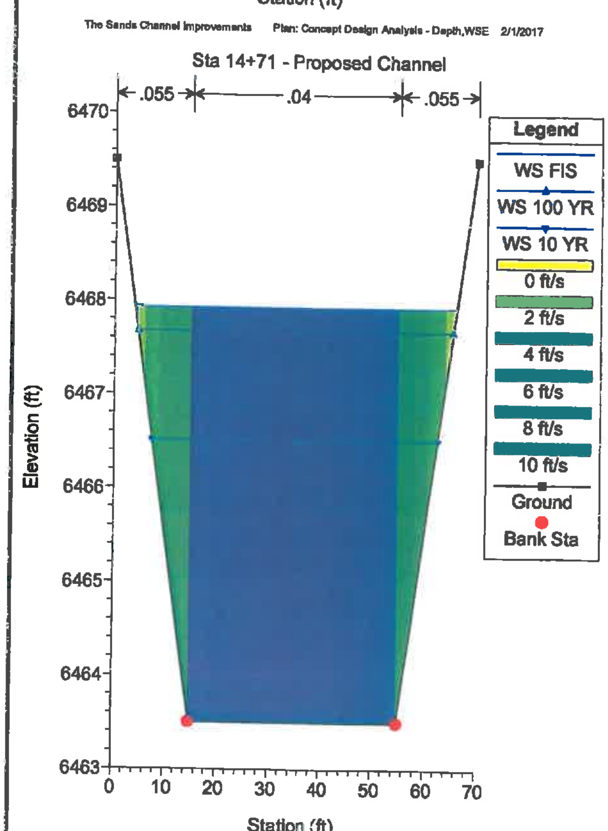

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 14+05 - Proposed Channel
.055
.04
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6467
6466
6465
6464
6463
6462
6461
6460
0 10 20 30 40 50 60 70
Station (ft)

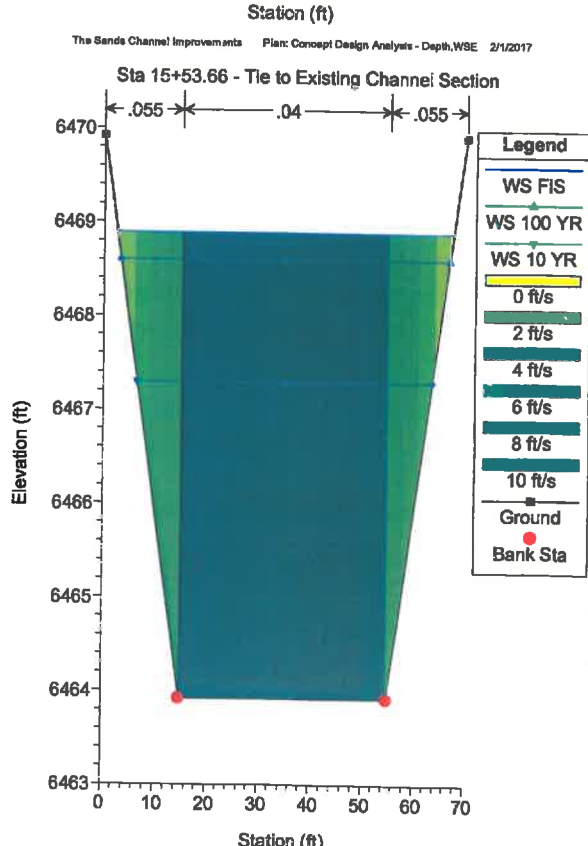

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 14+15 - D/S edge of Riprap Apron
.055
.05
.055
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
Ground
Bank Sta
Elevation (ft)
6467
6466
6465
6464
6463
6462
6461
6460
0 10 20 30 40 50 60 70
Station (ft)

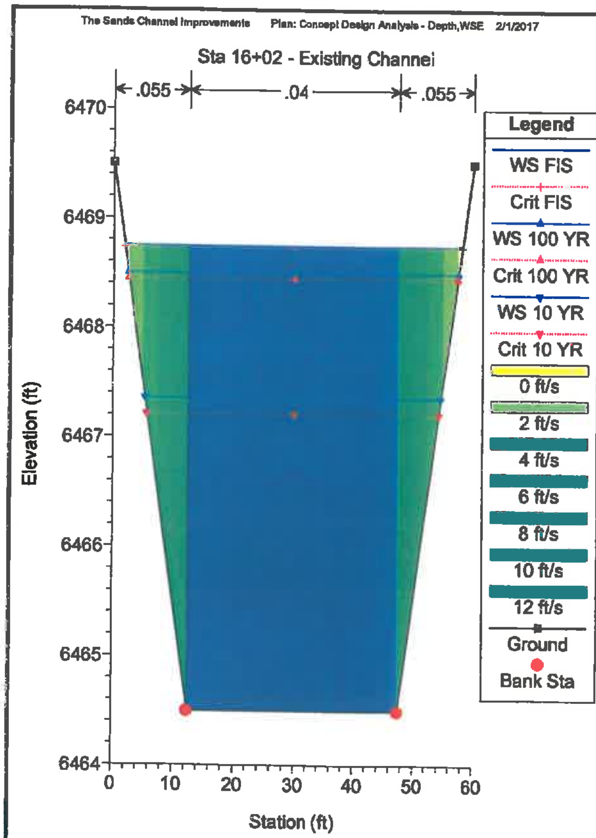

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 14+50 - Bttm of Wall DStruct. No. 4 (3' Vert.)
.055
.05
.055
Legend
Crit FIS
Crit 100 YR
WS FIS
Crit 10 YR
WS 100 YR
WS 10 YR
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
Ground
Bank Sta
Elevation (ft)
6470
6468
6466
6464
6462
6460
0 10 20 30 40 50 60 70
Station (ft)

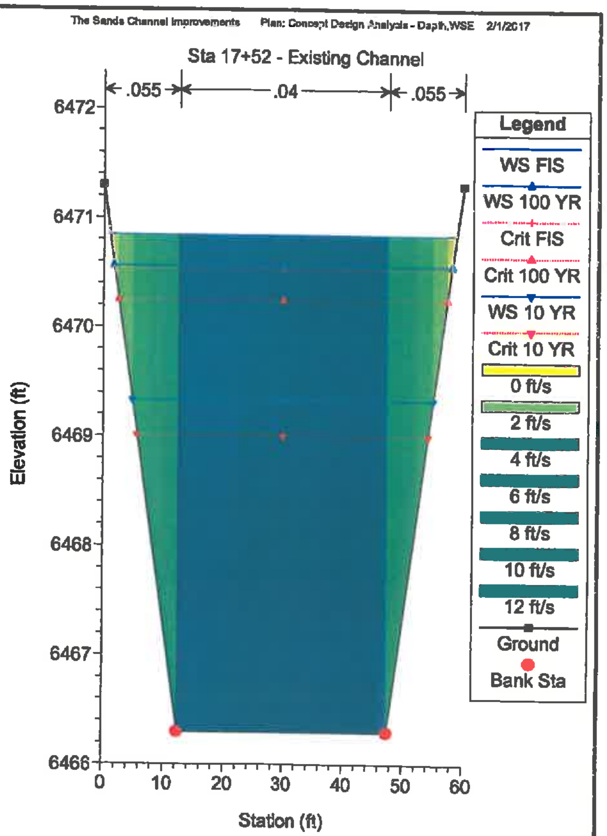

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 14+50.1 - Crest of DStruct. No. 4 (3' Vert.)
.055
.05
.055
Elevation (ft)
Station (ft)
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta

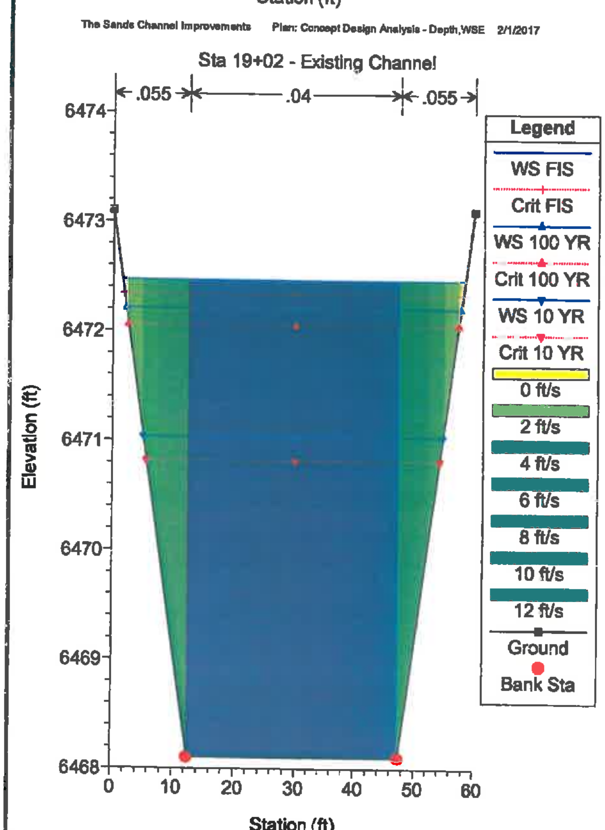

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 14+61 - U/S edge of Riprap Apron
.055
.05
.055
Elevation (ft)
Station (ft)
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta

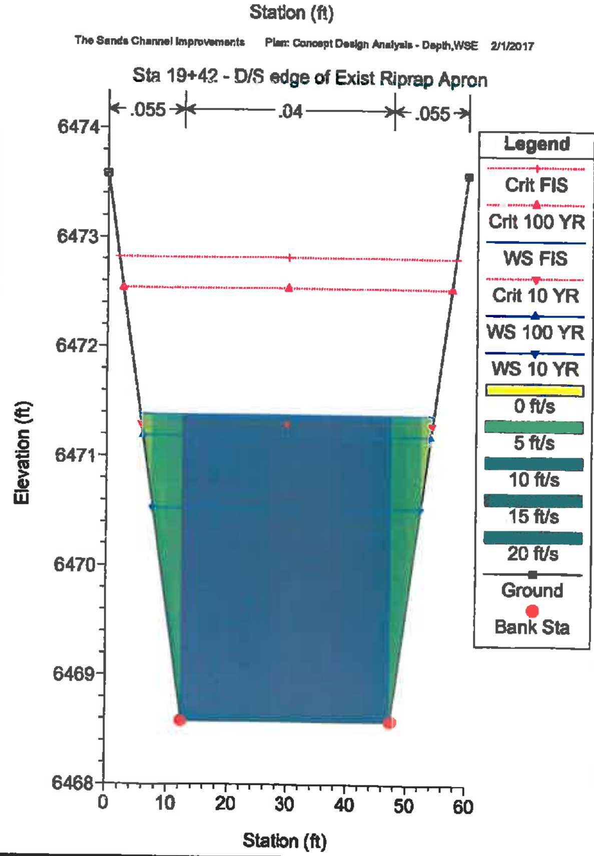

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 14+71 - Proposed Channel
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta

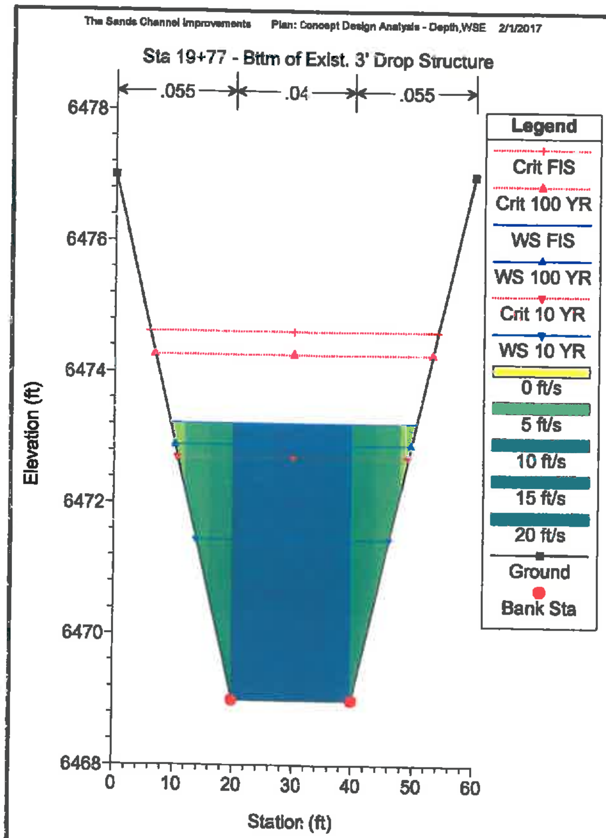

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 15+53.66 - Tie to Existing Channel Section
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta

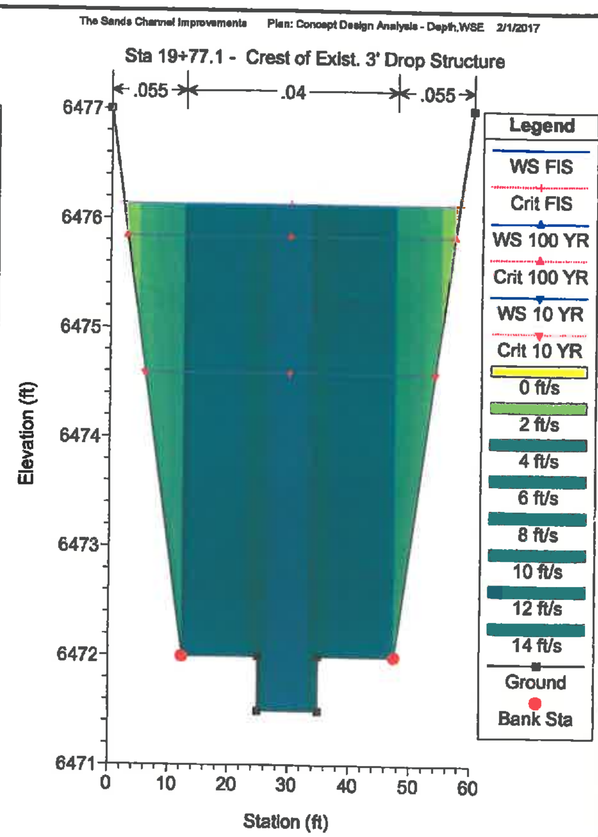

The Sands Channel Improvements
Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 16+02 - Existing Channel
.055
.04
.055
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

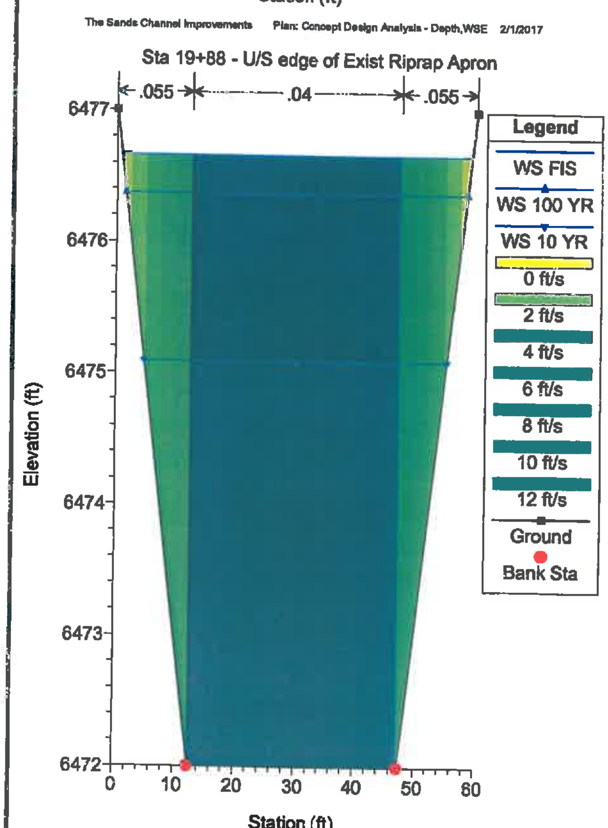

The Sands Channel Improvements
Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 17+52 - Existing Channel
.055
.04
.055
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

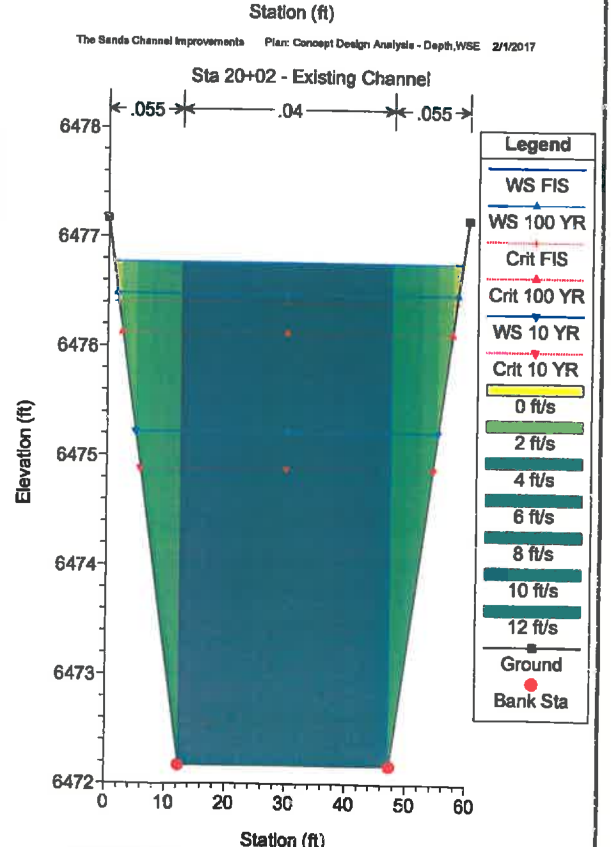

The Sands Channel Improvements
Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 19+02 - Existing Channel
.055
.04
.055
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

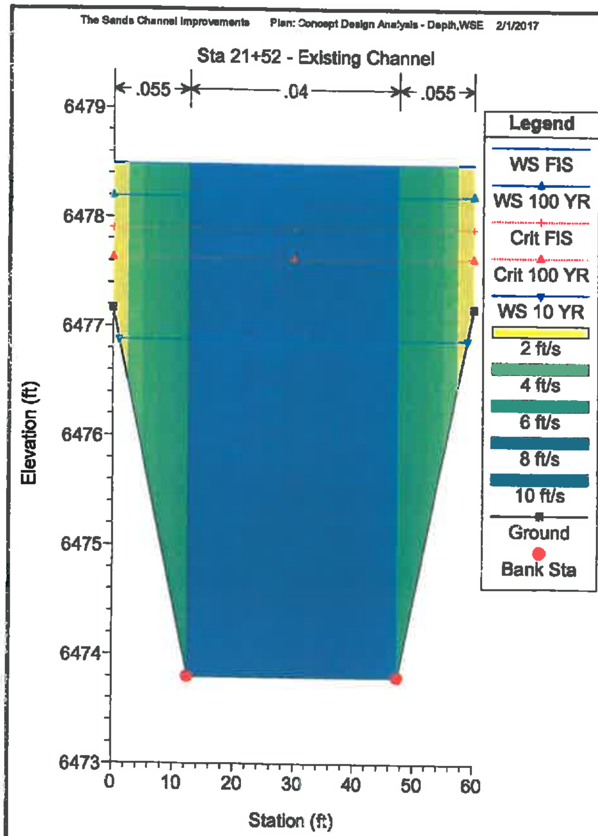

The Sands Channel Improvements
Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 19+42 - D/S edge of Exist Riprap Apron
.055
.04
.055
Legend
Crit FIS
Crit 100 YR
WS FIS
Crit 10 YR
WS 100 YR
WS 10 YR
0 ft/s
5 ft/s
10 ft/s
15 ft/s
20 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

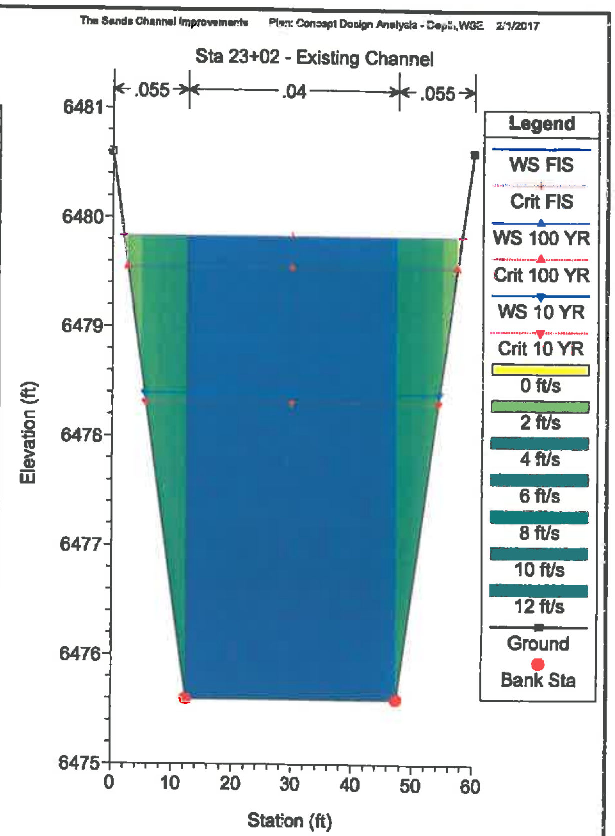

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 19+77 - Bttm of Exist. 3' Drop Structure
.055
.04
.055
Legend
Crit FIS
Crit 100 YR
WS FIS
WS 100 YR
Crit 10 YR
WS 10 YR
0 ft/s
5 ft/s
10 ft/s
15 ft/s
20 ft/s
Ground
Bank Sta
Elevation (ft)
6468
6470
6472
6474
6476
6478
0
10
20
30
40
50
60
Station (ft)

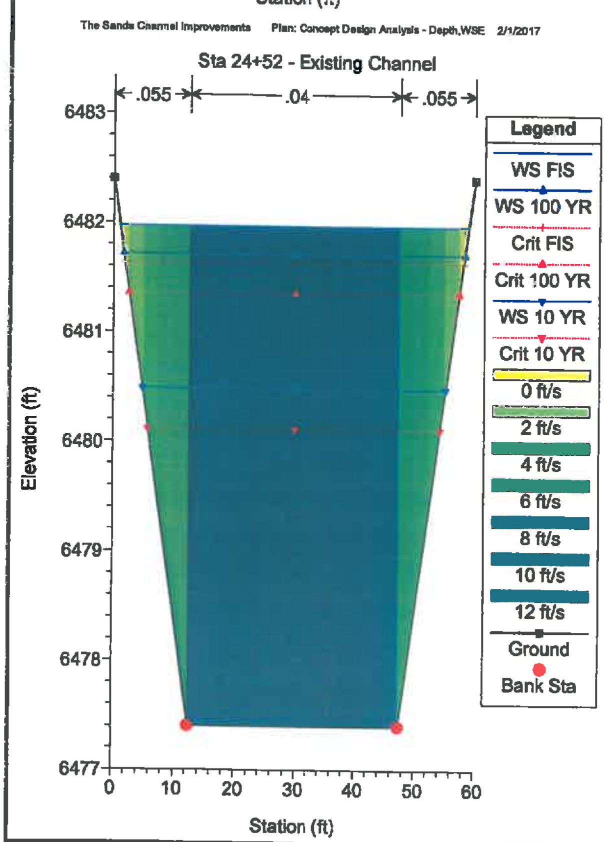

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 19+77.1 - Crest of Exist. 3' Drop Structure
.055
.04
.055
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta
Elevation (ft)
6471
6472
6473
6474
6475
6476
6477
0
10
20
30
40
50
60
Station (ft)

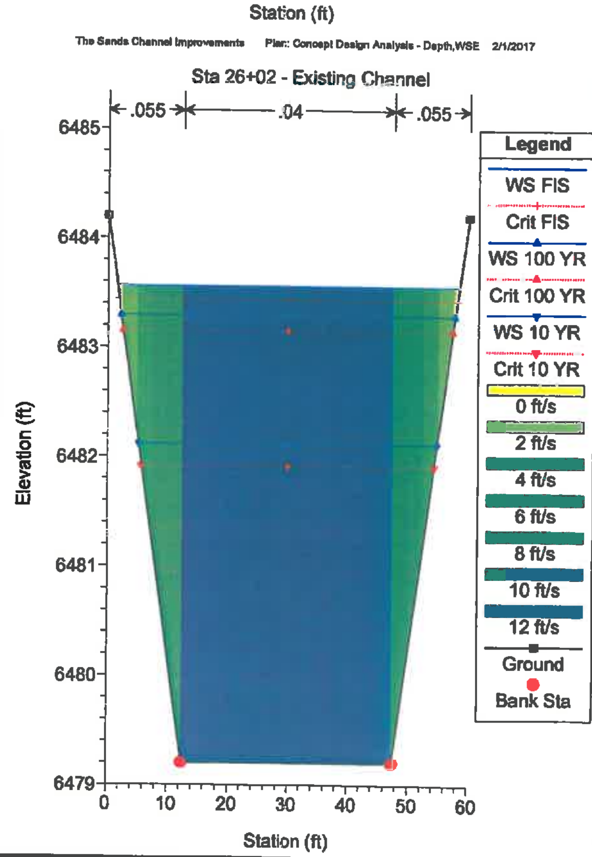

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 19+88 - U/S edge of Exist Riprap Apron
.055
.04
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
6472
6473
6474
6475
6476
6477
0
10
20
30
40
50
60
Station (ft)

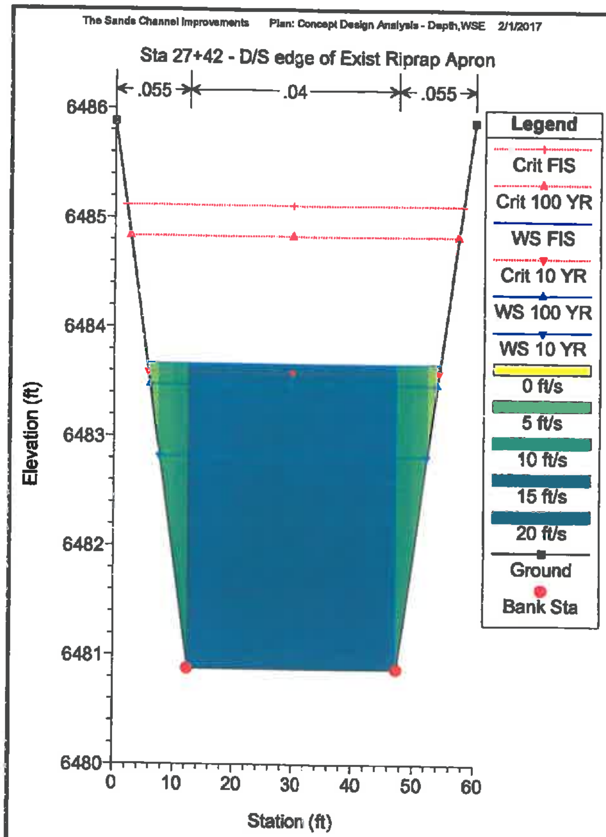

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 20+02 - Existing Channel
.055
.04
.055
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
6472
6473
6474
6475
6476
6477
6478
0
10
20
30
40
50
60
Station (ft)

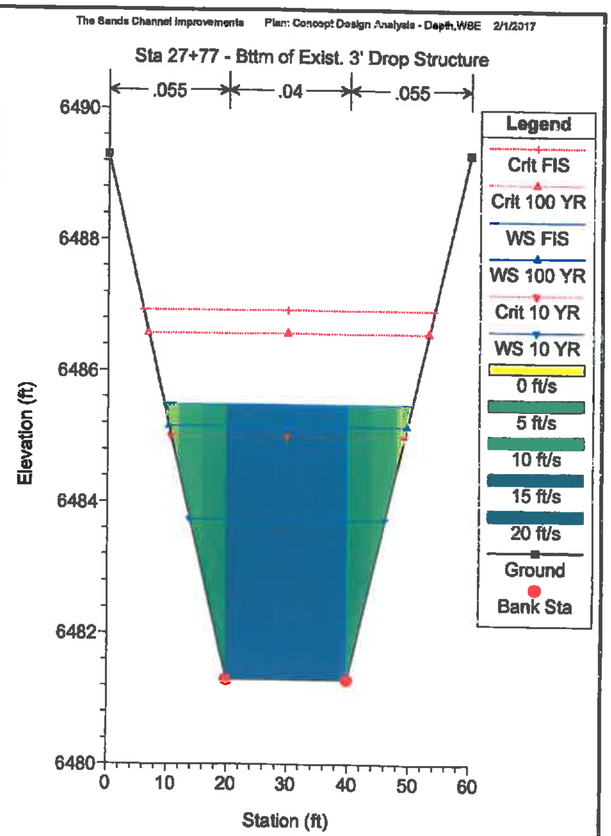

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 21+52 - Existing Channel
.055
.04
.055
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)
6473
6474
6475
6476
6477
6478
6479
0
10
20
30
40
50
60

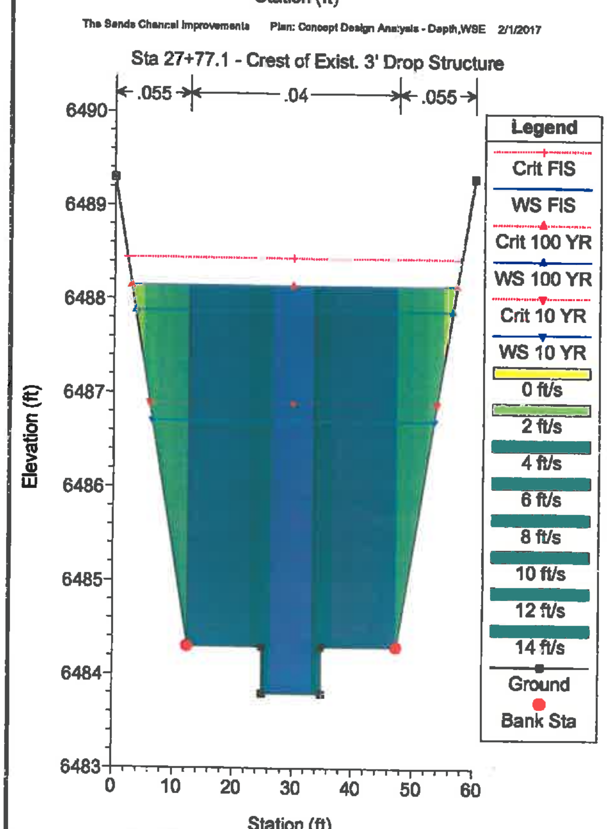

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 23+02 - Existing Channel
.055
.04
.055
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)
6475
6476
6477
6478
6479
6480
6481
0
10
20
30
40
50
60

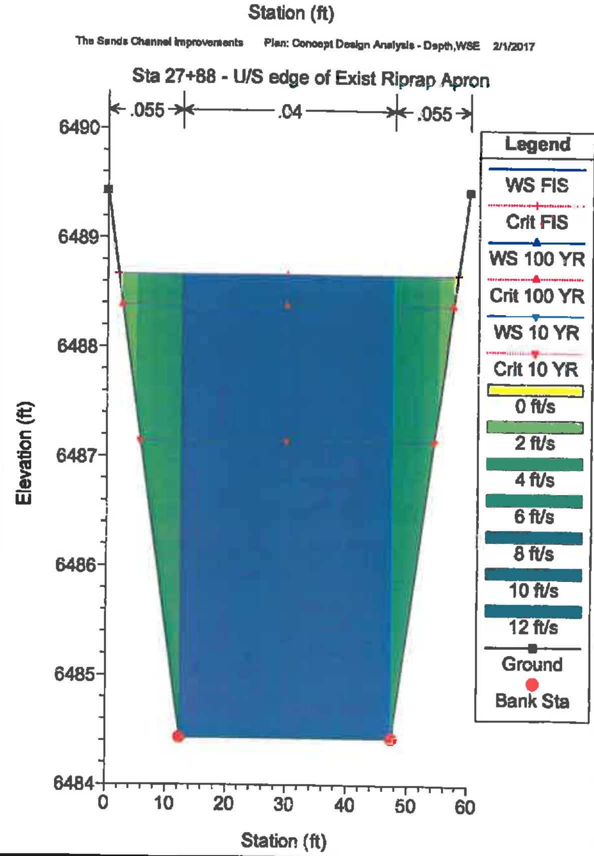

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 24+52 - Existing Channel
.055
.04
.055
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)
6477
6478
6479
6480
6481
6482
6483
0
10
20
30
40
50
60

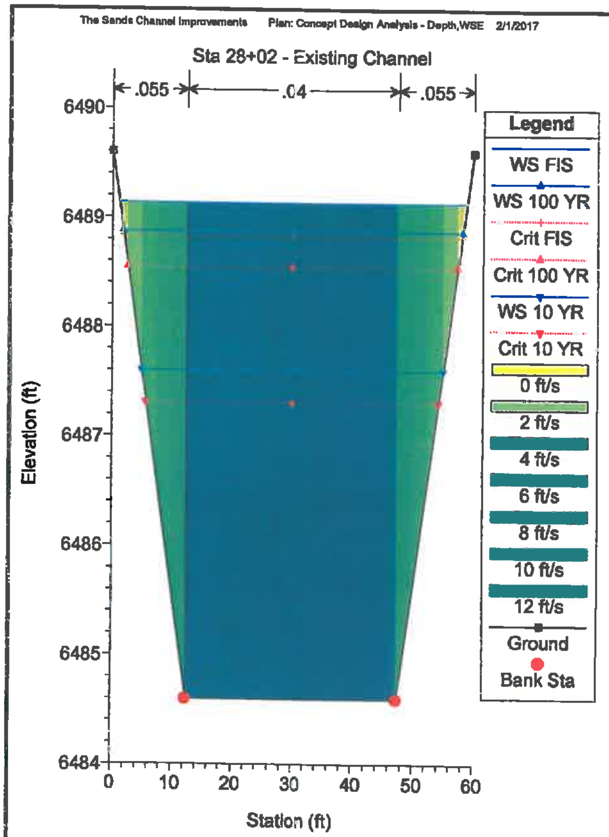

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 26+02 - Existing Channel
.055
.04
.055
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)
6479
6480
6481
6482
6483
6484
6485
0
10
20
30
40
50
60

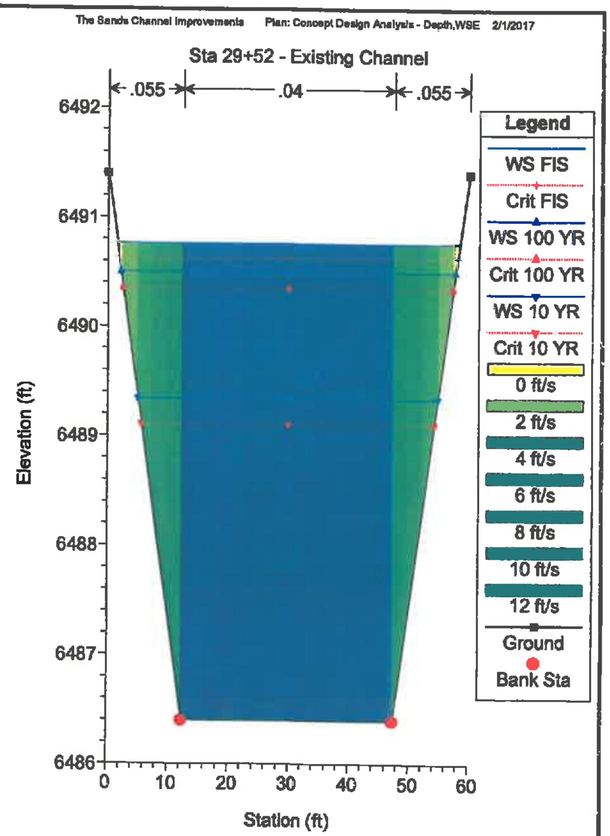

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 27+42 - D/S edge of Exist Riprap Apron
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
Crit FIS
Crit 100 YR
WS FIS
Crit 10 YR
WS 100 YR
WS 10 YR
0 ft/s
5 ft/s
10 ft/s
15 ft/s
20 ft/s
Ground
Bank Sta

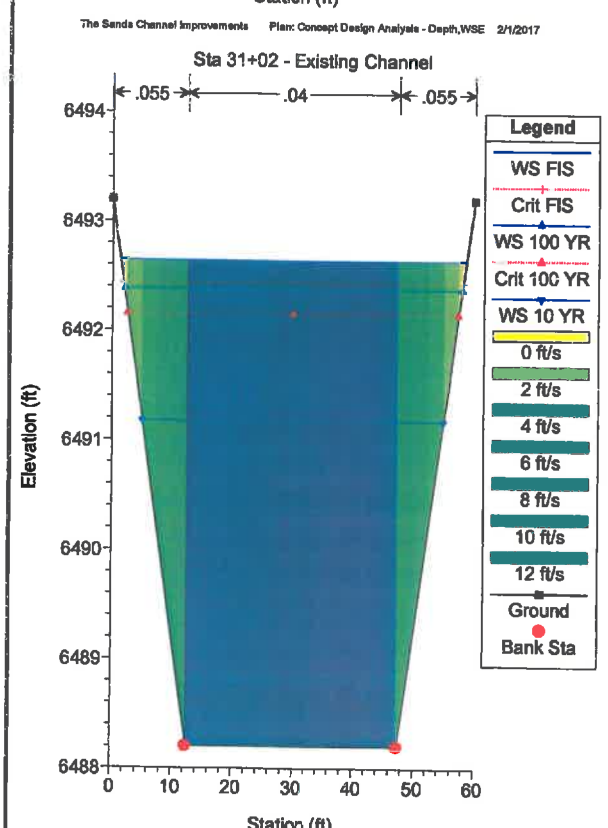

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 27+77 - Bttm of Exist. 3' Drop Structure
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
Crit FIS
Crit 100 YR
WS FIS
WS 100 YR
Crit 10 YR
WS 10 YR
0 ft/s
5 ft/s
10 ft/s
15 ft/s
20 ft/s
Ground
Bank Sta

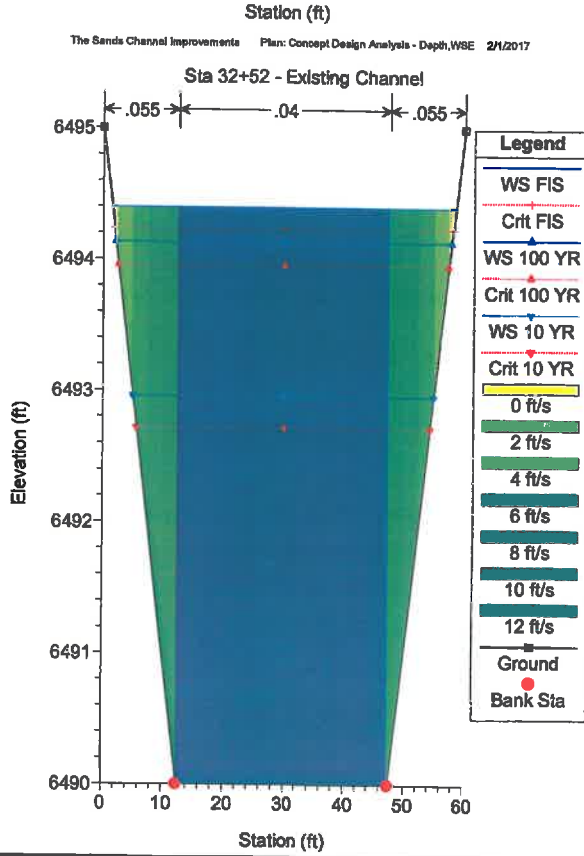

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 27+77.1 - Crest of Exist. 3' Drop Structure
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
Crit FIS
WS FIS
Crit 100 YR
WS 100 YR
Crit 10 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta

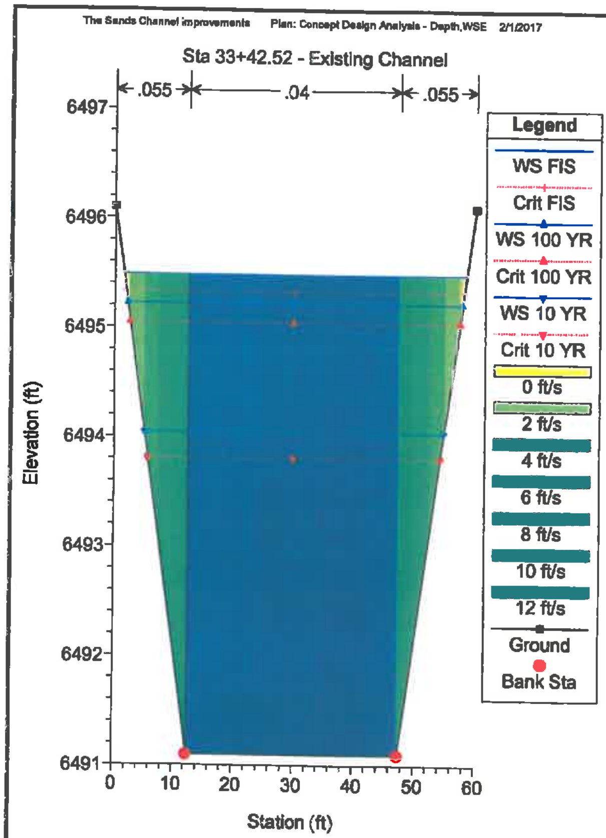

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 27+88 - U/S edge of Exist Riprap Apron
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta

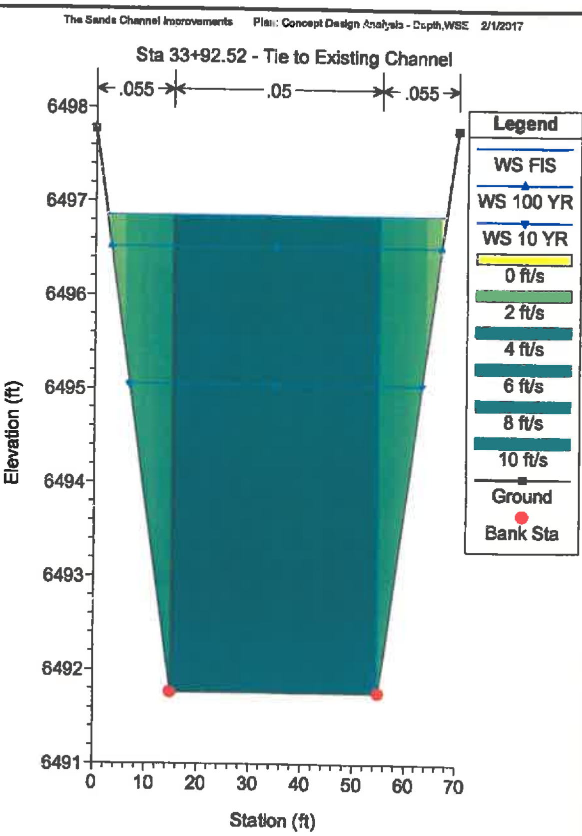

The Sands Channel Improvements
Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 28+02 - Existing Channel
.055
.04
.055
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

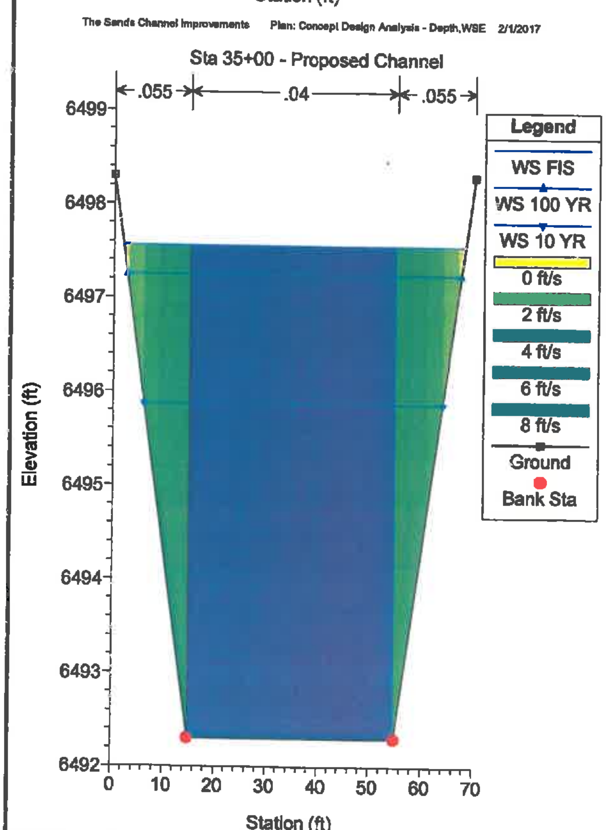

The Sands Channel Improvements
Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 29+52 - Existing Channel
.055
.04
.055
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

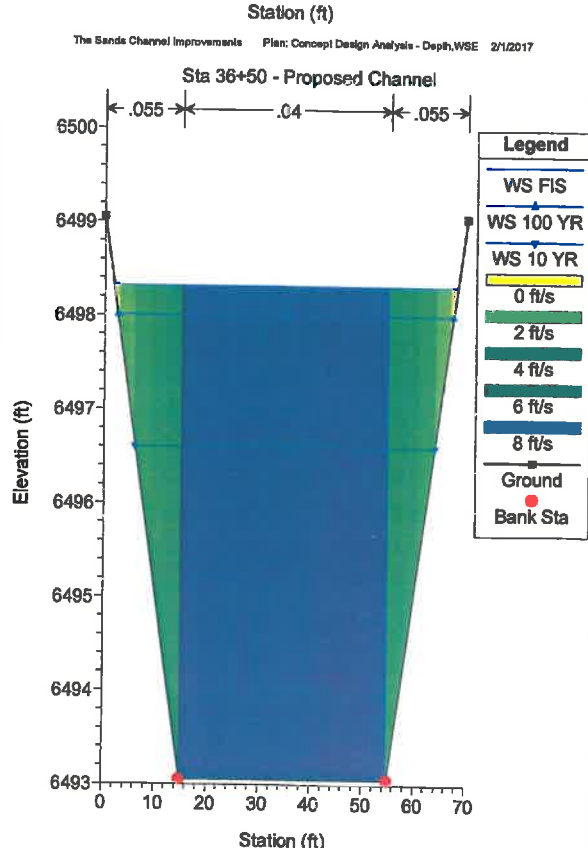

The Sands Channel Improvements
Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 31+02 - Existing Channel
.055
.04
.055
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

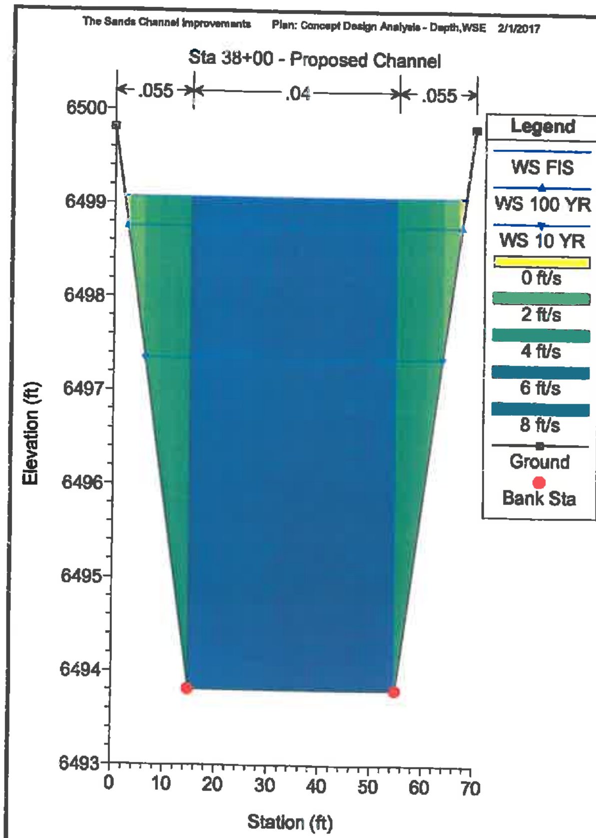

The Sands Channel Improvements
Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 32+52 - Existing Channel
.055
.04
.055
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

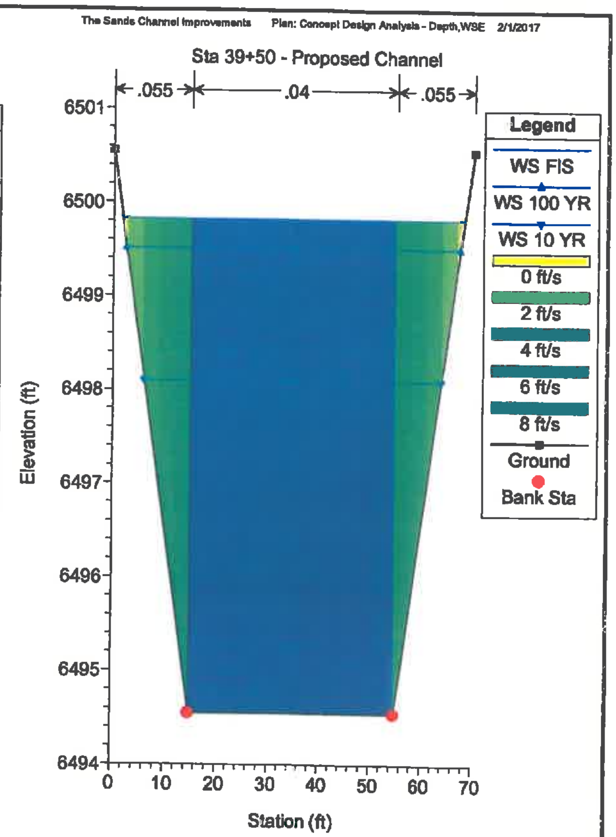

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 33+42.52 - Existing Channel
.055
.04
.055
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)
6491
6492
6493
6494
6495
6496
6497
0
10
20
30
40
50
60

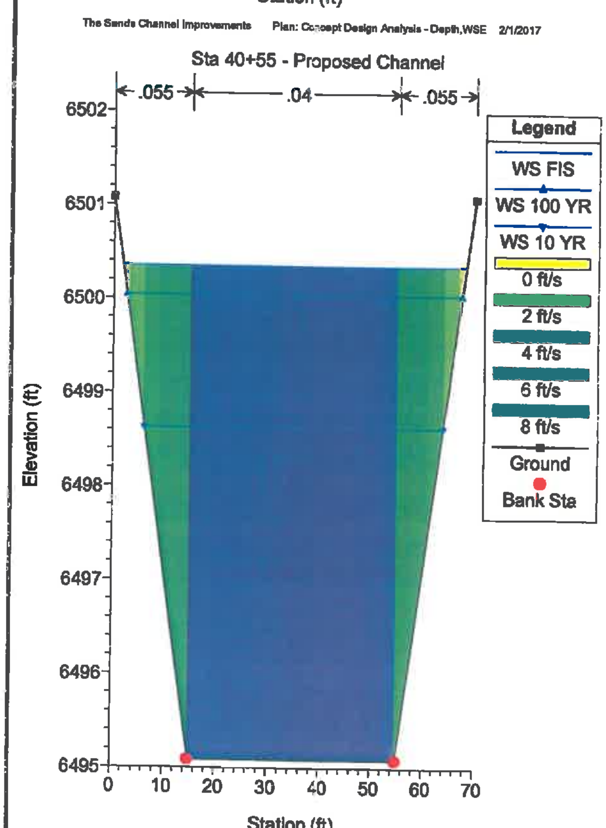

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 33+92.52 - Tie to Existing Channel
.055
.05
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)
6491
6492
6493
6494
6495
6496
6497
6498
0
10
20
30
40
50
60
70

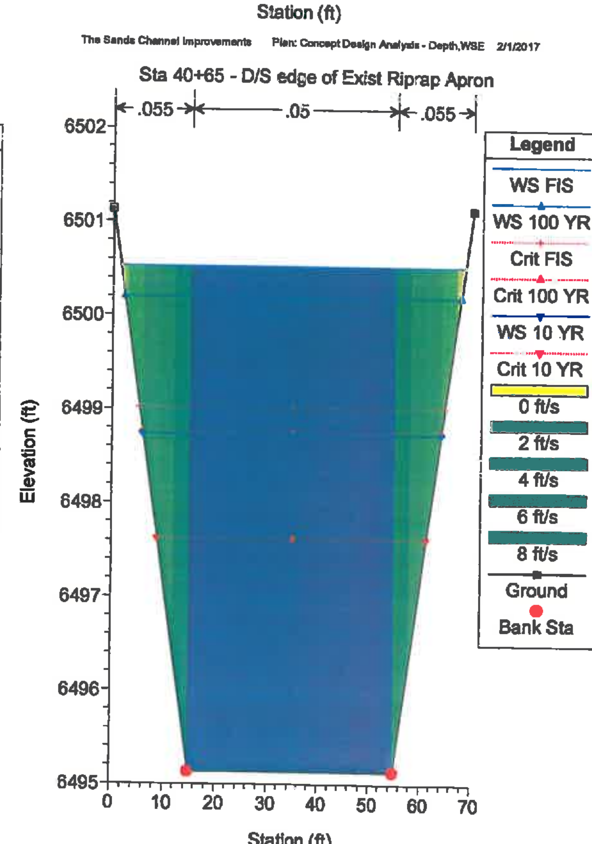

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 35+00 - Proposed Channel
.055
.04
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)
6492
6493
6494
6495
6496
6497
6498
6499
0
10
20
30
40
50
60
70

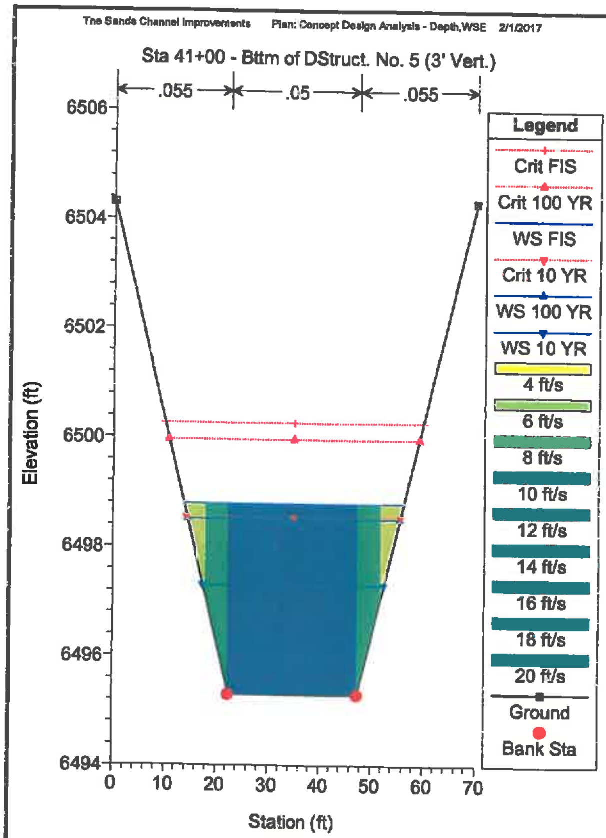

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 36+50 - Proposed Channel
.055
.04
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)
6493
6494
6495
6496
6497
6498
6499
6500
0
10
20
30
40
50
60
70

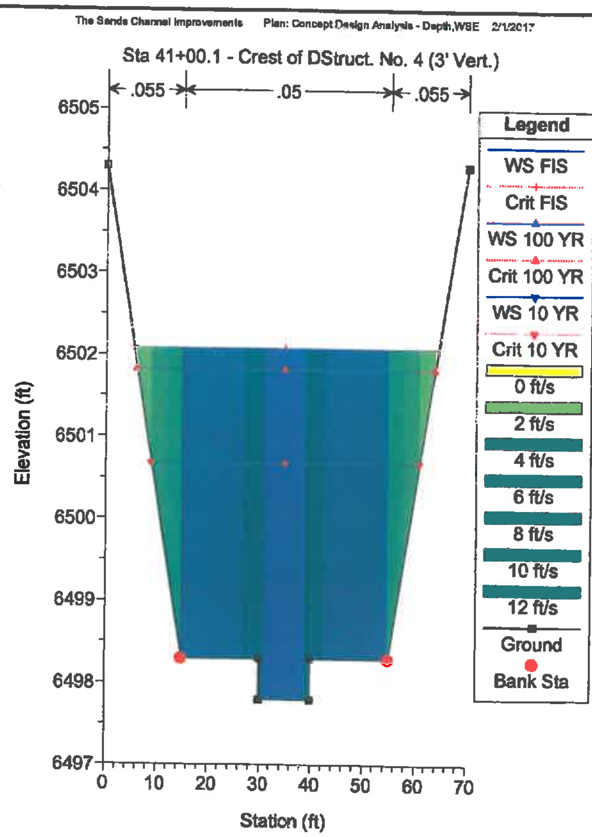

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 38+00 - Proposed Channel
.055
.04
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

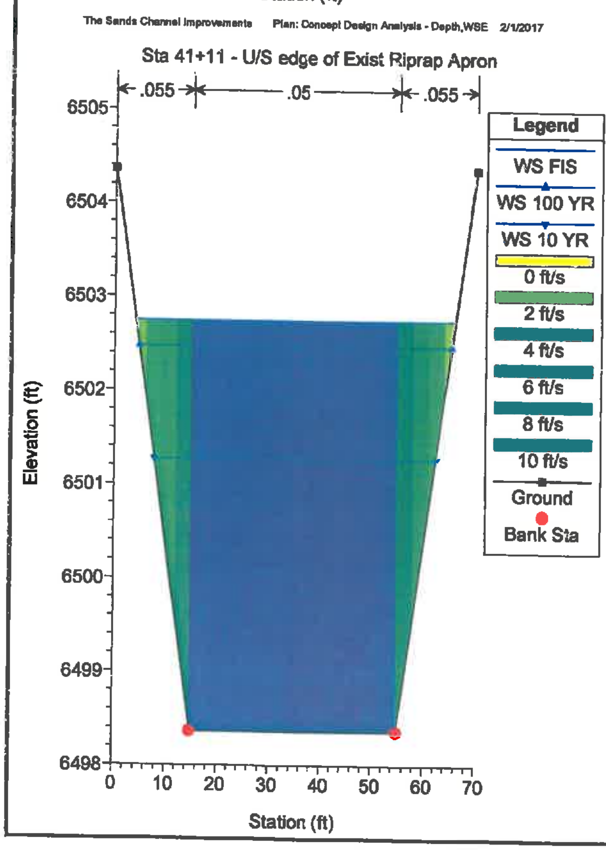

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 39+50 - Proposed Channel
.055
.04
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

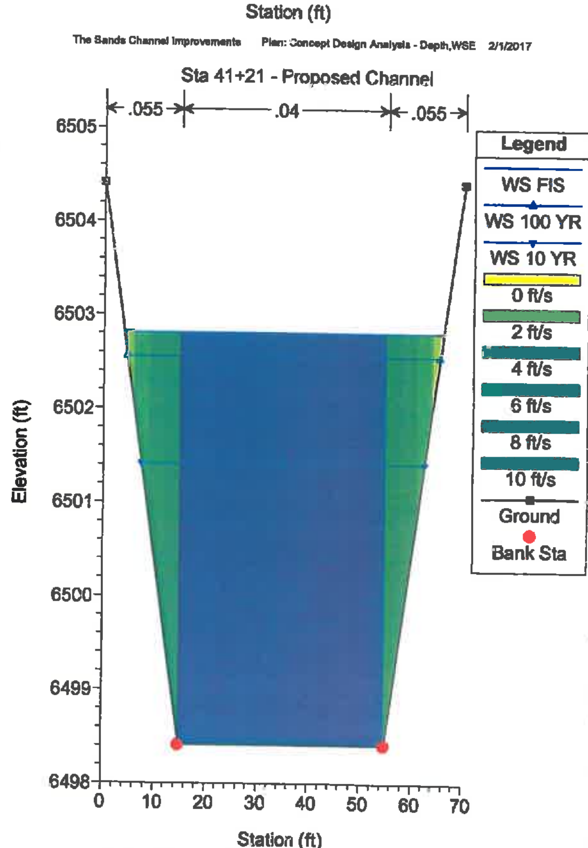

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 40+55 - Proposed Channel
.055
.04
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

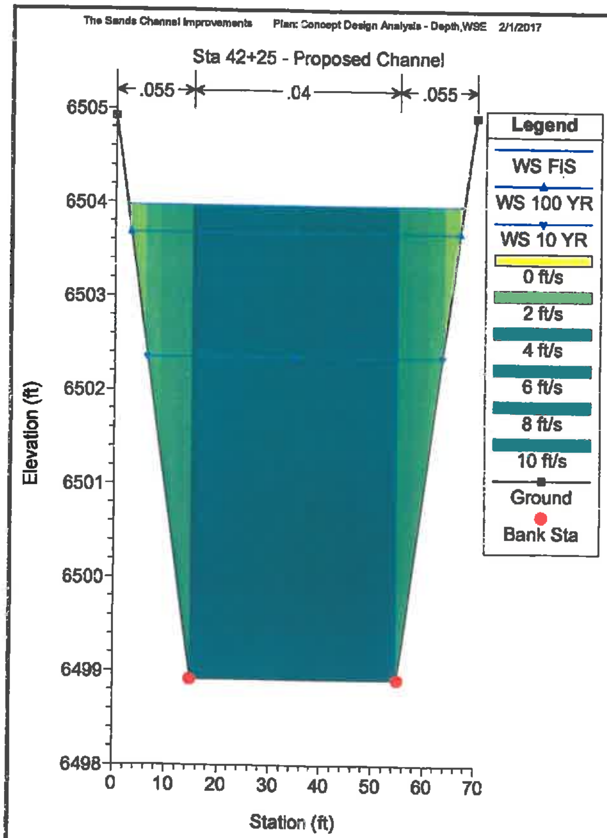

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 40+65 - D/S edge of Exist Riprap Apron
.055
.05
.055
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

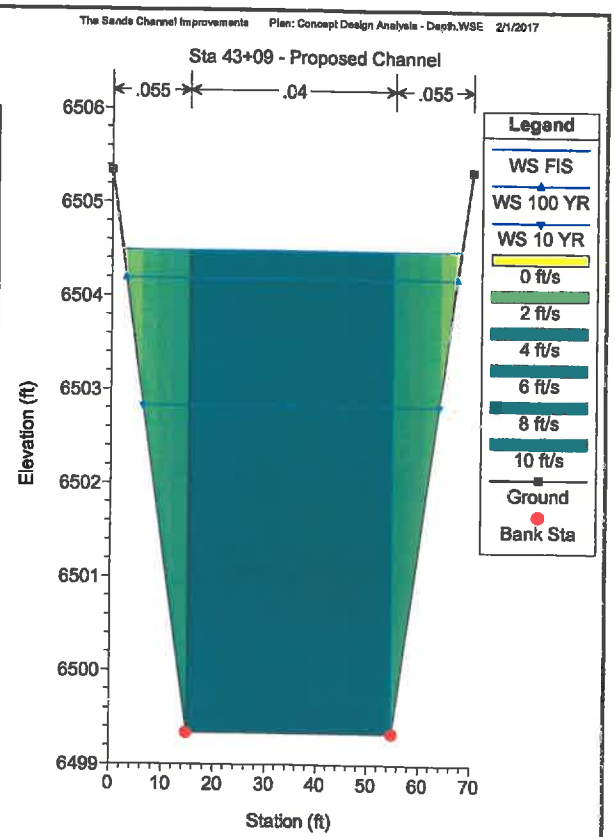

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 41+00 - Bttm of DStruct. No. 5 (3' Vert.)
.055
.05
.055
Elevation (ft)
Station (ft)
Legend
Crit FIS
Crit 100 YR
WS FIS
Crit 10 YR
WS 100 YR
WS 10 YR
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
Ground
Bank Sta

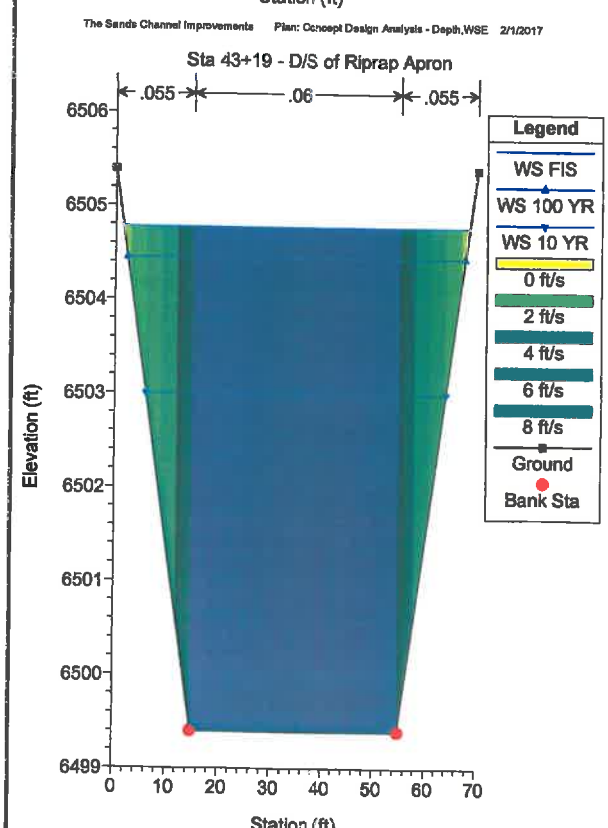

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 41+00.1 - Crest of DStruct. No. 4 (3' Vert.)
.055
.05
.055
Elevation (ft)
Station (ft)
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta

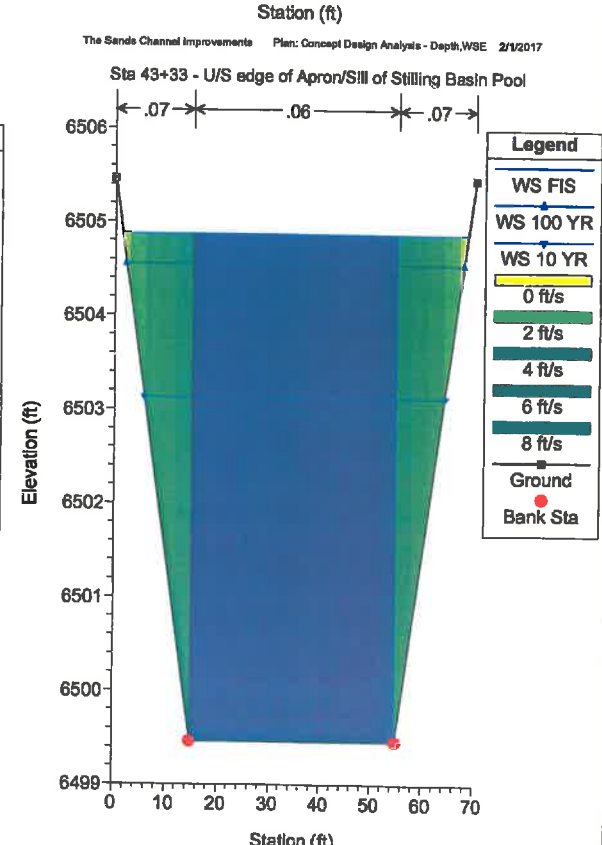

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 41+11 - U/S edge of Exist Riprap Apron
.055
.05
.055
Elevation (ft)
Station (ft)
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta

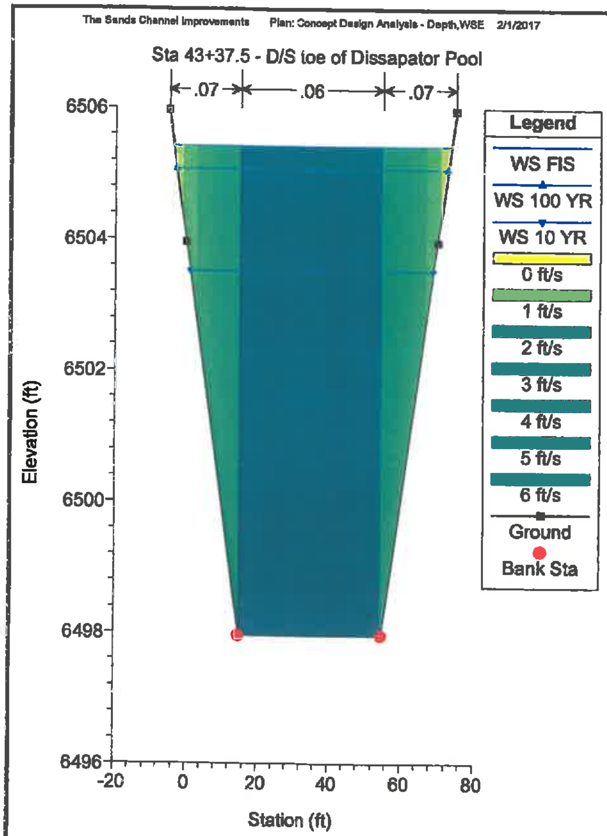

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 41+21 - Proposed Channel
.055
.04
.055
Elevation (ft)
Station (ft)
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta

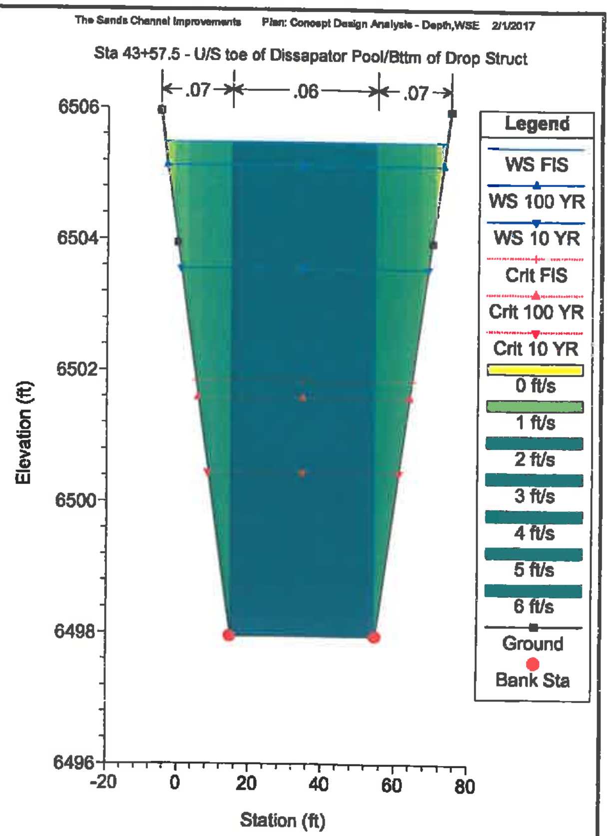

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 42+25 - Proposed Channel
.055
.04
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6498
6499
6500
6501
6502
6503
6504
6505
Station (ft)
0
10
20
30
40
50
60
70

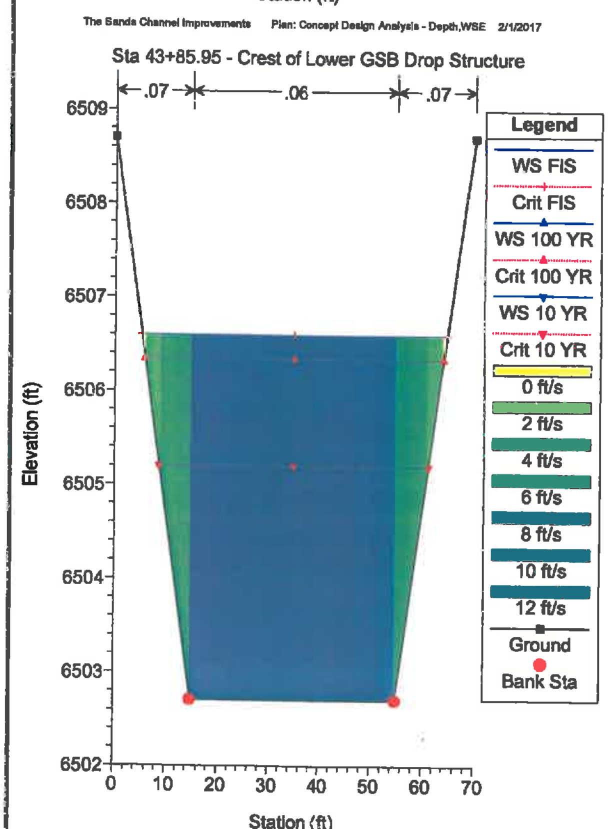

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 43+09 - Proposed Channel
.055
.04
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6499
6500
6501
6502
6503
6504
6505
6506
Station (ft)
0
10
20
30
40
50
60
70

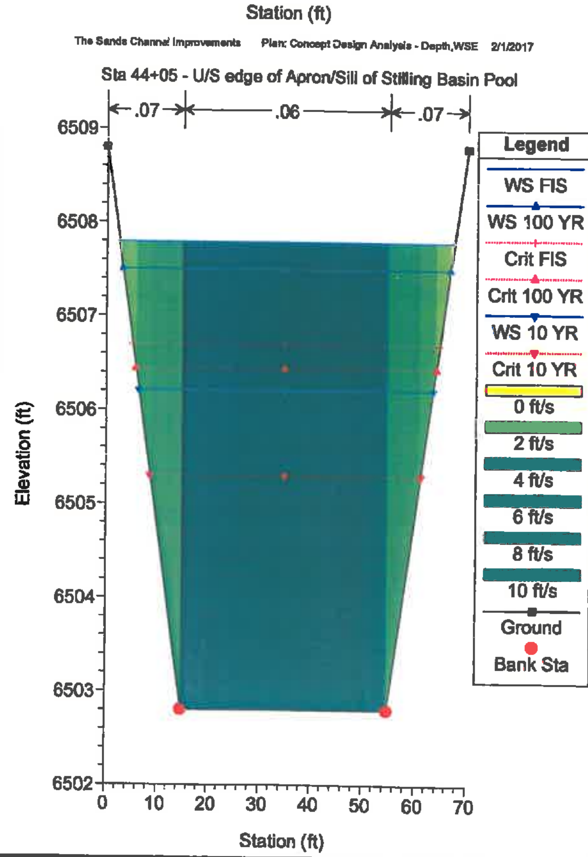

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 43+19 - D/S of Riprap Apron
.055
.06
.055
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
Ground
Bank Sta
Elevation (ft)
6499
6500
6501
6502
6503
6504
6505
6506
Station (ft)
0
10
20
30
40
50
60
70

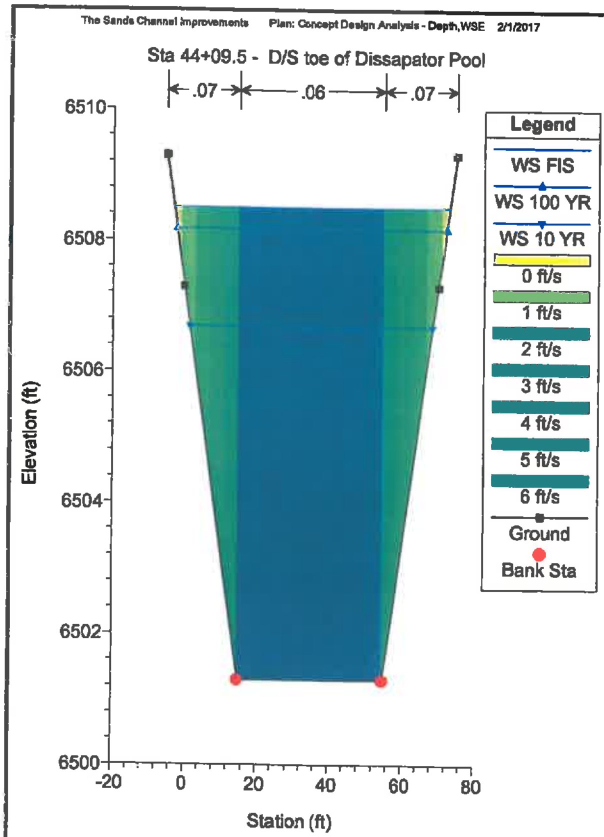

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 43+33 - U/S edge of Apron/Sill of Stilling Basin Pool
.07
.06
.07
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
Ground
Bank Sta
Elevation (ft)
6499
6500
6501
6502
6503
6504
6505
6506
Station (ft)
0
10
20
30
40
50
60
70

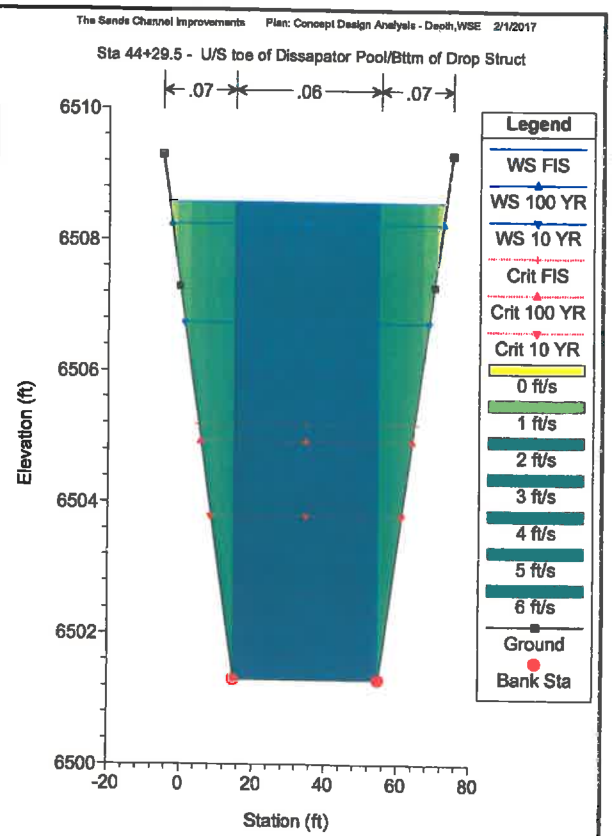

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 43+37.5 - D/S toe of Dissapator Pool
.07 .06 .07
Elevation (ft)
Station (ft)
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
Ground
Bank Sta

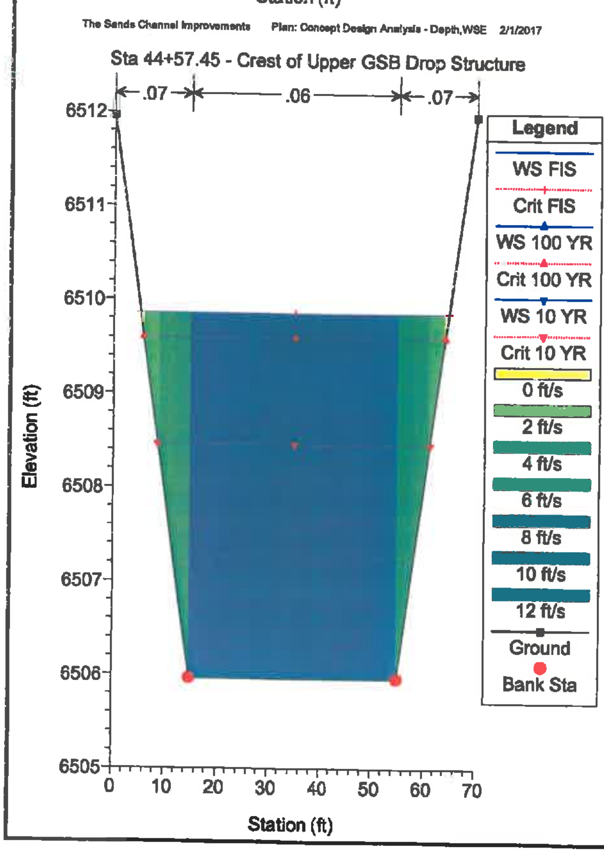

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 43+57.5 - U/S toe of Dissapator Pool/Bttm of Drop Struct
.07 .06 .07
Elevation (ft)
Station (ft)
Legend
WS FIS
WS 100 YR
WS 10 YR
Crit FIS
Crit 100 YR
Crit 10 YR
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
Ground
Bank Sta

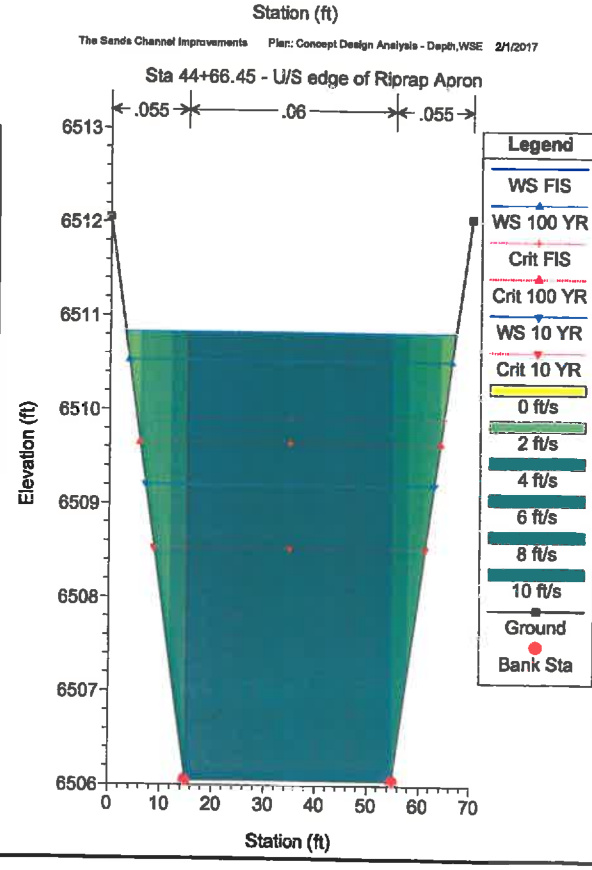

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 43+85.95 - Crest of Lower GSB Drop Structure
.07 .06 .07
Elevation (ft)
Station (ft)
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta


The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 44+05 - U/S edge of Apron/Sill of Stilling Basin Pool
.07 .06 .07
Elevation (ft)
Station (ft)
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta


The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 44+09.5 - D/S toe of Dissapator Pool
.07
.06
.07
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
Ground
Bank Sta
Elevation (ft)
6510
6508
6506
6504
6502
6500
-20
0
20
40
60
80
Station (ft)

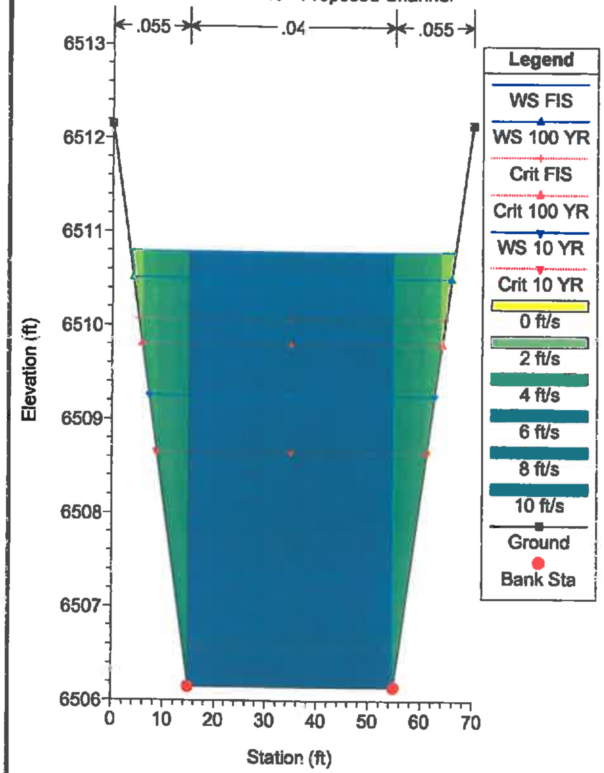

The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 44+29.5 - U/S toe of Dissapator Pool/Bttm of Drop Struct
.07
.06
.07
Legend
WS FIS
WS 100 YR
WS 10 YR
Crit FIS
Crit 100 YR
Crit 10 YR
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
Ground
Bank Sta
Elevation (ft)
6510
6508
6506
6504
6502
6500
-20
0
20
40
60
80
Station (ft)


The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 44+57.45 - Crest of Upper GSB Drop Structure
.07
.06
.07
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
6512
6511
6510
6509
6508
6507
6506
6505
0
10
20
30
40
50
60
70
Station (ft)


The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 44+66.45 - U/S edge of Riprap Apron
.055
.06
.055
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6513
6512
6511
6510
6509
6508
6507
6506
0
10
20
30
40
50
60
70
Station (ft)

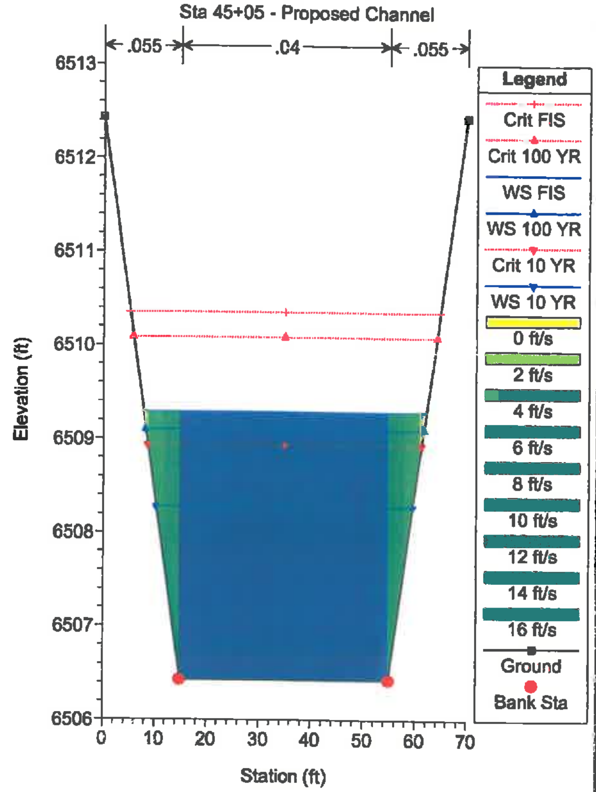
The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017

Sta 44+76.45 - Proposed Channel



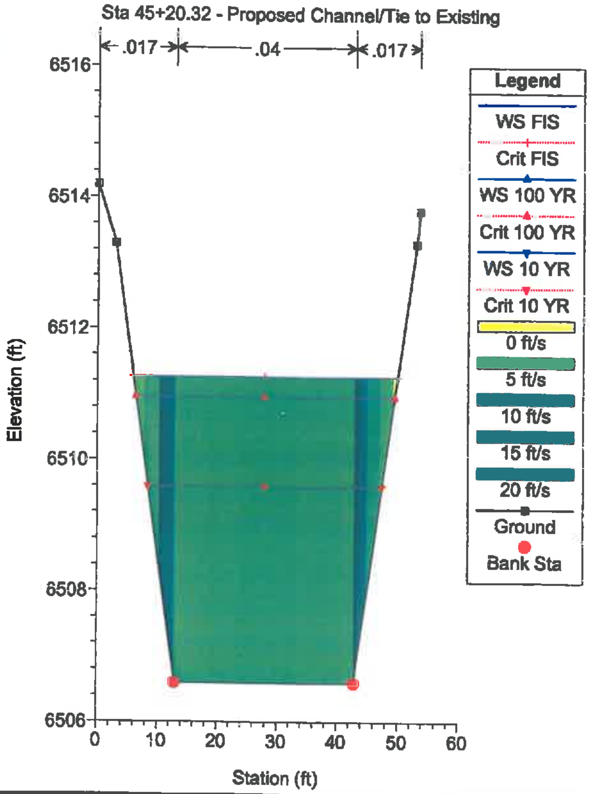
The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017

Sta 45+05 - Proposed Channel



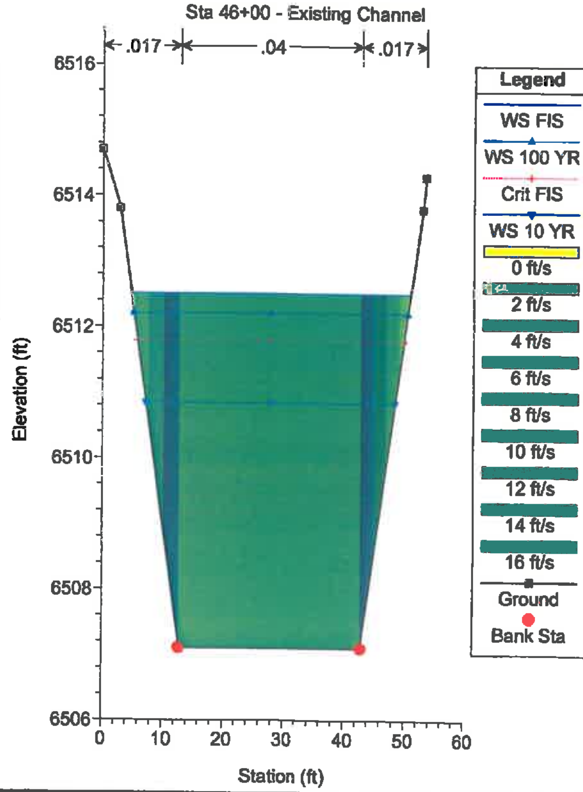
The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017

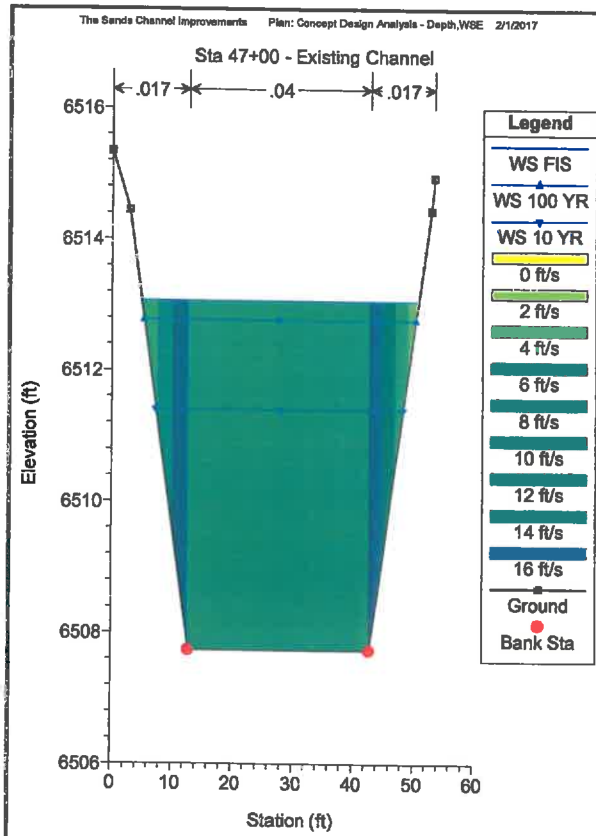
Sta 45+20.32 - Proposed Channel/Tie to Existing

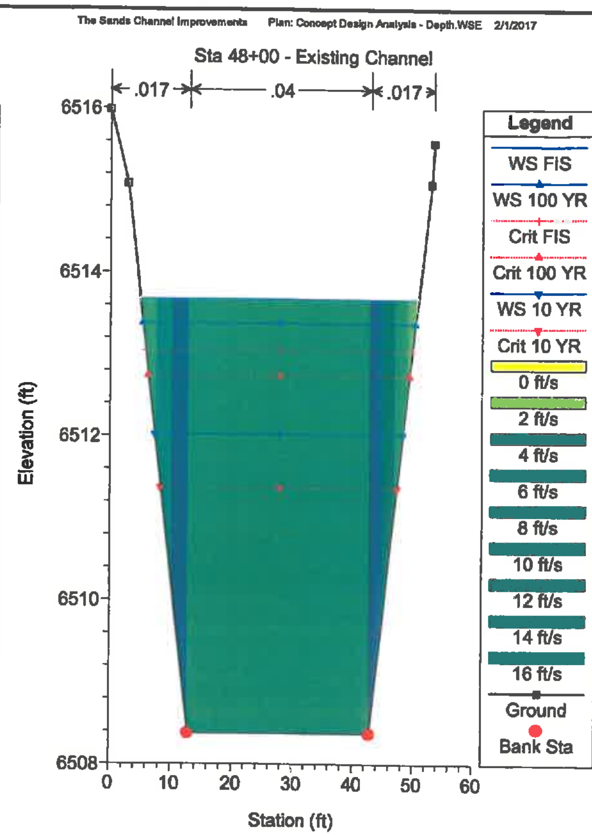


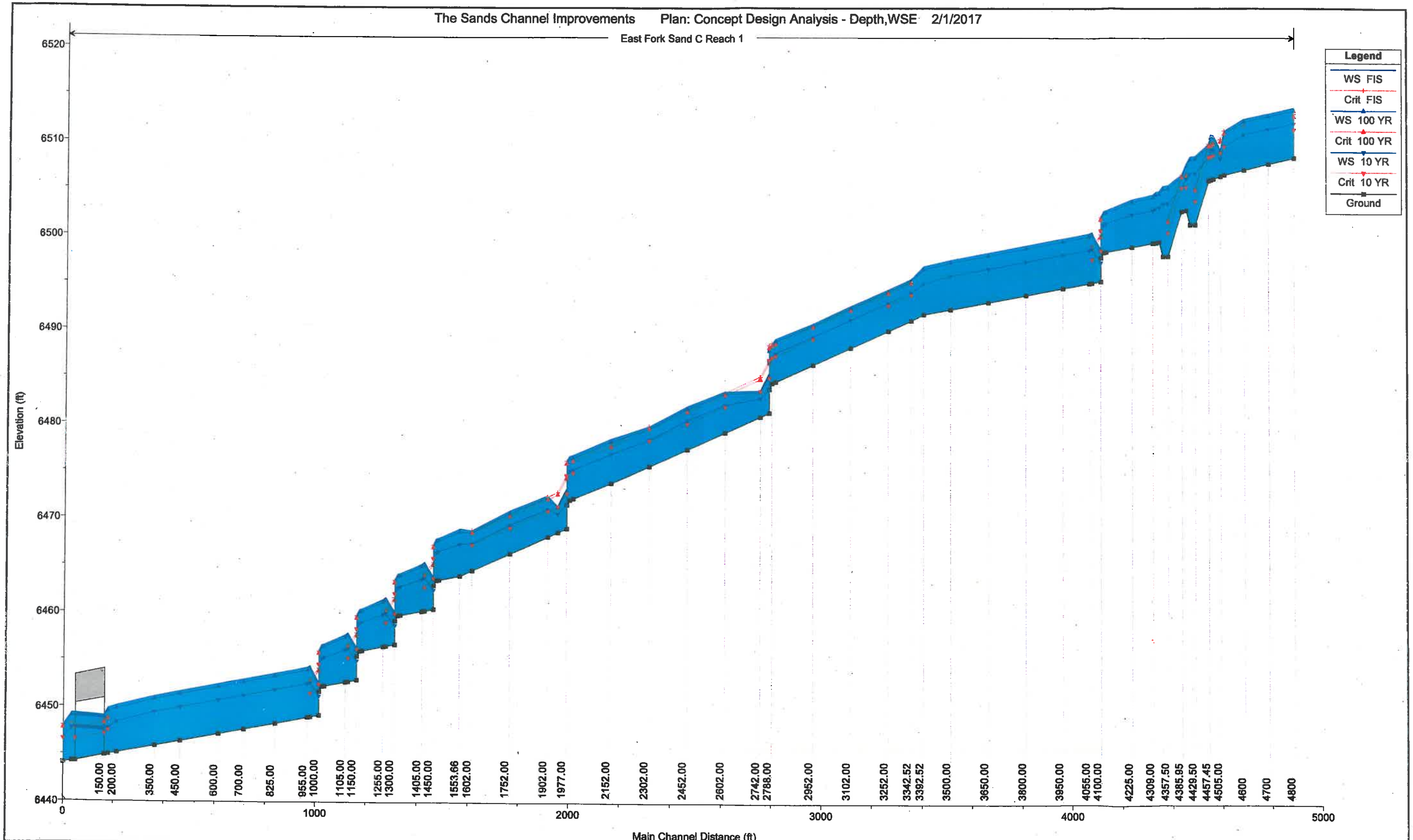
The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017

Sta 46+00 - Existing Channel




The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
Sta 47+00 - Existing Channel
.017
.04
.017
Elevation (ft)
Station (ft)
Legend
WS FIS
WS 100 YR
WS 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
Ground
Bank Sta


The Sands Channel Improvements Plan: Concept Design Analysis - Depth.WSE 2/1/2017
Sta 48+00 - Existing Channel
.017
.04
.017
Elevation (ft)
Station (ft)
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
Crit 10 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
Ground
Bank Sta



The Sands Channel Improvements Plan: Concept Design Analysis - Depth,WSE 2/1/2017
East Fork Sand C Reach 1
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
Ground
Elevation (ft)
Main Channel Distance (ft)
6440
6450
6460
6470
6480
6490
6500
6510
6520
0
1000
2000
3000
4000
5000
150.00
200.00
350.00
450.00
600.00
700.00
825.00
955.00
1000.00
1105.00
1150.00
1255.00
1300.00
1405.00
1450.00
1553.66
1602.00
1752.00
1902.00
1977.00
2152.00
2302.00
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2602.00
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3102.00
3252.00
3342.52
3392.52
3500.00
3650.00
3800.00
3950.00
4055.00
4100.00
4225.00
4309.00
4357.50
4385.95
4429.50
4457.45
4505.00
4600
4700
4800

HEC-RAS MODEL INPUT/OUTPUT

VELOCITY/SHEAR/FROUDE NO.

TheSandsChannelImprovements.rep

HEC-RAS HEC-RAS 5.0.3 September 2016
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX   XXXX        XXXX     XX     XXXX
X     X  X       X    X       X   X   X  X   X
X     X  X       X            X   X  X    X  X
XXXXXXX  XXXX    X      XXX   XXXX   XXXXXX   XXXX
X     X  X       X            X X    X    X       X
X     X  X       X    X       X  X   X    X       X
X     X  XXXXXX   XXXX        X   X  X    X  XXXXX
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PROJECT DATA
Project Title: The Sands Channel Improvements
Project File : TheSandsChannelImprovements.prj
Run Date and Time: 2/1/2017 9:20:19 AM

Project in English units

PLAN DATA

Plan Title: Concept Design Analysis - Vel,Fr,Sh
Plan File : o:\43089A\MS Rd-Const Ave\HEC-RAS\TheSandsChannelImprovements.p02

Geometry Title: Proposed and Existing - Vel, Fr, Sh
Geometry File : o:\43089A\MS Rd-Const Ave\HEC-RAS\TheSandsChannelImprovements.g02

Flow Title : FIS,100,10,5
Flow File : o:\43089A\MS Rd-Const Ave\HEC-RAS\TheSandsChannelImprovements.f08

Plan Description:
Concept Plan Analysis - To evaluate Velocity, Froude, Shear Stress

Plan Summary Information:

Number of:	Cross Sections	= 84	Multiple Openings	=	0
	Culverts	= 1	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options
Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Mixed Flow

FLOW DATA

Flow Title: FIS,100,10,5
Flow File : o:\43089A\MS Rd-Const Ave\HEC-RAS\TheSandsChannelImprovements.f08

Flow Data (cfs)

River	Reach	RS	FIS	100 YR	10 YR	5 YR
East Fork Sand C	Reach 1	4800	1920	1720	950	475

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
East Fork Sand C	Reach 1	FIS	Normal S = 0.0064	Critical
East Fork Sand C	Reach 1	100 YR	Normal S = 0.0064	Critical
East Fork Sand C	Reach 1	10 YR	Normal S = 0.0064	Critical

GEOMETRY DATA

Geometry Title: Proposed and Existing - Vel, Fr, Sh
Geometry File : o:\43089A\MS Rd-Const Ave\HEC-RAS\TheSandsChannelImprovements.g02

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4800

INPUT
Description: Sta 48+00 - Existing Channel
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6515.98	2.9	6515.08	12.95	6508.38	42.95	6508.38	53	6515.08
53.5	6515.58								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.013	12.95	.03	42.95	.013

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.95	42.95	100	100	100	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4700

INPUT
Description: Sta 47+00 - Existing Channel
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6515.34	2.9	6514.44	12.95	6507.74	42.95	6507.74	53	6514.44
53.5	6514.94								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.013	12.95	.03	42.95	.013

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.95	42.95	100	100	100	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4600

INPUT
Description: Sta 46+00 - Existing Channel
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6514.7	2.9	6513.8	12.95	6507.1	42.95	6507.1	53	6513.8
53.5	6514.3								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.013	12.95	.03	42.95	.013

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.95	42.95	79.68	79.68	79.68	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4520.32

INPUT
Description: Sta 45+20.32 - Proposed Channel/Tie to Existing
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6514.19	2.9	6513.29	12.95	6506.59	42.95	6506.59	53	6513.29
53.5	6513.79								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.013	12.95	.03	42.95	.013

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.95	42.95	15.32	15.32	15.32	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4505.00

INPUT
Description: Sta 45+05 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6512.43	15	6506.43	55	6506.43	70	6512.43

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.03	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	28.55	28.55	28.55	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4476.45

INPUT
Description: Sta 44+76.45 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6512.15	15	6506.15	55	6506.15	70	6512.15

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.03	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	10	10	10	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4466.45

INPUT
Description: Sta 44+66.45 - U/S edge of Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6512.05	15	6506.05	55	6506.05	70	6512.05

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.04	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	9	9	9	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4457.45

INPUT
Description: Sta 44+57.45 - Crest of Upper GSB Drop Structure
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6511.96	15	6505.96	55	6505.96	70	6511.96

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	15	.05	55	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	54.3	54.3	54.3	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4429.50

INPUT
Description: Sta 44+29.5 - U/S toe of Dissapator Pool/Bttm of Drop Struct
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-5	6509.3	0	6507.3	15	6501.3	55	6501.3	70	6507.3
75	6509.3								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-5	.06	15	.05	55	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	20	20	20	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4409.50

INPUT
Description: Sta 44+09.5 - D/S toe of Dissapator Pool
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-5	6509.3	0	6507.3	15	6501.3	55	6501.3	70	6507.3
75	6509.3								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-5	.06	15	.05	55	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	15.6	15.6	15.6	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4405.00

INPUT
Description: Sta 44+05 - U/S edge of Apron/Sill of Stilling Basin Pool
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6508.8	15	6502.8	55	6502.8	70	6508.8

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	15	.05	55	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	19	19	19	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4385.95

INPUT
Description: Sta 43+85.95 - Crest of Lower GSB Drop Structure
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6508.7	15	6502.7	55	6502.7	70	6508.7

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	15	.05	55	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	55.3	55.3	55.3	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4357.50

INPUT
Description: Sta 43+57.5 - U/S toe of Dissapator Pool/Bttm of Drop Struct
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-5	6505.96	0	6503.96	15	6497.96	55	6497.96	70	6503.96
75	6505.96								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-5	.06	15	.05	55	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	20	20	20	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4337.50

INPUT
Description: Sta 43+37.5 - D/S toe of Dissapator Pool
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-5	6505.96	0	6503.96	15	6497.96	55	6497.96	70	6503.96
75	6505.96								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-5	.06	15	.05	55	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	15.7	15.7	15.7	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4333.00

INPUT
Description: Sta 43+33 - U/S edge of Apron/Sill of Stilling Basin Pool
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6505.46	15	6499.46	55	6499.46	70	6505.46

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.06	15	.05	55	.06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	14	14	14	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4319.00

INPUT
Description: Sta 43+19 - D/S of Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6505.39	15	6499.39	55	6499.39	70	6505.39

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.04	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	10	10	10	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4309.00

INPUT
Description: Sta 43+09 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6505.34	15	6499.34	55	6499.34	70	6505.34

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.03	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	84	84	84	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4225.00

INPUT
Description: Sta 42+25 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6504.92	15	6498.92	55	6498.92	70	6504.92

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.03	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	104	104	104	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4121.00

INPUT
Description: Sta 41+21 - Proposed Channel
Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6504.41	15	6498.41	55	6498.41	70	6504.41

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.03	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	10	10	10	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4111.00

INPUT
Description: Sta 41+11 - U/S edge of Exist Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6504.36	15	6498.36	55	6498.36	70	6504.36

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.04	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	11	11	11	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4100.10

INPUT
Description: Sta 41+00.1 - Crest of DStruct. No. 4 (3' Vert.)
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6504.3	15	6498.3	30	6498.3	30	6497.8	40	6497.8

40	6498.3	55	6498.3	70	6504.3

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.04	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	.1	.1	.1	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4100.00

INPUT
Description: Sta 41+00 - Bttm of DStruct. No. 5 (3' Vert.)
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6504.3	22.5	6495.3	47.5	6495.3	70	6504.3

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	22.5	.04	47.5	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
22.5	47.5	35	35	35	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4065.00

INPUT
Description: Sta 40+65 - D/S edge of Exist Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6501.13	15	6495.13	55	6495.13	70	6501.13

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.04	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	10	10	10	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 4055.00

INPUT
Description: Sta 40+55 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6501.08	15	6495.08	55	6495.08	70	6501.08

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.03	55	.045

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Bank Sta: Left    Right     Lengths: Left Channel   Right      Coeff Contr.    Expan.
            15       55                105     105    105                .1        .3
CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                 RS: 3950.00

INPUT
Description: Sta 39+50 - Proposed Channel
Station Elevation Data     num=       4
     Sta     Elev       Sta     Elev       Sta     Elev       Sta     Elev
       0  6500.55        15  6494.55        55  6494.55        70  6500.55

Manning's n Values         num=       3
     Sta    n Val       Sta    n Val       Sta    n Val
       0     .045        15      .03        55     .045

Bank Sta: Left    Right     Lengths: Left Channel   Right      Coeff Contr.    Expan.
            15       55                150     150    150                .1        .3
CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                 RS: 3800.00

INPUT
Description: Sta 38+00 - Proposed Channel
Proposed North
Station Elevation Data     num=       4
     Sta     Elev       Sta     Elev       Sta     Elev       Sta     Elev
       0  6499.81        15  6493.81        55  6493.81        70  6499.81

Manning's n Values         num=       3
     Sta    n Val       Sta    n Val       Sta    n Val
       0     .045        15      .03        55     .045

Bank Sta: Left    Right     Lengths: Left Channel   Right      Coeff Contr.    Expan.
            15       55                150     150    150                .1        .3
CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                 RS: 3650.00

INPUT
Description: Sta 36+50 - Proposed Channel
Station Elevation Data     num=       4
     Sta     Elev       Sta     Elev       Sta     Elev       Sta     Elev
       0  6499.05        15  6493.05        55  6493.05        70  6499.05

Manning's n Values         num=       3
     Sta    n Val       Sta    n Val       Sta    n Val
       0     .045        15      .03        55     .045

Bank Sta: Left    Right     Lengths: Left Channel   Right      Coeff Contr.    Expan.
            15       55                150     150    150                .1        .3
CROSS SECTION
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RIVER: East Fork Sand C
REACH: Reach 1                RS: 3500.00

INPUT
Description: Sta 35+00 - Proposed Channel
Station Elevation Data    num=        4
     Sta     Elev      Sta    Elev      Sta     Elev      Sta     Elev
       0   6498.3       15  6492.3       55   6492.3       70   6498.3

Manning's n Values         num=        3
     Sta    n Val      Sta   n Val      Sta    n Val
       0     .045       15     .03       55     .045

Bank Sta: Left    Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
            15       55             107.48  107.48  107.48                .1       .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                RS: 3392.52

INPUT
Description: Sta 33+92.52 - Tie to Existing Channel
Proposed North
              (Beginning STA of plans Sheet CH05)
Station Elevation Data    num=        4
     Sta     Elev      Sta    Elev      Sta     Elev      Sta     Elev
       0 6497.77        15 6491.77       55  6491.77       70  6497.77

Manning's n Values         num=        3
     Sta    n Val      Sta   n Val      Sta    n Val
       0     .045       15     .04       55     .045

Bank Sta: Left    Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
            15       55                 50      50      50                .1       .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                RS: 3342.52

INPUT
Description: Sta 33+42.52 - Existing Channel
Trasition from Kiow Existing to
              Ms Civil Proposed North
Station Elevation Data    num=        4
     Sta     Elev      Sta    Elev      Sta     Elev      Sta     Elev
       0   6496.1     12.5  6491.1     47.5   6491.1       60   6496.1

Manning's n Values         num=        3
     Sta    n Val      Sta   n Val      Sta    n Val
       0     .045     12.5     .03     47.5     .045

Bank Sta: Left    Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
          12.5     47.5              90.52   90.52   90.52                .1       .3

CROSS SECTION


RIVER: East Fork Sand C
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REACH: Reach 1 RS: 3252.00

INPUT
Description: Sta 32+52 - Existing Channel
Existing Channel Kiowa
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6495	12.5	6490	47.5	6490	60	6495

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	12.5	.03	47.5	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	150	150	150	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 3102.00

INPUT
Description: Sta 31+02 - Existing Channel
Existing Channel KiowaExisting
Channel Kiowa
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6493.2	12.5	6488.2	47.5	6488.2	60	6493.2

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	12.5	.03	47.5	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	150	150	150	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 2952.00

INPUT
Description: Sta 29+52 - Existing Channel
Sta 29+52 - Existing Channel Kiowa
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6491.4	12.5	6486.4	47.5	6486.4	60	6491.4

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	12.5	.03	47.5	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	150	150	150	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 2802.00

INPUT
Description: Sta 28+02 - Existing Channel
Existing Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6489.6	12.5	6484.6	47.5	6484.6	60	6489.6

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	12.5	.03	47.5	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	14	14	14	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 2788.00

INPUT
Description: Sta 27+88 - U/S edge of Exist Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
06489.432		12.56484.432		47.56484.432		606489.432	

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	12.5	.03	47.5	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	11	11	11	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 2777.10

INPUT
Description: Sta 27+77.1 - Crest of Exist. 3' Drop Structure
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6489.3	12.5	6484.3	25	6484.3	25	6483.8	35	6483.8
35	6484.3	47.5	6484.3	60	6489.3				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	12.5	.03	47.5	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	.1	.1	.1	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 2777.00

INPUT
Description: Sta 27+77 - Bttm of Exist. 3' Drop Structure
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

0	6489.3	20	6481.3	40	6481.3	60	6489.3

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	20	.03	40	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
20	40	35	35	35	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 2742.00

INPUT
Description: Sta 27+42 - D/S edge of Exist Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6485.88	12.5	6480.88	47.5	6480.88	60	6485.88

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	12.5	.03	47.5	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	140	140	140	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 2602.00

INPUT
Description: Sta 26+02 - Existing Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6484.2	12.5	6479.2	47.5	6479.2	60	6484.2

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	12.5	.03	47.5	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	150	150	150	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 2452.00

INPUT
Description: Sta 24+52 - Existing Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6482.4	12.5	6477.4	47.5	6477.4	60	6482.4

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	12.5	.03	47.5	.045

```
Bank Sta: Left    Right      Lengths: Left Channel   Right      Coeff Contr.    Expan.
          12.5    47.5                 150     150     150                .1        .3
CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                RS: 2302.00

INPUT
Description: Sta 23+02 - Existing Channel
Station Elevation Data    num=       4
     Sta     Elev      Sta    Elev       Sta     Elev       Sta     Elev
       0   6480.6     12.5  6475.6      47.5   6475.6        60   6480.6

Manning's n Values        num=       3
     Sta    n Val      Sta   n Val       Sta    n Val
       0     .045     12.5     .03      47.5     .045

Bank Sta: Left    Right      Lengths: Left Channel   Right      Coeff Contr.    Expan.
          12.5    47.5                 150     150     150                .1        .3
CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                RS: 2152.00

INPUT
Description: Sta 21+52 - Existing Channel
Station Elevation Data    num=       4
     Sta     Elev      Sta    Elev       Sta     Elev       Sta     Elev
       0  6477.17     12.5  6473.8      47.5   6473.8        60  6477.17

Manning's n Values        num=       3
     Sta    n Val      Sta   n Val       Sta    n Val
       0     .045     12.5     .03      47.5     .045

Bank Sta: Left    Right      Lengths: Left Channel   Right      Coeff Contr.    Expan.
          12.5    47.5                 150     150     150                .1        .3
CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                RS: 2002.00

INPUT
Description: Sta 20+02 - Existing Channel
Station Elevation Data    num=       4
     Sta     Elev      Sta    Elev       Sta     Elev       Sta     Elev
       0  6477.17     12.5 6472.17      47.5  6472.17        60  6477.17

Manning's n Values        num=       3
     Sta    n Val      Sta   n Val       Sta    n Val
       0     .045     12.5     .03      47.5     .045

Bank Sta: Left    Right      Lengths: Left Channel   Right      Coeff Contr.    Expan.
          12.5    47.5                  14      14      14                .1        .3
CROSS SECTION
```

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1988.00

INPUT
Description: Sta 19+88 - U/S edge of Exist Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6477	12.5	6472	47.5	6472	60	6477

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	12.5	.03	47.5	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	11	11	11	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1977.10

INPUT
Description: Sta 19+77.1 - Crest of Exist. 3' Drop Structure
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6477	12.5	6472	25	6472	25	6471.5	35	6471.5
35	6472	47.5	6472	60	6477				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	12.5	.03	47.5	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	.1	.1	.1	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1977.00

INPUT
Description: Sta 19+77 - Bttm of Exist. 3' Drop Structure
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6477	20	6469	40	6469	60	6477

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	20	.03	40	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
20	40	35	35	35	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1942.00

INPUT
Description: Sta 19+42 - D/S edge of Exist Riprap Apron

Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6473.58	12.5	6468.58	47.5	6468.58	60	6473.58

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	12.5	.03	47.5	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	40	40	40	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1902.00

INPUT
Description: Sta 19+02 - Existing Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6473.1	12.5	6468.1	47.5	6468.1	60	6473.1

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	12.5	.03	47.5	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	150	150	150	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1752.00

INPUT
Description: Sta 17+52 - Existing Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6471.3	12.5	6466.3	47.5	6466.3	60	6471.3

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	12.5	.03	47.5	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
12.5	47.5	150	150	150	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1602.00

INPUT
Description: Sta 16+02 - Existing Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6469.5	12.5	6464.5	47.5	6464.5	60	6469.5

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val

0	.045	12.5	.03	47.5	.045

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
12.5 47.5 48 48.34 48.37 .1 .3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1553.66

INPUT
Description: Sta 15+53.66 - Tie to Existing Channel Section
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6469.92	15	6463.92	55	6463.92	70	6469.92

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.03	55	.045

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
15 55 73 82.66 94 .1 .3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1471.00

INPUT
Description: Sta 14+71 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6469.5	15	6463.5	55	6463.5	70	6469.5

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.03	55	.045

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
15 55 10 10 10 .1 .3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1461.00

INPUT
Description: Sta 14+61 - U/S edge of Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6469.45	15	6463.45	55	6463.45	70	6469.45

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.04	55	.045

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
15 55 11 11 11 .1 .3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1450.10

INPUT
Description: Sta 14+50.1 - Crest of DStruct. No. 4 (3' Vert.)
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6469.4	15	6463.4	30	6463.4	30	6462.9	40	6462.9
40	6463.4	55	6463.4	70	6469.4				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.04	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	.1	.1	.1	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1450.00

INPUT
Description: Sta 14+50 - Bttm of Wall DStruct. No. 4 (3' Vert.)
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6469.4	22.5	6460.4	47.5	6460.4	70	6469.4

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	22.5	.04	47.5	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
22.5	47.5	32	35	36	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1415.00

INPUT
Description: Sta 14+15 - D/S edge of Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6466.22	15	6460.22	55	6460.22	70	6466.22

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.04	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	10	10	10	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1405.00

```
INPUT
Description: Sta 14+05 - Proposed Channel
Station Elevation Data     num=        4
     Sta     Elev       Sta     Elev       Sta     Elev       Sta     Elev
       0  6466.17        15  6460.17        55  6460.17        70  6466.17

Manning's n Values         num=        3
     Sta    n Val       Sta    n Val       Sta    n Val
       0     .045        15      .03        55     .045

Bank Sta: Left    Right     Lengths: Left Channel    Right       Coeff Contr.    Expan.
            15       55                  84      84       84                .1        .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                 RS: 1321.00

INPUT
Description: Sta 13+21 - Proposed Channel
Station Elevation Data     num=        4
     Sta     Elev       Sta     Elev       Sta     Elev       Sta     Elev
       0  6465.75        15  6459.75        55  6459.75        70  6465.75

Manning's n Values         num=        3
     Sta    n Val       Sta    n Val       Sta    n Val
       0     .045        15      .03        55     .045

Bank Sta: Left    Right     Lengths: Left Channel    Right       Coeff Contr.    Expan.
            15       55                  10      10       10                .1        .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                 RS: 1311.00

INPUT
Description: Sta 13+11 -  U/S edge of Riprap Apron
Station Elevation Data     num=        4
     Sta     Elev       Sta     Elev       Sta     Elev       Sta     Elev
       0   6465.7        15   6459.7        55   6459.7        70   6465.7

Manning's n Values         num=        3
     Sta    n Val       Sta    n Val       Sta    n Val
       0     .045        15      .04        55     .045

Bank Sta: Left    Right     Lengths: Left Channel    Right       Coeff Contr.    Expan.
            15       55                  11      11       11                .1        .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                 RS: 1300.10

INPUT
Description: Sta 13+00.1 - Crest of DStruct. No. 3 (3' Vert.)
Station Elevation Data     num=        8
     Sta     Elev       Sta     Elev       Sta     Elev       Sta     Elev       Sta     Elev
       0  6465.65        15  6459.65        30  6459.65        30  6459.15        40  6459.15
      40  6459.65        55  6459.65        70  6465.65
```

```
Manning's n Values          num=        3
     Sta    n Val      Sta   n Val      Sta    n Val
      0      .045       15     .04       55    .045

Bank Sta: Left    Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
            15       55                   .1      .1       .1               .1       .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1              RS: 1300.00

INPUT
Description: Sta 13+00 - Bttm of Wall DStruct. No. 3 (3' Vert.)
Station Elevation Data      num=        4
     Sta     Elev      Sta    Elev      Sta     Elev       Sta     Elev
       0  6465.65     22.5 6456.65     47.5  6456.65        70  6465.65

Manning's n Values          num=        3
     Sta    n Val      Sta   n Val      Sta    n Val
      0      .045     22.5     .04     47.5    .045

Bank Sta: Left    Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
          22.5     47.5                   35      35       35               .1       .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1              RS: 1265.00

INPUT
Description: Sta 12+65 - D/S edge of Riprap Apron
Station Elevation Data      num=        4
     Sta     Elev      Sta    Elev      Sta     Elev       Sta     Elev
       0  6462.47       15 6456.47       55  6456.47        70  6462.47

Manning's n Values          num=        3
     Sta    n Val      Sta   n Val      Sta    n Val
      0      .045       15     .04       55    .045

Bank Sta: Left    Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
            15       55                   10      10       10               .1       .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1              RS: 1255.00

INPUT
Description: Sta 12+55 - Proposed Channel
Station Elevation Data      num=        4
     Sta     Elev      Sta    Elev      Sta     Elev       Sta     Elev
       0  6462.42       15 6456.42       55  6456.42        70  6462.42

Manning's n Values          num=        3
     Sta    n Val      Sta   n Val      Sta    n Val
      0      .045       15     .03       55    .045

Bank Sta: Left    Right    Lengths: Left Channel   Right      Coeff Contr.   Expan.
```

15	55		86	84	82	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1171.00

INPUT
Description: Sta 11+71 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6462	15	6456	55	6456	70	6462

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.03	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	10	10	10	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1161.00

INPUT
Description: Sta 11+61 - U/S edge of Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6461.95	15	6455.95	55	6455.95	70	6461.95

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.04	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	11	11	11	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1150.10

INPUT
Description: Sta 1150.10 - Crest of DStruct. No. 2 (3' Vert.)
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6461.9	15	6455.9	30	6455.9	30	6455.4	40	6455.4
40	6455.9	55	6455.9	70	6461.9				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.04	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	.1	.1	.1	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1150.00

INPUT
Description: Sta 11+50 - Bttm of Wall DStruct. No. 2 (3' Vert.)
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6461.9	22.5	6452.9	47.5	6452.9	70	6461.9

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	22.5	.04	47.5	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
22.5	47.5	35	35	35	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1115.00

INPUT
Description: Sta 11+15 - D/S edge of Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6458.72	15	6452.72	55	6452.72	70	6458.72

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.04	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	10	10	10	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1105.00

INPUT
Description: Sta 11+05 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6458.67	15	6452.67	55	6452.67	70	6458.67

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.03	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	88	84	82	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1021.00

INPUT
Description: Sta 10+21 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6458.25	15	6452.25	55	6452.25	70	6458.25

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.03	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	10	10	10	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1011.00

INPUT
Description: Sta 10+11 - U/S edge of Riprap Apron
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6458.2	15	6452.2	55	6452.2	70	6458.2

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.04	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	11	11	11	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1000.10

INPUT
Description: Sta 10+00.1 - Crest of DStruct. No. 1 (3' Vert.)
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6458.15	15	6452.15	30	6452.15	30	6451.65	40	6451.65
40	6452.15	55	6452.15	70	6458.15				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.04	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	.1	.1	.1	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 1000.00

INPUT
Description: Sta 10+00 - Bttm of Wall DStruct. No. 1 (3' Vert.)
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6458.15	22.5	6449.15	47.5	6449.15	70	6458.15

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val

```
     0     .045     22.5      .04     47.5     .045

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
          22.5     47.5                35       35      35                .1        .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                RS: 965.00

INPUT
Description: Sta 9+65 - D/S edge of Riprap Apron
Station Elevation Data     num=        4
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0  6454.97       15  6448.97       55  6448.97       70  6454.97

Manning's n Values          num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0     .045       15      .04       55     .045

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
            15       55                10       10      10                .1        .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                RS: 955.00

INPUT
Description: Sta 9+55 - Proposed Channel
Station Elevation Data     num=        4
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0  6454.92       15  6448.92       55  6448.92       70  6454.92

Manning's n Values          num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0     .045       15      .03       55     .045

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
            15       55               130      130     130                .1        .3

CROSS SECTION


RIVER: East Fork Sand C
REACH: Reach 1                RS: 825.00

INPUT
Description: Sta 8+25 - Proposed Channel
Station Elevation Data     num=        4
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0  6454.27       15  6448.27       55  6448.27       70  6454.27

Manning's n Values          num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0     .045       15      .03       55     .045

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
            15       55               125      125     125                .1        .3

CROSS SECTION
```

RIVER: East Fork Sand C
REACH: Reach 1 RS: 700.00

INPUT
Description: Sta 7+00 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6453.65	15	6447.65	55	6447.65	70	6453.65

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.03	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	101	100	99	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 600.00

INPUT
Description: Sta 6+00 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6453.15	15	6447.15	55	6447.15	70	6453.15

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.03	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	155	150	145	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 450.00

INPUT
Description: Sta 4+50 - Proposed Channel
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6452.4	15	6446.4	55	6446.4	70	6452.4

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.03	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	103	100	96	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 350.00

INPUT

Description: Sta 3+50 - Proposed Channel

Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6451.9	15	6445.9	55	6445.9	70	6451.9

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.03	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	151	150	149	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 200.00

INPUT
Description: Sta 2+00 -50' U/S of Box Culvert

Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6451.15	15	6445.15	55	6445.15	70	6451.15

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.03	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	34	34	34	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 166.00

INPUT
Description: Sta 1+66 - 16' U/S of Box Culvert

Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6450.98	15	6444.98	55	6444.98	70	6450.98

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.03	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	145	145	145	.1	.3

CULVERT

RIVER: East Fork Sand C
REACH: Reach 1 RS: 150.00

INPUT
Description: Box Culvert at Constitution Ave
Distance from Upstream XS = 16
Deck/Roadway Width = 115
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 6

```
 Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
   0 6453.98                9 6453.98                9 6453.98
  61 6453.98               61 6453.98               70 6453.98

Upstream Bridge Cross Section Data
Station Elevation Data    num=       4
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
       0  6450.98        9   6444.9       61   6444.9       70  6450.98

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0     .045        9      .03       61     .045

Bank Sta: Left    Right     Coeff Contr.    Expan.
             9       61              .1        .3

Downstream  Deck/Roadway Coordinates
    num=       6
 Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
   0 6453.33                9 6453.33                9 6453.33
  61 6453.33               61 6453.33               70 6453.33

Downstream Bridge Cross Section Data
Station Elevation Data    num=       4
     Sta     Elev      Sta     Elev      Sta     Elev      Sta     Elev
      06450.255         96444.255        616444.255        706450.255

Manning's n Values         num=       3
     Sta    n Val      Sta    n Val      Sta    n Val
       0     .045        9      .04       61     .045

Bank Sta: Left    Right     Coeff Contr.    Expan.
             9       61              .1        .3

Upstream Embankment side slope                    =       0 horiz. to 1.0 vertical
Downstream Embankment side slope                  =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins               =
Energy head used in spillway design               =
Spillway height used in design                    =
Weir crest shape                                  = Broad Crested

Number of Culverts =  1

Culvert Name      Shape       Rise     Span
Constitution         Box         6     12.5
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n   Bottom n  Depth Blocked  Entrance Loss Coef
Exit Loss Coef
                 16     115     .013      .013          0                        .4
     1
Number of Barrels =  4
Upstream    Elevation =  6444.9
Centerline Stations
    Sta.     Sta.     Sta.     Sta.
   15.25    28.42    41.58    54.75
Downstream Elevation =  6444.325
Centerline Stations
    Sta.     Sta.     Sta.     Sta.
   15.25    28.42    41.58    54.75
```

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: 21.00

INPUT
Description: Sta 0+21 -35' D/S of Box Culvert
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6450.255	15	6444.255	55	6444.255	70	6450.255

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.04	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	35	35	35	.1	.3

CROSS SECTION

RIVER: East Fork Sand C
REACH: Reach 1 RS: -14.00

INPUT
Description: Sta -0+14 - 69' D/S of Box Culvert
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6450.08	15	6444.08	55	6444.08	70	6450.08

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	15	.04	55	.045

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
15	55	-14	-14	-14	.1	.3

SUMMARY OF MANNING'S N VALUES

River:East Fork Sand C

Reach	River Sta.	n1	n2	n3
Reach 1	4800	.013	.03	.013
Reach 1	4700	.013	.03	.013
Reach 1	4600	.013	.03	.013
Reach 1	4520.32	.013	.03	.013
Reach 1	4505.00	.045	.03	.045
Reach 1	4476.45	.045	.03	.045
Reach 1	4466.45	.045	.04	.045
Reach 1	4457.45	.06	.05	.06
Reach 1	4429.50	.06	.05	.06
Reach 1	4409.50	.06	.05	.06
Reach 1	4405.00	.06	.05	.06
Reach 1	4385.95	.06	.05	.06
Reach 1	4357.50	.06	.05	.06
Reach 1	4337.50	.06	.05	.06
Reach 1	4333.00	.06	.05	.06
Reach 1	4319.00	.045	.04	.045
Reach 1	4309.00	.045	.03	.045

Reach 1	4225.00	.045	.03	.045
Reach 1	4121.00	.045	.03	.045
Reach 1	4111.00	.045	.04	.045
Reach 1	4100.10	.045	.04	.045
Reach 1	4100.00	.045	.04	.045
Reach 1	4065.00	.045	.04	.045
Reach 1	4055.00	.045	.03	.045
Reach 1	3950.00	.045	.03	.045
Reach 1	3800.00	.045	.03	.045
Reach 1	3650.00	.045	.03	.045
Reach 1	3500.00	.045	.03	.045
Reach 1	3392.52	.045	.04	.045
Reach 1	3342.52	.045	.03	.045
Reach 1	3252.00	.045	.03	.045
Reach 1	3102.00	.045	.03	.045
Reach 1	2952.00	.045	.03	.045
Reach 1	2802.00	.045	.03	.045
Reach 1	2788.00	.045	.03	.045
Reach 1	2777.10	.045	.03	.045
Reach 1	2777.00	.045	.03	.045
Reach 1	2742.00	.045	.03	.045
Reach 1	2602.00	.045	.03	.045
Reach 1	2452.00	.045	.03	.045
Reach 1	2302.00	.045	.03	.045
Reach 1	2152.00	.045	.03	.045
Reach 1	2002.00	.045	.03	.045
Reach 1	1988.00	.045	.03	.045
Reach 1	1977.10	.045	.03	.045
Reach 1	1977.00	.045	.03	.045
Reach 1	1942.00	.045	.03	.045
Reach 1	1902.00	.045	.03	.045
Reach 1	1752.00	.045	.03	.045
Reach 1	1602.00	.045	.03	.045
Reach 1	1553.66	.045	.03	.045
Reach 1	1471.00	.045	.03	.045
Reach 1	1461.00	.045	.04	.045
Reach 1	1450.10	.045	.04	.045
Reach 1	1450.00	.045	.04	.045
Reach 1	1415.00	.045	.04	.045
Reach 1	1405.00	.045	.03	.045
Reach 1	1321.00	.045	.03	.045
Reach 1	1311.00	.045	.04	.045
Reach 1	1300.10	.045	.04	.045
Reach 1	1300.00	.045	.04	.045
Reach 1	1265.00	.045	.04	.045
Reach 1	1255.00	.045	.03	.045
Reach 1	1171.00	.045	.03	.045
Reach 1	1161.00	.045	.04	.045
Reach 1	1150.10	.045	.04	.045
Reach 1	1150.00	.045	.04	.045
Reach 1	1115.00	.045	.04	.045
Reach 1	1105.00	.045	.03	.045
Reach 1	1021.00	.045	.03	.045
Reach 1	1011.00	.045	.04	.045
Reach 1	1000.10	.045	.04	.045
Reach 1	1000.00	.045	.04	.045
Reach 1	965.00	.045	.04	.045
Reach 1	955.00	.045	.03	.045
Reach 1	825.00	.045	.03	.045
Reach 1	700.00	.045	.03	.045
Reach 1	600.00	.045	.03	.045
Reach 1	450.00	.045	.03	.045
Reach 1	350.00	.045	.03	.045

Reach 1	200.00	.045	.03	.045
Reach 1	166.00	.045	.03	.045
Reach 1	150.00	Culvert		
Reach 1	21.00	.045	.04	.045
Reach 1	-14.00	.045	.04	.045

SUMMARY OF REACH LENGTHS

River: East Fork Sand C

Reach	River Sta.	Left	Channel	Right
Reach 1	4800	100	100	100
Reach 1	4700	100	100	100
Reach 1	4600	79.68	79.68	79.68
Reach 1	4520.32	15.32	15.32	15.32
Reach 1	4505.00	28.55	28.55	28.55
Reach 1	4476.45	10	10	10
Reach 1	4466.45	9	9	9
Reach 1	4457.45	54.3	54.3	54.3
Reach 1	4429.50	20	20	20
Reach 1	4409.50	15.6	15.6	15.6
Reach 1	4405.00	19	19	19
Reach 1	4385.95	55.3	55.3	55.3
Reach 1	4357.50	20	20	20
Reach 1	4337.50	15.7	15.7	15.7
Reach 1	4333.00	14	14	14
Reach 1	4319.00	10	10	10
Reach 1	4309.00	84	84	84
Reach 1	4225.00	104	104	104
Reach 1	4121.00	10	10	10
Reach 1	4111.00	11	11	11
Reach 1	4100.10	.1	.1	.1
Reach 1	4100.00	35	35	35
Reach 1	4065.00	10	10	10
Reach 1	4055.00	105	105	105
Reach 1	3950.00	150	150	150
Reach 1	3800.00	150	150	150
Reach 1	3650.00	150	150	150
Reach 1	3500.00	107.48	107.48	107.48
Reach 1	3392.52	50	50	50
Reach 1	3342.52	90.52	90.52	90.52
Reach 1	3252.00	150	150	150
Reach 1	3102.00	150	150	150
Reach 1	2952.00	150	150	150
Reach 1	2802.00	14	14	14
Reach 1	2788.00	11	11	11
Reach 1	2777.10	.1	.1	.1
Reach 1	2777.00	35	35	35
Reach 1	2742.00	140	140	140
Reach 1	2602.00	150	150	150
Reach 1	2452.00	150	150	150
Reach 1	2302.00	150	150	150
Reach 1	2152.00	150	150	150
Reach 1	2002.00	14	14	14
Reach 1	1988.00	11	11	11
Reach 1	1977.10	.1	.1	.1
Reach 1	1977.00	35	35	35
Reach 1	1942.00	40	40	40
Reach 1	1902.00	150	150	150

Reach 1	1752.00	150	150	150
Reach 1	1602.00	48	48.34	48.37
Reach 1	1553.66	73	82.66	94
Reach 1	1471.00	10	10	10
Reach 1	1461.00	11	11	11
Reach 1	1450.10	.1	.1	.1
Reach 1	1450.00	32	35	36
Reach 1	1415.00	10	10	10
Reach 1	1405.00	84	84	84
Reach 1	1321.00	10	10	10
Reach 1	1311.00	11	11	11
Reach 1	1300.10	.1	.1	.1
Reach 1	1300.00	35	35	35
Reach 1	1265.00	10	10	10
Reach 1	1255.00	86	84	82
Reach 1	1171.00	10	10	10
Reach 1	1161.00	11	11	11
Reach 1	1150.10	.1	.1	.1
Reach 1	1150.00	35	35	35
Reach 1	1115.00	10	10	10
Reach 1	1105.00	88	84	82
Reach 1	1021.00	10	10	10
Reach 1	1011.00	11	11	11
Reach 1	1000.10	.1	.1	.1
Reach 1	1000.00	35	35	35
Reach 1	965.00	10	10	10
Reach 1	955.00	130	130	130
Reach 1	825.00	125	125	125
Reach 1	700.00	101	100	99
Reach 1	600.00	155	150	145
Reach 1	450.00	103	100	96
Reach 1	350.00	151	150	149
Reach 1	200.00	34	34	34
Reach 1	166.00	145	145	145
Reach 1	150.00	Culvert		
Reach 1	21.00	35	35	35
Reach 1	-14.00	-14	-14	-14

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: East Fork Sand C

Reach	River Sta.	Contr.	Expan.
Reach 1	4800	.1	.3
Reach 1	4700	.1	.3
Reach 1	4600	.1	.3
Reach 1	4520.32	.1	.3
Reach 1	4505.00	.1	.3
Reach 1	4476.45	.1	.3
Reach 1	4466.45	.1	.3
Reach 1	4457.45	.1	.3
Reach 1	4429.50	.1	.3
Reach 1	4409.50	.1	.3
Reach 1	4405.00	.1	.3
Reach 1	4385.95	.1	.3
Reach 1	4357.50	.1	.3
Reach 1	4337.50	.1	.3
Reach 1	4333.00	.1	.3
Reach 1	4319.00	.1	.3

Reach 1	4309.00	.1	.3
Reach 1	4225.00	.1	.3
Reach 1	4121.00	.1	.3
Reach 1	4111.00	.1	.3
Reach 1	4100.10	.1	.3
Reach 1	4100.00	.1	.3
Reach 1	4065.00	.1	.3
Reach 1	4055.00	.1	.3
Reach 1	3950.00	.1	.3
Reach 1	3800.00	.1	.3
Reach 1	3650.00	.1	.3
Reach 1	3500.00	.1	.3
Reach 1	3392.52	.1	.3
Reach 1	3342.52	.1	.3
Reach 1	3252.00	.1	.3
Reach 1	3102.00	.1	.3
Reach 1	2952.00	.1	.3
Reach 1	2802.00	.1	.3
Reach 1	2788.00	.1	.3
Reach 1	2777.10	.1	.3
Reach 1	2777.00	.1	.3
Reach 1	2742.00	.1	.3
Reach 1	2602.00	.1	.3
Reach 1	2452.00	.1	.3
Reach 1	2302.00	.1	.3
Reach 1	2152.00	.1	.3
Reach 1	2002.00	.1	.3
Reach 1	1988.00	.1	.3
Reach 1	1977.10	.1	.3
Reach 1	1977.00	.1	.3
Reach 1	1942.00	.1	.3
Reach 1	1902.00	.1	.3
Reach 1	1752.00	.1	.3
Reach 1	1602.00	.1	.3
Reach 1	1553.66	.1	.3
Reach 1	1471.00	.1	.3
Reach 1	1461.00	.1	.3
Reach 1	1450.10	.1	.3
Reach 1	1450.00	.1	.3
Reach 1	1415.00	.1	.3
Reach 1	1405.00	.1	.3
Reach 1	1321.00	.1	.3
Reach 1	1311.00	.1	.3
Reach 1	1300.10	.1	.3
Reach 1	1300.00	.1	.3
Reach 1	1265.00	.1	.3
Reach 1	1255.00	.1	.3
Reach 1	1171.00	.1	.3
Reach 1	1161.00	.1	.3
Reach 1	1150.10	.1	.3
Reach 1	1150.00	.1	.3
Reach 1	1115.00	.1	.3
Reach 1	1105.00	.1	.3
Reach 1	1021.00	.1	.3
Reach 1	1011.00	.1	.3
Reach 1	1000.10	.1	.3
Reach 1	1000.00	.1	.3
Reach 1	965.00	.1	.3
Reach 1	955.00	.1	.3
Reach 1	825.00	.1	.3
Reach 1	700.00	.1	.3
Reach 1	600.00	.1	.3
Reach 1	450.00	.1	.3

Reach 1	350.00		.1	.3
Reach 1	200.00		.1	.3
Reach 1	166.00		.1	.3
Reach 1	150.00	Culvert		
Reach 1	21.00		.1	.3
Reach 1	-14.00		.1	.3

EXIST

PROP

HEC-RAS Plan: Concept D[illegible] River: East Fork Sand C Reach: Reach 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Max Chl Dpth (ft)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Shear LOB (lb/sq ft)	Shear Chan (lb/sq ft)	Shear ROB (lb/sq ft)	Flow Area (sq ft)	Froude # Chl
Reach 1	4800	FIS	1920.00	6506.38	6512.93	6513.05	6515.04	0.006401	4.55	13.99	10.88	13.[illegible]	0.76	1.82	0.76	167.57	0.90
Reach 1	4800	100 YR	1720.00	6506.38	6512.67	6512.73	6514.62	0.006399	4.29	13.46	10.47	13.46	0.71	1.72	0.71	156.43	0.89
Reach 1	4800	10 YR	950.00	6506.38	6511.50	6511.38	6512.73	0.006381	3.12	10.87	8.45	10.87	0.52	1.24	0.52	108.24	0.84
Reach 1	4800	5 YR	475.00	6506.38	6510.51	6510.30	6511.23	0.006398	2.13	8.42	6.56	8.42	0.35	0.86	0.35	70.56	0.79
Reach 1	4700	FIS	1920.00	6507.74	6512.36	6512.41	6514.40	0.006065	4.61	13.77	10.70	13.77	0.73	1.75	0.73	170.24	0.88
Reach 1	4700	100 YR	1720.00	6507.74	6512.06	6512.09	6513.98	0.006229	4.32	13.34	10.36	13.34	0.70	1.68	0.70	157.78	[illegible]
Reach 1	4700	10 YR	950.00	6507.74	6510.87	6510.73	[illegible]512.09	0.006337	3.13	10.84	8.43	10.84	0.61	1.24	0.51	106.48	0.84
Reach 1	4700	5 YR	475.00	6507.74	6509.87		6510.[illegible]	0.006390	2.13	8.42	6.55	8.42	0.35	0.85	0.35	70.59	0.79
Reach 1	4600	FIS	1920.00	6507.10	6511.64	6511.77	6513.76	0.006440	4.54	14.02	10.90	14.02	0.76	1.83	0.76	167.25	0.90
Reach 1	4600	100 YR	1720.00	6507.10	6511.39	6511.45	6513.34	0.006432	4.29	13.46	10.48	13.46	0.72	1.72	0.72	156.18	0.89
Reach 1	4600	10 YR	950.00	6507.10	6510.34	6510.09	6511.47	0.005579	3.24	10.41	8.10	10.41	0.47	1.13	0.47	112.84	0.79
Reach 1	4600	5 YR	475.00	6507.10	6509.34		6509.98	0.005336	2.24	7.96	6.19	7.96	0.31	0.75	0.31	74.61	0.73
Reach 1	4520.32	FIS	1920.00	6506.59	6511.15	6511.28	6513.25	0.006377	4.55	13.98	10.87	13.98	0.75	1.81	0.75	167.76	0.90
Reach 1	4520.32	100 YR	1720.00	6506.[illegible]	6510.88	6510.94	6512.83	0.006399	4.29	13.46	10.47	13.46	0.71	1.72	0.71	156.43	0.89
Reach 1	4520.32	10 YR	950.00	6506.59	6509.59	6509.59	6510.94	0.007418	3.00	11.40	8.86	11.40	0.56	1.39	0.56	103.33	0.90
Reach 1	4520.32	5 YR	475.00	6506.59	6508.51	6508.51	6509.41	0.009206	1.92	9.44	7.34	9.44	0.46	1.10	0.46	63.13	0.93
Reach 1	4505.00	FIS	1920.00	6506.43	6509.27	6510.37	6512.92	0.025143	2.84	6.30	15.76	6.30	2.07	4.46	2.07	133.94	1.65
Reach 1	4505.00	100 YR	1720.00	6506.43	6509.07	6510.12	6512.50	0.025963	2.64	6.10	15.26	6.10	1.[illegible]	4.28	1.99	123.21	1.65
Reach 1	4505.00	10 YR	950.00	6506.43	6508.23	6508.95	6510.62	0.029719	1.80	5.05	12.53	5.06	1.55	3.34	1.55	80.07	1.66
Reach 1	4505.00	5 YR	475.00	6506.43	6507.59	6508.03	6509.10	0.033323	1.16	3.96	9.97	3.96	1.12	2.41	1.12	49.[illegible]	1.63
Reach 1	4476.45	FIS	1920.00	6506.15	6509.45	6510.09	6512.06	0.015000	3.30	5.37	13.44	5.37	1.43	3.09	1.43	1[illegible].16	1.30
Reach 1	4476.45	100 YR	1720.00	6506.15	6509.29	6509.84	6511.84	0.014315	3.14	5.06	12.70	5.06	1.30	2.81	1.30	150.18	1.26
Reach 1	4476.45	10 YR	950.00	6506.15	6508.97	6508.67	6509.88	0.006350	2.82	3.15	7.87	3.15	0.52	1.12	0.52	132.57	0.83
Reach 1	4476.45	5 YR	475.00	6506.16	6508.02	6507.76	6508.57	0.006459	1.87	2.42	6.05	2.42	0.35	0.76	0.35	83.76	0.76
Reach 1	4466.45	FIS	1920.00	6506.05	6509.30	6509.94	6511.67	0.02[illegible]347	3.25	7.11	13.34	7.11	2.53	5.44	2.53	156.19	1.31
Reach 1	4466.4[illegible]	100 YR	1720.00	6506.05	6510.20	6509.[illegible]	6511.36	0.009009	4.15	4.85	9.10	4.85	1.08	2.33	1.08	209.02	0.79
Reach 1	4466.45	10 YR	950.00	6506.05	6508.96	6508.54	6509.77	0.009603	2.91	3.96	7.43	3.96	0.81	1.76	0.81	137.82	0.77
Reach 1	4466.45	5 YR	475.00	6506.05	6507.[illegible]	6507.64	6508.46	0.00[illegible]760	1.94	3.07	5.76	3.07	0.56	1.21	0.56	86.79	0.73
Reach 1	4457.45	FIS	1920.00	6505.96	6509.[illegible]	6509.86	6511.58	0.022224	3.90	5.48	10.97	5.48	2.51	6.41	2.51	193.96	0.96
Reach 1	4457.45	100 YR	1720.00	6505.96	6509.81	6509.81	6511.21	0.022493	3.66	5.28	10.57	5.28	2.38	6.13	2.38	179.41	0.96
Reach 1	4457.45	10 YR	950.00	6505.[illegible]	6508.46	6508.45	6509.60	0.026161	2.49	4.42	8.84	4.42	1.89	4.07	1.89	115.27	0.[illegible]
Reach 1	4457.45	5 YR	475.00	6505.96	6507.55	6507.35	[illegible]508.31	0.030641	1.59	3.55	7.10	3.55	1.42	3.05	1.42	70.10	0.[illegible]
Reach 1	4429.50	FIS	1920.00	6501.30	6508.45	6505.20	6508.85	0.002476	7.15	2.74	5.49	2.74	0.51	1.11	0.51	413.80	0.36
Reach 1	4429.50	100 YR	1720.00	6501.30	6508.11	6504.95	6508.48	0.002373	6.81	2.60	5.20	2.60	0.47	1.01	0.47	388.63	0.35
Reach 1	4429.50	10 YR	950.00	6501.30	6506.62	6503.79	6506.82	0.001795	5.32	1.91	3.83	1.91	0.28	0.59	0.26	283.64	0.29
Reach 1	4429.50	5 YR	475.00	6501.30	6505.39	6502.89	[illegible]505.48	0.001150	4.09	1.29	2.58	1.29	0.14	0.29	0.14	205.29	0.22
Reach 1	4409.50	FIS	1920.00	6501.30	6508.39		6508.60	0.002554	7.09	2.77	5.54	2.77	0.52	1.13	0.52	409.26	0.37
Reach 1	4409.50	100 YR	1720.00	6501.30	6508.06		6508.43	0.002447	6.76	2.63	5.25	2.63	0.48	1.03	0.48	384.45	0.36
Reach 1	4409.50	10 YR	950.00	6501.30	6506.58		6506.79	0.001836	5.28	1.93	3.86	1.93	0.28	0.61	0.28	280.95	0.30
Reach 1	4409.50	5 YR	475.00	6501.30	6505.36		6505.46	0.001175	4.06	1.30	2.59	1.30	0.14	0.30	0.14	203.76	0.23
Reach 1	4405.00	FIS	1920.00	6502.80	6507.61	6506.70	6508.67	0.010489	4.81	4.33	8.67	4.33	1.46	3.15	1.46	250.31	0.70
Reach 1	4405.00	100 YR	1720.00	6502.80	6507.32	6506.46	6508.30	0.010538	4.52	4.17	8.34	4.17	1.38	2.97	1.38	231.82	0.69
Reach 1	4405.00	10 YR	950.00	6502.80	6506.05	6505.29	6506.[illegible]	0.010320	3.25	3.31	6.63	3.31	0.97	2.10	0.97	156.57	0.65
Reach 1	4405.00	5 YR	475.00	6502.80	6505.02	6504.39	6505.39	0.009773	2.22	2.50	5.00	2.50	0.63	1.35	0.63	101.16	0.[illegible]
Reach 1	4385.96	FIS	1920.00	6502.70	6506.80	6505.80	6508.32	0.022224	3.90	5.48	10.97	5.48	2.51	6.41	2.51	193.96	0.96
Reach 1	4385.96	100 YR	1720.00	6502.70	6506.35	6506.35	6507.96	0.022493	3.66	5.28	10.57	5.26	2.38	6.13	2.38	179.41	0.96
Reach 1	4385.96	10 YR	950.00	6502.70	6505.19	6505.19	6506.34	0.026161	2.49	4.42	8.84	4.42	1.[illegible]	4.07	1.89	115.27	0.[illegible]
Reach 1	4385.96	5 YR	475.00	6502.70	6504.29	6504.29	6505.05	0.030641	1.[illegible]	3.55	7.10	3.55	1.42	3.05	1.42	70.10	0.99
Reach 1	4367.50	FIS	1920.00	6497.96	6505.14	6501.86	6505.54	0.002435	7.18	2.73	5.46	2.73	0.51	1.09	0.51	416.24	0.36
Reach 1	4367.50	100 YR	1720.00	6497.96	6504.80	6501.61	6505.16	0.002342	6.84	2.59	5.18	2.[illegible]	0.46	1.00	0.46	390.44	0.35
Reach 1	4367.50	10 YR	950.00	6497.96	6503.28	6500.45	6503.48	0.001792	5.32	1.91	3.83	1.91	0.28	0.[illegible]	0.28	263.25	0.29
Reach 1	4367.50	5 YR	475.00	6497.96	6502.02	6499.55	6502.12	0.001174	4.06	1.30	2.59	1.30	0.14	0.30	0.14	203.85	0.23
Reach 1	4337.50	FIS	1920.00	6497.96	6505.06		6505.49	0.002510	7.12	2.76	5.51	2.75	0.52	1.12	0.52	411.80	0.36
Reach 1	4337.50	100 YR	1720.00	6497.96	6504.74		6505.11	0.002414	6.78	2.61	5.23	2.61	0.47	1.02	0.47	386.32	0.35
Reach 1	4337.50	10 YR	950.00	6497.96	6503.24		6503.44	0.001843	5.27	1.93	3.87	1.93	0.28	0.61	0.28	280.56	0.30
Reach 1	4337.50	5 YR	475.00	6497.96	6502.00		6502.10	0.001201	4.04	1.30	2.81	1.30	0.14	0.30	0.14	202.29	0.23
Reach 1	4333.00	FIS	1920.00	6499.46	6504.34		6505.36	0.009977	4.88	4.27	8.54	4.27	1.41	3.04	1.41	254.83	0.[illegible]
Reach 1	4333.00	100 YR	1720.00	6499.46	6504.03		6504.98	0.010128	4.57	4.11	8.24	4.11	1.34	2.89	1.34	234.97	0.[illegible]
Reach 1	4333.00	10 YR	950.00	6499.46	6502.70		6503.34	0.010451	3.24	3.32	6.65	3.32	0.98	2.11	0.98	166.91	0.65
Reach 1	4333.00	5 YR	475.00	6499.46	6501.64		6502.02	0.010424	2.18	2.56	5.10	2.55	0.[illegible]	1.42	0.[illegible]	[illegible].07	0.61
Reach 1	4319.00	FIS	1920.00	6499.39	6504.22		6505.25	0.006490	4.83	4.56	8.55	4.56	0.91	1.96	0.91	251.72	0.[illegible]
Reach 1	4319.00	100 YR	1720.00	6[illegible].39	6503.91		6504.87	0.006647	4.52	4.41	8.26	4.41	0.87	1.87	0.87	231.66	0.[illegible]
Reach 1	4319.00	10 YR	950.00	6499.39	6502.55		6503.22	0.007249	3.16	3.63	6.81	3.63	0.66	1.43	0.66	151.21	0.[illegible]
Reach 1	4319.00	5 YR	475.00	6499.39	6501.48		[illegible]501.90	0.007704	2.09	2.84	5.32	2.84	0.47	1.00	0.47	94.3[illegible]	0.55
Reach 1	4309.00	FIS	1920.00	6499.34	6503.90		6505.17	0.004816	4.56	3.78	9.45	3.78	0.64	1.37	0.64	234.38	0.78
Reach 1	4309.00	100 YR	1720.00	6[illegible].34	6503.61		6504.79	0.004854	4.27	3.63	9.09	3.63	0.60	1.30	0.60	216.65	0.78
Reach 1	4309.00	10 YR	950.00	6[illegible].34	6502.37		6503.16	0.004916	3.03	2.91	7.28	2.91	0.43	0.[illegible]	0.43	144.33	0.74
Reach 1	4309.00	5 YR	475.00	6[illegible].34	6501.37		6501.83	0.004942	2.03	2.23	5.58	2.23	0.29	0.63	0.29	91.34	0.[illegible]
Reach 1	4225.00	FIS	1920.00	6498.92	6503.52		6504.76	0.004676	4.60	3.74	9.36	3.74	0.62	1.34	0.62	236.75	0.77
Reach 1	4225.00	100 YR	1720.00	6498.92	6503.23		6504.39	0.004711	4.31	3.60	9.00	3.60	0.59	1.27	0.59	218.90	0.76
Reach 1	4225.00	10 YR	950.00	6498.92	6501.97		6502.74	0.004807	3.05	2.89	7.23	2.89	0.43	0.92	0.43	146.43	0.73
Reach 1	4225.00	5 YR	475.00	6498.92	6500.98		6501.42	0.004817	2.04	2.21	5.53	2.21	0.29	0.61	0.29	92.10	0.[illegible]
Reach 1	4121.00	FIS	1920.00	6498.41	6502.47	6502.36	6504.12	0.007263	4.06	4.29	10.74	4.29	0.85	1.34	0.85	203.49	0.94
Reach 1	4121.00	100 YR	1720.00	6498.41	6502.22	6502.10	6503.75	0.007246	3.81	4.11	10.29	4.11	0.80	1.73	0.80	1[illegible].92	0.93
Reach 1	4121.00	10 YR	950.00	6[illegible].41	6501.15	6500.93	6502.12	0.00[illegible]	2.74	3.24	8.11	3.24	0.58	1.20	0.56	128.41	0.86
Reach 1	4121.00	5 YR	475.00	6498.41	6500.28		6500.63	0.006464	1.87	2.42	6.05	2.42	0.35	0.76	0.35	83.74	0.78
Reach 1	4111.00	FIS	1920.00	6498.36	6502.51	6502.25	6503.96	0.011240	4.15	5.42	10.17	5.42	1.35	2.91	1.35	208.93	0.[illegible]
Reach 1	4111.00	100 YR	1720.00	6498.36	6502.24	6501.99	6503.61	0.011449	3.88	5.23	9.81	5.23	1.29	2.77	1.29	192.83	0.88
Reach 1	4111.00	10 YR	950.00	6498.36	6501.08	6500.85	6502.02	0.012315	2.71	4.28	8.02	4.28	0.97	2.09	0.97	127.02	0.[illegible]
Reach 1	4111.00	5 YR	475.00	6498.36	6500.15		6500.74	0.013091	1.79	3.33	6.26	3.33	0.[illegible]	1.46	0.[illegible]	79.[illegible]	0.82
Reach 1	4100.10	FIS	1920.00	6497.80	6502.09	6502.09	6503.80	0.014490	4.29	5.79	10.93	5.79	1.59	3.46	1.59	192.57	0.97
Reach 1	4100.10	100 YR	1720.00	6497.80	6501.83	6501.83	6503.44	0.014836	4.03	5.59	10.57	5.59	1.52	3.30	1.52	177.48	0.97
Reach 1	4100.10	10 YR	950.00	6497.80	6500.68	6500.68	6501.83	0.017228	2.88	4.63	8.84	4.63	1.19	2.63	1.19	114.20	0.99
Reach 1	4100.10	5 YR	475.00	6497.80	6499.78	6499.78	6500.54	0.020046	1.98	3.64	7.09	3.64	0.86	1.96	0.86	69.55	0.[illegible]
Reach 1	4100.00	FIS	1920.00	6495.30	6498.51	6500.29	6503.50	0.045330	3.61	9.84	18.45	9.84	4.71	10.14	4.71	118.39	1.74
Reach 1	4100.00	100 YR	1720.00	6495.30	6498.53	6[illegible].97	6503.13	0.050369	3.23	9.70	18.20	9.70	4.71	10.14	4.71	106.65	1.79

HEC-RAS Plan: Concept Desl River: East Fork Sand C Reach: Reach 1 (Continued)

PROP

EXIST

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Max Chl Dpth	Vel Left	Vel Chnl	Vel Right	Shear LOB	Shear Chan	Shear ROB	Flow Area	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft)	(ft/s)	(ft/s)	(ft/s)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(sq ft)	
Reach 1	4100.00	10 YR	950.00	6495.30	6497.31	6496.56	6501.52	0.063122	2.01	9.09	17.06	9.09	4.85	10.44	4.85	60.39	2.12
Reach 1	4100.00	5 YR	475.00	6495.30	6496.42	6497.41	6500.23	0.158416	1.12	8.61	16.97	8.61	5.15	11.10	5.16	31.21	2.66
Reach 1	4065.00	FIS	1920.00	6495.13	6497.90	6499.02	6501.57	0.046623	2.77	8.44	15.84	8.44	3.76	8.06	3.76	130.22	1.60
Reach 1	4065.00	100 YR	1720.00	6495.13	6497.76	6498.76	6501.06	0.045352	2.63	8.02	15.06	8.02	3.45	7.44	3.45	122.26	1.64
Reach 1	4065.00	10 YR	950.00	6495.13	6496.28	6497.62	6498.95	0.007328	3.16	3.64	6.83	3.64	0.67	1.44	0.67	150.[illegible]	0.66
Reach 1	4065.00	5 YR	475.00	6495.13	6497.21	6496.72	6497.63	0.007779	2.08	2.85	5.34	2.85	0.47	1.01	0.47	94.02	0.65
Reach 1	4055.00	FIS	1920.00	6495.08	6499.60	6499.02	6500.89	0.004983	4.62	3.82	9.55	3.82	0.65	1.40	0.65	231.60	0.79
Reach 1	4055.00	100 YR	1720.00	6495.08	6499.32	6496.77	6500.52	0.004994	4.24	3.67	9.17	3.67	0.61	1.32	0.61	214.56	0.79
Reach 1	4055.00	10 YR	950.00	6495.08	6498.10		6498.88	0.005007	3.02	2.93	7.32	2.93	0.44	0.94	0.44	143.47	0.74
Reach 1	4055.00	5 YR	475.00	6495.08	6497.10		6497.57	0.005024	2.02	2.24	5.60	2.24	0.29	0.63	0.29	90.86	0.70
Reach 1	3950.00	FIS	1920.00	6494.55	6499.06		6500.37	0.004921	4.53	3.80	9.61	3.80	0.65	1.39	0.65	232.61	0.79
Reach 1	3950.00	100 YR	1720.00	6494.55	6498.60		6500.00	0.004936	4.25	3.65	9.14	3.65	0.61	1.31	0.61	215.43	0.76
Reach 1	3950.00	10 YR	950.00	6494.55	6497.58		6498.36	0.004935	3.03	2.91	7.29	2.91	0.43	0.93	0.43	144.17	0.74
Reach 1	3950.00	5 YR	475.00	6494.55	6496.58		6497.04	0.004909	2.03	2.22	5.57	2.22	0.29	0.62	0.29	91.54	0.69
Reach 1	3800.00	FIS	1920.00	6493.81	6498.35		6499.63	0.004906	4.54	3.80	9.51	3.80	0.65	1.39	0.65	232.83	0.79
Reach 1	3800.00	100 YR	1720.00	6493.81	6498.06		6499.26	0.004942	4.26	3.65	9.14	3.65	0.61	1.31	0.61	216.34	0.76
Reach 1	3800.00	10 YR	950.00	6493.81	6496.82		6497.61	0.005027	3.01	2.93	7.33	2.93	0.44	0.95	0.44	143.26	0.74
Reach 1	3800.00	5 YR	475.00	6493.81	6495.82		6496.29	0.005070	2.01	2.25	5.62	2.26	0.30	0.64	0.30	90.59	0.70
Reach 1	3650.00	FIS	1920.00	6493.05	6497.67		6498.90	0.004592	4.62	3.72	9.31	3.72	0.62	1.32	0.62	238.23	0.76
Reach 1	3650.00	100 YR	1720.00	6493.05	6497.38		6498.52	0.004551	4.33	3.58	8.97	3.58	0.58	1.26	0.58	219.87	0.76
Reach 1	3650.00	10 YR	950.00	6493.05	6496.19		6496.87	0.004826	3.05	2.89	7.24	2.89	0.43	0.92	0.43	145.25	0.73
Reach 1	3650.00	5 YR	475.00	6493.05	6495.06		6495.54	0.004917	2.03	2.23	5.57	2.23	0.29	0.62	0.29	91.49	0.69
Reach 1	3500.00	FIS	1920.00	6492.30	6497.10		6498.23	0.004016	4.80	3.57	8.93	3.57	0.56	1.20	0.56	249.56	0.72
Reach 1	3500.00	100 YR	1720.00	6492.30	6496.79		6497.84	0.004089	4.49	3.44	8.62	3.44	0.53	1.15	0.53	229.63	0.72
Reach 1	3500.00	10 YR	950.00	6492.30	6495.46		6496.17	0.004260	3.16	2.78	6.96	2.78	0.39	0.84	0.39	151.43	0.69
Reach 1	3500.00	5 YR	475.00	6492.30	6494.46		6494.[illegible]	0.004052	2.15	2.10	5.26	2.10	0.26	0.54	0.26	97.43	0.63
Reach 1	3392.52	FIS	1920.00	6491.77	6496.66		6497.66	0.006213	4.89	4.50	8.44	4.50	0.88	1.90	0.88	255.48	0.67
Reach 1	3392.52	100 YR	1720.00	6491.77	6496.31		6497.27	0.006507	4.54	4.38	8.22	4.38	0.86	1.85	0.86	233.35	0.68
Reach 1	3392.52	10 YR	950.00	6491.77	6494.84		6495.55	0.008011	3.07	3.74	7.02	3.74	0.71	1.53	0.71	146.30	0.71
Reach 1	3392.52	5 YR	475.00	6491.77	6493.72		6494.21	0.009884	1.95	3.04	5.71	3.04	0.56	1.18	0.56	87.69	0.72
Reach 1	3342.52	FIS	1920.00	6491.10	6495.36	6495.35	6497.22	0.007833	4.25	4.60	11.51	4.60	0.97	2.08	0.97	194.02	0.98
Reach 1	3342.52	100 YR	1720.00	6491.10	6495.07	6495.07	6496.83	0.008036	3.97	4.45	11.13	4.46	0.92	1.99	0.92	178.20	0.98
Reach 1	3342.52	10 YR	950.00	6491.10	6493.62	6493.82	6495.07	0.009214	2.72	3.70	9.26	3.70	0.73	1.56	0.73	113.66	0.99
Reach 1	3342.52	5 YR	475.00	6491.10	6492.84	6492.84	6493.[illegible]	0.010718	1.74	2.97	7.42	2.97	0.54	1.17	0.54	[illegible].54	0.9[illegible]
Reach 1	3252.00	FIS	1920.00	6490.00	6493.72	6494.25	6496.26	0.012582	3.72	5.33	13.34	5.33	1.36	2.92	1.36	164.73	1.22
Reach 1	3252.00	100 YR	1720.00	6490.00	6493.48	6493.97	6495.85	0.012811	3.48	5.14	12.86	5.14	1.29	2.76	1.29	151.84	1.22
Reach 1	3252.00	10 YR	950.00	6490.00	6492.43	6492.72	6494.03	0.013590	2.43	4.17	10.44	4.17	0.96	2.06	0.9[illegible]	[illegible].87	1.16
Reach 1	3252.00	5 YR	475.00	6490.00	6491.53	6491.74	6492.58	0.013398	1.63	3.18	7.95	3.18	0.63	1.36	0.63	63.77	1.10
Reach 1	3102.00	FIS	1920.00	6488.20	6492.02	6492.45	6494.41	0.011498	3.81	5.18	12.97	5.18	1.27	2.74	1.27	1[illegible].91	1.17
Reach 1	3102.00	100 YR	1720.00	6488.20	6491.81	6492.17	6493.[illegible]	0.011201	3.61	4.93	12.34	4.93	1.17	2.52	1.17	158.97	1.14
Reach 1	3102.00	10 YR	950.00	6488.20	6490.62	6490.92	6492.18	0.010511	2.62	3.86	9.65	3.86	0.80	1.72	0.80	108.77	1.05
Reach 1	3102.00	5 YR	475.00	64[illegible].20	6489.93	64[illegible].94	6490.77	0.011065	1.73	3.00	7.60	3.00	0.55	1.19	0.55	67.84	1.01
Reach 1	2952.00	FIS	1920.00	6486.40	6490.16	6490.65	6492.64	0.012062	3.76	5.26	13.17	5.26	1.32	2.84	1.32	167.04	1.20
Reach 1	2952.00	100 YR	1720.00	6486.40	6489.[illegible]	6490.37	6492.23	0.012174	3.53	5.06	12.66	5.06	1.24	2.[illegible]	1.24	154.61	1.19
Reach 1	2952.00	10 YR	950.00	6486.40	6488.87	6489.12	6490.42	0.012616	2.47	4.10	10.25	4.10	0.92	1.98	0.92	101.63	1.15
Reach 1	2952.00	5 YR	475.00	6486.40	64[illegible].06	6488.14	6488.97	0.012706	1.6[illegible]	3.18	7.82	3.18	0.61	1.31	0.61	64.67	1.07
Reach 1	2802.00	FIS	1920.00	6484.60	6488.36	6488.86	6490.83	0.011934	3.77	5.24	13.12	5.24	1.31	2.81	1.31	167.76	1.19
Reach 1	2802.00	100 YR	1720.00	6484.60	64[illegible].16	6488.57	6490.41	0.011636	3.55	5.02	12.56	5.02	1.22	2.63	1.22	158.00	1.17
Reach 1	2802.00	10 YR	950.00	6484.60	6487.17	6487.32	64[illegible].59	0.011176	2.57	3.93	9.83	3.93	0.83	1.79	0.83	106.57	1.06
Reach 1	2802.00	5 YR	475.00	6484.60	6486.32	6486.34	6487.17	0.011205	1.72	3.01	7.52	3.01	0.56	1.20	0.56	67.56	1.01
Reach 1	27[illegible].00	FIS	1920.00	6484.43	6488.21	64[illegible].68	6490.[illegible]	0.011984	3.77	5.24	13.12	5.24	1.31	2.81	1.31	167.76	1.19
Reach 1	2788.00	100 YR	1720.00	6484.43	6487.[illegible]	6488.40	6490.26	0.011[illegible]	3.56	5.02	12.56	5.02	1.22	2.63	1.22	158.00	1.17
Reach 1	2788.00	10 YR	950.00	6484.43	6487.04	6487.15	6488.41	0.010724	2.60	3.[illegible]	9.71	3.[illegible]	0.81	1.74	0.81	106.05	1.06
Reach 1	27[illegible].00	5 YR	475.00	6484.43	6486.17	6486.17	6487.00	0.010663	1.73	2.98	7.46	2.98	0.55	1.18	0.55	[illegible].24	1.00
Reach 1	2777.10	FIS	1920.00	6483.80	6487.63	6488.46	6490.50	0.013662	4.08	5.41	13.63	5.41	1.42	3.09	1.42	159.64	1.25
Reach 1	2777.10	100 YR	1720.00	6483.80	6487.50	6488.15	6490.08	0.013956	3.80	5.19	13.10	5.19	1.34	2.92	1.34	147.79	1.24
Reach 1	2777.10	10 YR	950.00	6483.80	6486.55	6486.90	64[illegible].25	0.015084	2.75	4.18	10.69	4.18	0.99	2.19	0.[illegible]	96.59	1.22
Reach 1	2777.10	5 YR	475.00	6483.80	6485.68	6485.91	6486.81	0.018714	1.86	3.33	8.73	3.33	0.74	1.71	0.74	67.26	1.25
Reach 1	2777.00	FIS	1920.00	6481.30	6485.48	6486.98	6490.29	0.021961	4.17	7.60	19.03	7.60	2.66	5.72	2.[illegible]	127.07	1.64
Reach 1	2777.00	100 YR	1720.00	6481.30	6485.15	6486.63	6489.67	0.023717	3.85	7.49	18.74	7.49	2.65	5.70	2.65	114.04	1.68
Reach 1	2777.00	10 YR	950.00	6481.30	6483.74	6485.04	6487.[illegible]	0.037265	2.44	6.[illegible]	17.34	6.[illegible]	2.64	5.68	2.64	63.73	1.96
Reach 1	2777.00	5 YR	475.00	6481.30	6482.67	6483.74	64[illegible].54	0.070329	1.37	6.48	16.21	6.48	2.79	6.02	2.79	32.12	2.44
Reach 1	2742.00	FIS	1920.00	6480.88	6483.46	6485.13	6489.15	0.044265	2.60	7.87	19.[illegible]	7.87	3.33	7.17	3.33	107.67	2.15
Reach 1	2742.00	100 YR	1720.00	6480.88	6483.28	6484.85	6488.87	0.046459	2.40	7.66	19.16	7.66	3.23	6.97	3.23	98.49	2.18
Reach 1	2742.00	10 YR	950.00	6480.88	6482.51	6483.60	6486.30	0.053866	1.83	6.36	15.92	6.36	2.54	5.48	2.5[illegible]	63.67	2.20
Reach 1	2742.00	5 YR	475.00	6480.88	6482.02	6482.62	6484.02	0.045020	1.14	4.59	11.49	4.59	1.49	3.21	1.49	43.29	1.89
Reach 1	2602.00	FIS	1920.00	6479.20	6483.06	64[illegible].45	6485.40	0.011087	3.85	5.12	12.82	5.12	1.24	2.67	1.24	172.05	1.16
Reach 1	2602.00	100 YR	1720.00	6479.20	6482.87	6483.17	6484.97	0.010633	3.66	4.85	12.14	4.85	1.13	2.43	1.13	161.83	1.12
Reach 1	2602.00	10 YR	950.00	6479.20	6481.92	6481.92	64[illegible].17	0.009214	2.72	3.70	9.26	3.70	0.73	1.56	0.73	113.[illegible]	0.99
Reach 1	2602.00	5 YR	475.00	6479.20	6480.94	6480.94	6481.76	0.010715	1.74	2.97	7.42	2.97	0.54	1.17	0.54	68.54	0.9[illegible]
Reach 1	2452.00	FIS	1920.00	6477.40	6481.16	6481.65	6483.64	0.012149	3.76	5.27	13.19	5.27	1.32	2.85	1.32	166.72	1.20
Reach 1	2452.00	100 YR	1720.00	6477.40	6480.91	6481.37	6483.23	0.012371	3.61	5.09	12.72	5.09	1.26	2.71	1.26	153.66	1.20
Reach 1	2452.00	10 YR	950.00	6477.40	6479.81	6480.12	6481.44	0.014064	2.41	4.22	10.56	4.22	0.98	2.11	0.98	[illegible].74	1.20
Reach 1	2452.00	5 YR	475.00	6477.40	6479.04	6479.14	6479.98	0.013261	1.64	3.17	7.92	3.17	0.63	1.36	0.63	69.96	1.09
Reach 1	2302.00	FIS	1920.00	6475.60	6479.38	6479.85	6481.83	0.011876	3.78	5.24	13.10	5.24	1.30	2.80	1.30	1[illegible].04	1.19
Reach 1	2302.00	100 YR	1720.00	6475.60	6479.17	6479.57	6481.41	0.011666	3.57	4.99	12.49	4.[illegible]	1.21	2.60	1.21	156.76	1.17
Reach 1	2302.00	10 YR	950.00	6475.60	6478.25	6478.32	6479.58	0.010151	2.64	3.61	9.54	3.61	0.78	1.[illegible]	0.78	110.04	1.03
Reach 1	2302.00	5 YR	475.00	6475.60	6477.34	6477.34	6478.16	0.010718	1.74	2.97	7.42	2.97	0.54	1.17	0.54	66.54	0.[illegible]
Reach 1	2152.00	FIS	1920.00	6473.80	6477.29	6477.90	6479.86	0.014362	3.48	5.69	13.64	5.[illegible]	1.54	3.12	1.54	1[illegible]5.97	1.29
Reach 1	2152.00	100 YR	1720.00	6473.80	6477.09	6477.69	6479.47	0.014210	3.29	5.36	13.06	5.36	1.41	2.92	1.41	155.36	1.27
Reach 1	2152.00	10 YR	950.00	6473.80	6476.13	6475.47	6477.73	0.014687	2.33	4.33	10.56	4.33	1.03	2.14	1.03	101.67	1.22
Reach 1	2152.00	5 YR	475.00	6473.80	6475.38	6475.52	6476.33	0.013960	1.59	3.27	7.98	3.27	0.67	1.39	0.67	65.09	1.11
Reach 1	2002.00	FIS	1920.00	6472.17	6476.42	6476.42	6478.29	0.007833	4.25	4.60	11.51	4.60	0.97	2.08	0.97	194.02	0.98
Reach 1	2002.00	100 YR	1720.00	6472.17	6476.14	6476.14	6477.90	0.008035	3.97	4.45	11.13	4.45	0.92	1.[illegible]	0.92	178.20	0.98
Reach 1	2002.00	10 YR	950.00	6472.17	6474.89	6474.89	6476.14	0.009214	2.72	3.70	9.26	3.70	0.73	1.56	0.73	113.[illegible]	0.99
Reach 1	2002.00	5 YR	475.00	6472.17	6473.92	6473.91	6474.73	0.010514	1.75	2.96	7.38	2.95	0.53	1.15	0.53	[illegible].97	0.98

HEC-RAS Plan: Concept Desi River: East Fork Sand C Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Max Chl Dpth (ft)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Shear LOB (lb/sq ft)	Shear Chan (lb/sq ft)	Shear ROB (lb/sq ft)	Flow Area (sq ft)	Froude # Chl
Reach 1	1988.00	FIS	1920.00	6472.00	6476.01	6476.26	6478.15	0.009634	4.01	4.91	12.27	4.91	1.12	2.41	1.12	180.59	1.08
Reach 1	1988.00	100 YR	1720.00	6472.00	6475.74	6475.97	6477.76	0.009667	3.74	4.74	11.86	4.74	1.07	2.31	1.07	1[illegible].04	1.06
Reach 1	19[illegible].00	10 YR	950.00	6472.00	6474.77	6474.72	6475.97	0.008605	2.77	3.63	9.07	3.63	0.[illegible]	1.49	0.[illegible]	126.28	0.96
Reach 1	19[illegible].00	5 YR	475.00	6472.00	6473.82	6473.74	6474.57	0.009254	1.62	2.84	7.10	2.84	0.49	1.05	0.49	71.89	0.93
Reach 1	1977.10	FIS	1920.00	6471.50	6476.92	6476.16	6478.04	0.009742	4.42	4.85	12.21	4.85	1.11	2.40	1.11	180.37	1.07
Reach 1	1977.10	100 YR	1720.00	6471.50	6475.65	6475.85	6477.64	0.009976	4.15	4.68	11.80	4.[illegible]	1.06	2.29	1.05	165.82	1.07
Reach 1	1977.10	10 YR	950.00	6471.50	6474.60	6474.60	6476.66	0.009412	3.10	3.63	9.25	3.63	0.71	1.67	0.71	113.02	0.98
Reach 1	1977.10	5 YR	475.00	6471.50	6473.61	6473.61	6474.44	0.011173	2.11	2.87	7.46	2.87	0.52	1.19	0.52	67.66	0.99
Reach 1	1977.00	FIS	1920.00	6465.00	6473.26	6474.[illegible]	6477.80	0.020033	4.28	7.39	18.48	7.39	2.48	6.35	2.48	131.39	1.57
Reach 1	1977.00	100 YR	1720.00	6469.00	6472.94	6474.33	6477.39	0.021718	3.94	7.28	18.22	7.28	2.46	5.35	2.46	117.74	1.62
Reach 1	1977.00	10 YR	950.00	6463.00	6471.48	6472.74	6475.57	0.035187	2.46	6.81	17.03	6.81	2.53	6.45	2.53	65.04	1.91
Reach 1	1977.00	5 YR	475.00	6469.00	6470.39	6471.44	6474.15	0.067213	1.39	6.39	15.99	6.39	2.71	6.83	2.71	32.61	2.[illegible]
Reach 1	1942.00	FIS	1920.00	64[illegible].58	6471.21	6472.83	6476.73	0.042408	2.63	7.76	19.42	7.76	3.23	6.96	3.23	109.22	2.11
Reach 1	1942.00	100 YR	1720.00	6468.58	6471.01	6472.55	6476.26	0.044519	2.43	7.55	18.90	7.55	3.14	6.76	3.14	[illegible]	2.14
Reach 1	1942.00	10 YR	950.00	6468.58	6470.21	6471.30	6473.96	0.053372	1.63	6.34	15.87	6.34	2.53	5.44	2.53	63.86	2.19
Reach 1	1942.00	5 YR	475.00	64[illegible].58	64[illegible].73	6470.32	6471.72	0.044[illegible]5	1.15	4.58	11.47	4.58	1.48	3.20	1.48	43.39	1.89
Reach 1	1902.00	FIS	1920.00	6466.10	6471.23	6472.35	6474.[illegible]	0.023110	3.13	6.44	16.10	6.44	2.09	4.51	2.09	133.91	1.61
Reach 1	1902.00	100 YR	1720.00	6466.10	6471.05	6472.07	6474.49	0.022844	2.96	6.15	15.39	6.15	1.95	4.20	1.96	124.82	1.68
Reach 1	1902.00	10 YR	950.00	6466.10	6470.33	6470.82	6472.27	0.018446	2.23	4.58	11.47	4.58	1.19	2.56	1.19	90.28	1.36
Reach 1	1902.00	5 YR	475.00	64[illegible].10	6469.77	64[illegible].84	6470.67	0.012380	1.67	3.10	7.76	3.10	0.60	1.29	0.60	[illegible].42	1.06
Reach 1	1752.00	FIS	1920.00	6466.30	6470.40	6470.56	6472.43	0.008888	4.10	4.78	11.97	4.78	1.06	2.28	1.06	185.[illegible]	1.04
Reach 1	1752.00	100 YR	1720.00	6466.30	6470.20	6470.27	6472.03	0.008560	3.90	4.54	11.36	4.54	0.97	2.08	0.97	174.36	1.01
Reach 1	1752.00	10 YR	950.00	6466.30	64[illegible].02	64[illegible].02	6470.27	0.009214	2.72	3.70	9.26	3.70	0.73	1.56	0.73	113.66	0.[illegible]
Reach 1	1752.00	5 YR	475.00	6466.30	64[illegible].00	64[illegible].04	6468.87	0.011584	1.70	3.04	7.60	3.04	0.57	1.23	0.57	[illegible].84	1.03
Reach 1	1602.00	FIS	1920.00	6464.50	64[illegible].18	64[illegible].75	6470.76	0.013010	3.66	5.39	13.48	5.39	1.39	2.[illegible]	1.39	162.85	1.24
Reach 1	1602.00	100 YR	1720.00	6464.50	6467.93	64[illegible].47	6470.38	0.013430	3.43	5.22	13.06	5.22	1.33	2.86	1.33	149.42	1.24
Reach 1	1602.00	10 YR	950.00	6464.50	6466.91	6467.22	64[illegible].54	0.014064	2.41	4.22	10.56	4.22	0.[illegible]	2.11	0.98	98.74	1.20
Reach 1	1602.00	5 YR	475.00	6464.50	6466.17	6466.24	6467.07	0.012282	1.67	3.09	7.74	3.09	0.60	1.28	0.60	65.59	1.06
Reach 1	1553.[illegible]	FIS	1920.00	64[illegible].92	6467.06	6467.86	6470.01	0.018101	3.13	5.69	14.25	5.[illegible]	1.64	3.53	1.64	149.44	1.42
Reach 1	1553.66	100 YR	1720.00	6463.92	6466.84	6467.61	64[illegible].60	0.016303	2.92	5.48	13.70	5.48	1.55	3.34	1.56	138.35	1.41
Reach 1	1553.66	10 YR	950.00	6463.92	6466.92	6466.44	6467.71	0.005107	3.00	2.94	7.36	2.94	0.44	0.96	0.44	142.53	0.76
Reach 1	1553.66	5 YR	475.00	6463.92	6465.93	6465.52	6466.40	0.005092	2.01	2.25	5.63	2.25	0.30	0.64	0.30	90.46	0.70
Reach 1	1471.00	FIS	1920.00	6463.50	6467.62	6467.44	64[illegible].22	0.006914	4.12	4.23	10.58	4.23	0.82	1.78	0.82	206.95	0.92
Reach 1	1471.00	100 YR	1720.00	6463.50	6467.37	6467.19	6468.65	0.00[illegible]19	3.86	4.06	10.16	4.06	0.78	1.67	0.78	191.93	0.91
Reach 1	1471.00	10 YR	950.00	6463.50	64[illegible].26	64[illegible].02	6467.21	0.006792	2.76	3.21	8.04	3.21	0.54	1.17	0.54	129.64	0.86
Reach 1	1471.00	5 YR	475.00	6463.50	6465.39		6465.93	0.006317	1.89	2.40	6.01	2.40	0.35	0.74	0.35	84.37	0.77
Reach 1	1461.00	FIS	1920.00	6463.45	6467.65	6467.34	64[illegible].06	0.010712	4.20	5.34	10.02	5.34	1.31	2.81	1.31	212.35	0.86
Reach 1	1461.00	100 YR	1720.00	6463.45	6467.38	6467.08	6468.71	0.010950	3.93	5.16	9.68	5.16	1.25	2.69	1.25	196.74	0.86
Reach 1	1461.00	10 YR	950.00	6463.45	6466.19	6465.94	6467.11	0.011661	2.74	4.23	7.93	4.23	0.94	2.03	0.94	128.59	0.84
Reach 1	1461.00	5 YR	475.00	6463.45	6465.26		6465.83	0.012484	1.81	3.29	6.17	3.29	0.66	1.41	0.66	80.78	0.81
Reach 1	1450.10	FIS	1920.00	6462.90	6467.19	6467.19	64[illegible].90	0.014542	4.29	5.80	10.94	5.80	1.60	3.47	1.60	192.34	0.98
Reach 1	1450.10	100 YR	1720.00	6462.90	6466.93	6466.93	64[illegible].54	0.014836	4.03	5.59	10.57	5.[illegible]	1.62	3.30	1.52	177.48	0.97
Reach 1	1450.10	10 YR	950.00	6462.90	6465.78	6465.78	6466.9[illegible]	0.017228	2.88	4.63	8.84	4.63	1.19	2.63	1.19	114.20	0.[illegible]
Reach 1	1450.10	5 YR	475.00	6462.90	6464.87	6464.87	6465.64	0.020342	1.97	3.65	7.12	3.65	0.87	1.98	0.87	69.33	0.[illegible]
Reach 1	1450.00	FIS	1920.00	6460.40	6463.91	6465.39	6468.60	0.046330	3.51	9.84	18.45	9.84	4.71	10.14	4.71	118.39	1.74
Reach 1	1450.00	100 YR	1720.00	6460.40	6463.63	6465.07	64[illegible].23	0.05036[illegible]	3.23	9.70	18.20	9.70	4.71	10.14	4.71	106.66	1.79
Reach 1	1450.00	10 YR	950.00	6460.40	6462.41	6463.66	6466.62	0.083122	2.01	9.09	17.06	9.09	4.85	10.44	4.85	60.39	2.12
Reach 1	1450.00	5 YR	475.00	6460.40	6461.52	6462.51	6465.33	0.158658	1.12	8.52	16.98	8.52	5.16	11.11	5.16	31.20	2.66
Reach 1	1416.00	FIS	1920.00	6460.22	6462.[illegible]	6464.11	64[illegible].67	0.047028	2.77	8.46	15.[illegible]	8.46	3.77	8.13	3.77	129.85	1.[illegible]
Reach 1	1416.00	100 YR	1720.00	6460.22	6462.84	6463.85	6466.18	0.045797	2.62	8.05	15.10	8.05	3.48	7.49	3.48	121.89	1.66
Reach 1	1416.00	10 YR	950.00	6460.22	6463.37	6462.71	6464.04	0.007340	3.16	3.64	6.[illegible]	3.64	0.67	1.44	0.67	160.58	0.[illegible]
Reach 1	1416.00	5 YR	475.00	6460.22	6462.30	6461.81	6462.72	0.007779	2.08	2.85	5.34	2.85	0.47	1.01	0.47	94.02	0.65
Reach 1	1405.00	FIS	1920.00	6460.17	6464.70	6464.11	6465.[illegible]	0.004934	4.53	3.81	9.52	3.81	0.66	1.39	0.66	232.40	0.79
Reach 1	1405.00	100 YR	1720.00	6460.17	6464.42	6463.86	6465.61	0.004962	4.25	3.66	9.16	3.66	0.61	1.32	0.61	218.04	0.78
Reach 1	1405.00	10 YR	950.00	6460.17	6463.16		6463.97	0.005038	3.01	2.93	7.39	2.[illegible]	0.44	0.96	0.44	143.17	0.74
Reach 1	1405.00	5 YR	475.00	6460.17	6462.19		6462.66	0.005020	2.02	2.24	5.60	2.24	0.29	0.63	0.29	90.[illegible]	0.70
Reach 1	1321.00	FIS	1920.00	6459.75	6463.87	6463.[illegible]	6465.47	0.00[illegible]914	4.12	4.23	10.58	4.23	0.82	1.78	0.82	206.95	0.92
Reach 1	1321.00	100 YR	1720.00	6459.75	6463.62	6463.44	6465.10	0.00[illegible]19	3.86	4.06	10.16	4.06	0.78	1.67	0.78	191.93	0.91
Reach 1	1321.00	10 YR	950.00	6459.75	6462.51	6462.27	6463.46	0.006792	2.76	3.21	8.04	3.21	0.54	1.17	0.54	129.64	0.86
Reach 1	1321.00	5 YR	475.00	6459.75	6461.64		6462.18	0.006317	1.89	2.40	6.01	2.40	0.35	0.74	0.35	84.37	0.77
Reach 1	1311.00	FIS	1920.00	6459.70	6463.90	6463.59	6465.33	0.010712	4.20	5.34	10.02	5.34	1.31	2.81	1.31	212.35	0.86
Reach 1	1311.00	100 YR	1720.00	6459.70	6463.63	6463.33	6464.96	0.010950	3.93	5.16	9.68	5.16	1.25	2.[illegible]	1.25	196.74	0.86
Reach 1	1311.00	10 YR	950.00	6459.70	6462.44	6462.19	6463.36	0.011661	2.74	4.23	7.93	4.23	0.94	2.03	0.94	128.59	0.84
Reach 1	1311.00	5 YR	475.00	6459.70	6461.51		6462.08	0.012484	1.81	3.29	6.17	3.29	0.[illegible]	1.41	0.[illegible]	80.78	0.81
Reach 1	1300.10	FIS	1920.00	6459.15	64[illegible].44	6463.44	6465.15	0.014542	4.29	5.80	10.94	5.80	1.60	3.47	1.60	192.34	0.98
Reach 1	1300.10	100 YR	1720.00	6459.15	6463.18	6463.18	6464.79	0.014836	4.03	5.59	10.57	5.59	1.62	3.30	1.62	177.48	0.97
Reach 1	1300.10	10 YR	950.00	6459.15	6462.03	6462.03	6463.16	0.017228	2.[illegible]	4.63	8.84	4.63	1.19	2.63	1.19	114.20	0.[illegible]
Reach 1	1300.10	5 YR	475.00	6459.15	6461.12	6461.12	6461.89	0.020342	1.97	3.65	7.12	3.65	0.87	1.98	0.87	[illegible].33	0.[illegible]
Reach 1	1300.00	FIS	1920.00	6455.66	6460.16	6461.64	6464.85	0.046330	3.51	9.84	18.45	9.84	4.71	10.14	4.71	118.39	1.74
Reach 1	1300.00	100 YR	1720.00	6456.65	64[illegible].88	6461.32	6464.48	0.050369	3.23	9.70	18.20	9.70	4.71	10.14	4.71	106.66	1.79
Reach 1	1300.00	10 YR	950.00	6456.65	6458.88	6459.91	6462.87	0.083122	2.01	9.09	17.06	9.09	4.85	10.44	4.85	60.39	2.12
Reach 1	1300.00	5 YR	475.00	6456.65	6457.77	6458.76	6461.58	0.158658	1.12	8.52	16.98	8.52	5.16	11.11	5.16	31.20	2.[illegible]
Reach 1	1265.00	FIS	1920.00	6456.47	6459.24	6460.36	6462.91	0.04[illegible]54	2.77	8.45	15.86	8.45	3.76	8.10	3.76	130.01	1.[illegible]
Reach 1	1265.00	100 YR	1720.00	6456.47	64[illegible].09	6460.10	6462.43	0.045618	2.62	8.04	15.09	8.04	3.47	7.47	3.47	122.05	1.64
Reach 1	1265.00	10 YR	950.00	6456.47	6459.62	6458.96	6460.29	0.007340	3.15	3.64	6.[illegible]	3.64	0.67	1.44	0.67	160.58	0.[illegible]
Reach 1	1265.00	5 YR	475.00	6456.47	6458.55	6458.06	6458.97	0.007779	2.08	2.85	5.34	2.85	0.47	1.01	0.47	94.02	0.65
Reach 1	1255.00	FIS	1920.00	6456.42	6460.95	6460.36	6462.24	0.004934	4.53	3.81	9.52	3.81	0.66	1.39	0.66	232.40	0.79
Reach 1	1255.00	100 YR	1720.00	6456.42	6460.67	6460.11	6461.86	0.004962	4.25	3.[illegible]	9.15	3.66	0.61	1.32	0.61	215.04	0.78
Reach 1	1255.00	10 YR	950.00	6456.42	6459.43		6460.22	0.005038	3.01	2.93	7.33	2.93	0.44	0.95	0.44	143.17	0.74
Reach 1	1255.00	5 YR	475.00	6456.42	6458.44		6458.91	0.005020	2.02	2.24	5.60	2.24	0.29	0.63	0.29	90.88	0.70
Reach 1	1171.00	FIS	1920.00	6456.00	6460.12	6459.94	6461.72	0.006914	4.12	4.23	10.58	4.23	0.82	1.76	0.82	206.95	0.92
Reach 1	1171.00	100 YR	1720.00	6456.00	6459.87	6459.[illegible]	6461.35	0.00[illegible]19	3.86	4.06	10.15	4.06	0.78	1.67	0.78	191.93	0.91
Reach 1	1171.00	10 YR	950.00	6456.00	6458.76	6458.52	6459.71	0.006792	2.76	3.21	8.04	3.21	0.54	1.17	0.54	129.64	0.85
Reach 1	1171.00	5 YR	475.00	6456.00	6457.69		6458.43	0.006317	1.[illegible]	2.40	6.01	2.40	0.35	0.74	0.35	84.37	0.77
Reach 1	1161.00	FIS	1920.00	6455.95	6460.15	6459.64	6461.58	0.010712	4.20	5.34	10.02	5.34	1.31	2.81	1.31	212.35	0.86

EXIST

PROP

HEC-RAS Plan: Concept Desl River: East Fork Sand C Reach: R[illegible]ch 1 (Continued)

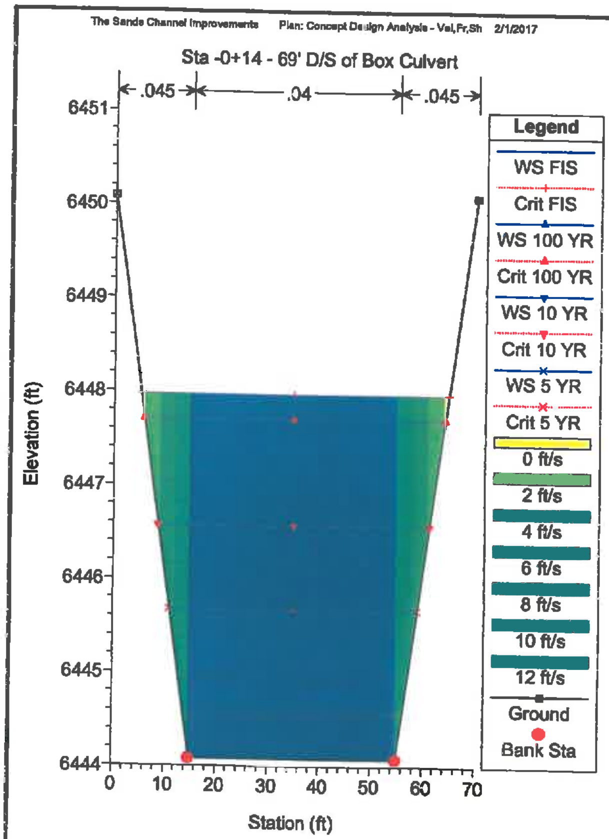
Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Max Chl Dpth (ft)	Vel Left (ft/s)	Vel Chnl (ft/s)	Vel Right (ft/s)	Shear LOB (lb/sq ft)	Shear Chan (lb/sq ft)	Shear ROB (lb/sq ft)	Flow Area (sq ft)	Froude # Chl
Reach 1	1161.00	100 YR	1720.00	6455.95	6459.66	6459.58	6461.21	0.010950	3.93	5.16	9.[illegible]	5.16	1.25	2.69	1.25	195.74	0.86
Reach 1	1161.00	10 YR	950.00	6455.95	6458.69	6458.44	6459.61	0.011861	2.74	4.23	7.93	4.23	0.94	2.03	0.94	128.[illegible]	0.84
Reach 1	1161.00	5 YR	475.00	6455.95	6457.76		6458.33	0.012484	1.81	3.29	5.17	3.29	0.[illegible]	1.41	0.[illegible]	80.78	0.81
Reach 1	1160.10	FIS	1920.00	6455.40	6459.69	6459.69	6461.40	0.014542	4.29	5.80	10.94	5.80	1.60	3.47	1.60	192.34	0.98
Reach 1	1160.10	100 YR	1720.00	6455.40	6459.43	6459.43	6461.04	0.014836	4.03	5.59	10.57	5.59	1.52	3.30	1.52	177.48	0.97
Reach 1	1160.10	10 YR	950.00	6455.40	6458.28	6458.28	6459.43	0.017228	2.88	4.63	8.84	4.63	1.19	2.63	1.19	114.20	0.[illegible]
Reach 1	1160.10	5 YR	475.00	6455.40	6457.37	6457.37	6458.14	0.020342	1.97	3.65	7.12	3.65	0.87	1.98	0.87	[illegible].33	0.[illegible]
Reach 1	1150.00	FIS	1920.00	6452.90	6456.41	6457.69	6461.10	0.046330	3.51	9.84	16.45	9.84	4.71	10.14	4.71	118.39	1.74
Reach 1	1150.00	100 YR	1720.00	6452.90	6456.13	6457.57	6460.73	0.0503[illegible]	3.23	9.70	16.20	9.70	4.71	10.14	4.71	106.65	1.79
Reach 1	1150.00	10 YR	950.00	6452.90	6454.91	6456.16	6459.12	0.083122	2.01	9.09	17.06	9.09	4.85	10.44	4.85	60.39	2.12
Reach 1	1150.00	5 YR	475.00	6452.90	6454.02	6455.01	6457.83	0.158656	1.12	8.52	15.98	8.62	5.16	11.11	5.16	31.20	2.66
Reach 1	1115.00	FIS	1920.00	6452.72	6455.49	6456.61	6459.16	0.04[illegible]54	2.77	8.45	15.86	8.45	3.76	8.10	3.76	130.01	1.[illegible]
Reach 1	1115.00	100 YR	1720.00	6452.72	6455.34	6456.35	6458.[illegible]	0.045616	2.62	8.04	15.09	8.04	3.47	7.47	3.47	122.05	1.64
Reach 1	1115.00	10 YR	950.00	6452.72	6455.66	6455.21	6456.54	0.007368	3.14	3.65	6.84	3.65	0.67	1.45	0.67	150.39	0.88
Reach 1	1115.00	5 YR	475.00	6452.72	6454.60	6454.31	6455.22	0.007779	2.06	2.85	5.34	2.86	0.47	1.01	0.47	94.02	0.65
Reach 1	1105.00	FIS	1920.00	6452.67	6457.20	6458.61	6458.49	0.004928	4.63	3.80	9.52	3.80	0.65	1.39	0.65	232.52	0.79
Reach 1	1105.00	100 YR	1720.00	6452.67	6456.92	6458.36	6458.12	0.004958	4.26	3.66	9.15	3.[illegible]	0.61	1.32	0.61	215.10	0.78
Reach 1	1105.00	10 YR	950.00	6452.67	6455.66		6456.47	0.005036	3.01	2.93	7.33	2.93	0.44	0.96	0.44	143.20	0.74
Reach 1	1105.00	5 YR	475.00	6452.67	6454.69		6455.16	0.005020	2.02	2.24	5.60	2.24	0.29	0.63	0.29	90.[illegible]	0.70
Reach 1	1021.00	FIS	1920.00	6452.25	6456.37	6456.19	6457.97	0.00[illegible]314	4.12	4.23	10.58	4.23	0.82	1.78	0.82	206.95	0.92
Reach 1	1021.00	100 YR	1720.00	6452.25	6456.12	6455.94	6457.60	0.00[illegible]319	3.86	4.06	10.15	4.06	0.78	1.67	0.78	191.93	0.91
Reach 1	1021.00	10 YR	950.00	6452.25	6455.01	6454.77	6455.96	0.006792	2.76	3.21	8.04	3.21	0.54	1.17	0.54	129.64	0.86
Reach 1	1021.00	5 YR	475.00	6452.25	6454.14		6454.66	0.006317	1.89	2.40	6.01	2.40	0.36	0.74	0.36	84.37	0.77
Reach 1	1011.00	FIS	1920.00	6452.20	6456.40	6456.09	6457.63	0.010712	4.20	5.34	10.02	5.34	1.31	2.81	1.31	212.35	0.86
Reach 1	1011.00	100 YR	1720.00	6452.20	6456.13	6455.83	6457.46	0.010950	3.93	5.16	9.[illegible]	5.16	1.25	2.[illegible]	1.25	195.74	0.86
Reach 1	1011.00	10 YR	950.00	6452.20	6454.94	6454.69	6455.86	0.011861	2.74	4.23	7.93	4.23	0.94	2.03	0.94	128.59	0.84
Reach 1	1011.00	5 YR	475.00	6452.20	6454.01		6454.58	0.012484	1.81	3.29	6.17	3.29	0.56	1.41	0.56	80.78	0.81
Reach 1	1000.10	FIS	1920.00	6451.65	6455.94	6455.94	6457.65	0.014542	4.29	5.80	10.94	5.80	1.60	3.47	1.60	192.34	0.98
Reach 1	1000.10	100 YR	1720.00	6451.65	6455.[illegible]	6455.68	6457.29	0.014836	4.03	5.59	10.57	5.59	1.52	3.30	1.52	177.48	0.97
Reach 1	1000.10	10 YR	950.00	6451.65	6454.53	6454.53	6455.[illegible]	0.017228	2.[illegible]	4.63	8.84	4.63	1.19	2.63	1.19	114.20	0.99
Reach 1	1000.10	5 YR	475.00	6451.65	6453.62	6453.62	6454.39	0.020342	1.97	3.65	7.12	3.65	0.87	1.98	0.87	[illegible].33	0.99
Reach 1	1000.00	FIS	1920.00	6449.15	6452.66	6454.14	6457.35	0.046330	3.51	9.84	16.45	9.84	4.71	10.14	4.71	118.39	1.74
Reach 1	1000.00	100 YR	1720.00	6449.15	6452.38	6453.82	6456.98	0.050369	3.23	9.70	16.20	9.70	4.71	10.14	4.71	106.6[illegible]	1.79
Reach 1	1000.00	10 YR	950.00	6449.15	6451.16	6452.41	6455.37	0.083122	2.01	9.09	17.06	9.09	4.85	10.44	4.85	60.39	2.12
Reach 1	1000.00	5 YR	475.00	6449.15	6450.27	6451.26	6454.06	0.15[illegible]56	1.12	8.52	15.98	8.62	5.16	11.11	5.16	31.20	2.66
Reach 1	965.00	FIS	1920.00	6448.97	6451.74	6452.86	6455.41	0.046654	2.77	8.45	15.86	8.45	3.76	8.10	3.76	130.01	1.66
Reach 1	965.00	100 YR	1720.00	6448.97	6451.59	6452.60	6454.93	0.045616	2.62	8.04	15.09	8.04	3.47	7.47	3.47	122.06	1.64
Reach 1	965.00	10 YR	950.00	6448.97	6452.12	6451.46	6452.80	0.007304	3.16	3.64	6.62	3.64	0.67	1.44	0.67	150.63	0.[illegible]
Reach 1	965.00	5 YR	475.00	6448.97	6451.05	6450.56	6451.47	0.007773	2.08	2.84	5.34	2.84	0.47	1.01	0.47	94.04	0.65
Reach 1	955.00	FIS	1920.00	6448.92	6453.44	6452.86	6454.73	0.004961	4.52	3.82	9.55	3.82	0.65	1.40	0.65	231.63	0.79
Reach 1	955.00	100 YR	1720.00	6448.92	6453.16	6452.61	6454.36	0.004984	4.24	3.66	9.16	3.66	0.61	1.32	0.61	214.71	0.78
Reach 1	955.00	10 YR	950.00	6448.92	6451.94		6452.72	0.004990	3.02	2.92	7.31	2.92	0.44	0.94	0.44	143.63	0.74
Reach 1	955.00	5 YR	475.00	6448.92	6450.[illegible]		6451.41	0.005003	2.02	2.24	5.60	2.24	0.29	0.63	0.29	90.98	0.[illegible]
Reach 1	825.00	FIS	1920.00	6448.27	6452.79		6454.08	0.004962	4.52	3.81	9.54	3.81	0.65	1.40	0.65	231.94	0.79
Reach 1	825.00	100 YR	1720.00	6448.27	6452.52		6453.71	0.004966	4.25	3.66	9.15	3.66	0.61	1.32	0.61	214.[illegible]	0.78
Reach 1	825.00	10 YR	950.00	6448.27	6451.30		6452.07	0.004966	3.02	2.92	7.30	2.92	0.44	0.94	0.44	143.67	0.74
Reach 1	825.00	5 YR	475.00	6448.27	6450.30		6450.78	0.004[illegible]	2.02	2.2[illegible]	5.68	2.2[illegible]	0.29	0.63	0.2[illegible]	91.2[illegible]	0.[illegible]
Reach 1	700.00	FIS	1920.00	6447.65	6452.17		6453.46	0.004962	4.52	3.81	9.54	3.81	0.65	1.40	0.65	231.94	0.79
Reach 1	700.00	100 YR	1720.00	6447.65	6451.89		6453.09	0.004982	4.24	3.66	9.16	3.66	0.61	1.32	0.61	214.74	0.78
Reach 1	700.00	10 YR	950.00	6447.65	6450.67		6451.45	0.004999	3.02	2.92	7.32	2.92	0.44	0.94	0.44	143.65	0.74
Reach 1	700.00	5 YR	475.00	6447.65	6449.67		6450.14	0.004[illegible]	2.02	2.24	5.60	2.24	0.29	0.63	0.29	91.00	0.[illegible]
Reach 1	600.00	FIS	1920.00	6447.16	6451.[illegible]		6452.97	0.004938	4.53	3.81	9.52	3.81	0.65	1.40	0.65	232.34	0.79
Reach 1	600.00	100 YR	1720.00	6447.16	6451.40		6452.59	0.004968	4.25	3.66	9.16	3.66	0.61	1.32	0.61	214.95	0.78
Reach 1	600.00	10 YR	950.00	6447.15	6450.17		6450.95	0.004[illegible]	3.02	2.92	7.31	2.92	0.44	0.94	0.44	143.58	0.74
Reach 1	600.00	5 YR	475.00	6447.15	6449.17		6449.64	0.005003	2.02	2.24	5.60	2.24	0.29	0.63	0.29	90.98	0.[illegible]
Reach 1	460.00	FIS	1920.00	6446.40	6450.96		6452.23	0.004804	4.56	3.77	9.44	3.77	0.64	1.37	0.64	234.54	0.78
Reach 1	460.00	100 YR	1720.00	6446.43	6450.66		6451.85	0.004906	4.26	3.64	9.12	3.64	0.61	1.31	0.61	216.67	0.78
Reach 1	460.00	10 YR	950.00	6446.43	6449.42		6450.20	0.004976	3.02	2.92	7.30	2.92	0.44	0.94	0.44	143.76	0.74
Reach 1	450.00	5 YR	475.00	6446.40	6448.42		6448.89	0.004995	2.02	2.24	5.59	2.24	0.29	0.63	0.29	91.03	0.[illegible]
Reach 1	350.00	FIS	1920.00	6445.90	6450.52		6451.76	0.004615	4.61	3.73	9.33	3.73	0.62	1.33	0.62	237.83	0.77
Reach 1	350.00	100 YR	1720.00	6445.90	6450.18		6451.36	0.004821	4.28	3.63	9.07	3.63	0.60	1.29	0.60	217.16	0.77
Reach 1	350.00	10 YR	950.00	6445.90	6448.93		6449.70	0.004965	3.02	2.92	7.30	2.92	0.44	0.94	0.44	143.87	0.74
Reach 1	350.00	5 YR	475.00	6445.90	6447.92		6448.39	0.004968	2.02	2.23	5.58	2.23	0.29	0.[illegible]	0.29	91.20	0.[illegible]
Reach 1	200.00	FIS	1920.00	6445.15	6449.94		6451.07	0.004058	4.79	3.58	8.[illegible]	3.58	0.58	1.21	0.58	246.66	0.72
Reach 1	200.00	100 YR	1720.00	6445.15	6449.53		6450.65	0.004467	4.36	3.54	8.86	3.54	0.57	1.22	0.57	222.94	0.75
Reach 1	200.00	10 YR	950.00	6445.16	6448.11		6448.98	0.005326	2.98	2.98	7.46	2.98	0.46	0.[illegible]	0.46	140.64	0.76
Reach 1	200.00	5 YR	475.00	6445.16	6447.15		6447.63	0.005203	2.00	2.26	5.67	2.26	0.30	0.65	0.30	89.89	0.71
Reach 1	166.00	FIS	1920.00	6444.96	6449.83	6448.92	6450.93	0.003[illegible]0	4.85	3.53	8.84	3.53	0.54	1.17	0.64	252.56	0.71
Reach 1	1[illegible].00	100 YR	1720.00	6444.96	6449.39	6448.67	6450.49	0.004336	4.41	3.51	8.78	3.51	0.56	1.19	0.56	226.24	0.74
Reach 1	166.00	10 YR	950.00	6444.[illegible]	6447.50	6447.50	6448.[illegible]	0.009363	2.52	3.55	6.87	3.55	0.[illegible]	1.47	0.[illegible]	113.60	0.[illegible]
Reach 1	166.00	5 YR	475.00	6444.96	6446.58	6446.58	6447.36	0.011196	1.60	2.86	7.16	2.86	0.52	1.12	0.52	70.19	1.00
Reach 1	150.00		Culvert														
Reach 1	21.00	FIS	1920.00	6444.26	6449.00	6448.15	6450.07	0.00[illegible]21	4.76	4.65	8.73	4.65	0.96	2.06	0.96	246.26	0.71
Reach 1	21.00	100 YR	1720.00	6444.26	6448.72		6449.71	0.00[illegible]06	4.47	4.46	8.38	4.46	0.[illegible]	1.93	0.89	228.67	0.70
Reach 1	21.00	10 YR	950.00	6444.26	6447.47		6448.11	0.006797	3.22	3.56	6.67	3.56	0.63	1.36	0.63	151.46	0.66
Reach 1	21.00	5 YR	475.00	6444.26	6446.45		6446.83	0.006453	2.20	2.69	5.04	2.[illegible]	0.41	0.[illegible]	0.41	[illegible].86	0.60
Reach 1	-14.00	FIS	1920.00	6444.06	6447.97	6447.97	6449.67	0.014114	3.89	5.82	10.92	5.82	1.5[illegible]	3.43	1.[illegible]	193.53	0.98
Reach 1	-14.00	100 YR	1720.00	6444.06	6447.71	6447.71	6449.31	0.014543	3.63	5.64	10.58	5.64	1.53	3.29	1.53	177.[illegible]	0.98
Reach 1	-14.00	10 YR	950.00	6444.06	6446.57	6446.57	6447.71	0.016[illegible]7	2.49	4.70	8.81	4.70	1.20	2.59	1.20	115.01	0.99
Reach 1	-14.00	5 YR	475.00	6444.06	6445.67	6445.67	6446.42	0.019487	1.59	3.77	7.08	3.77	0.90	1.94	0.90	70.10	0.99

PROP

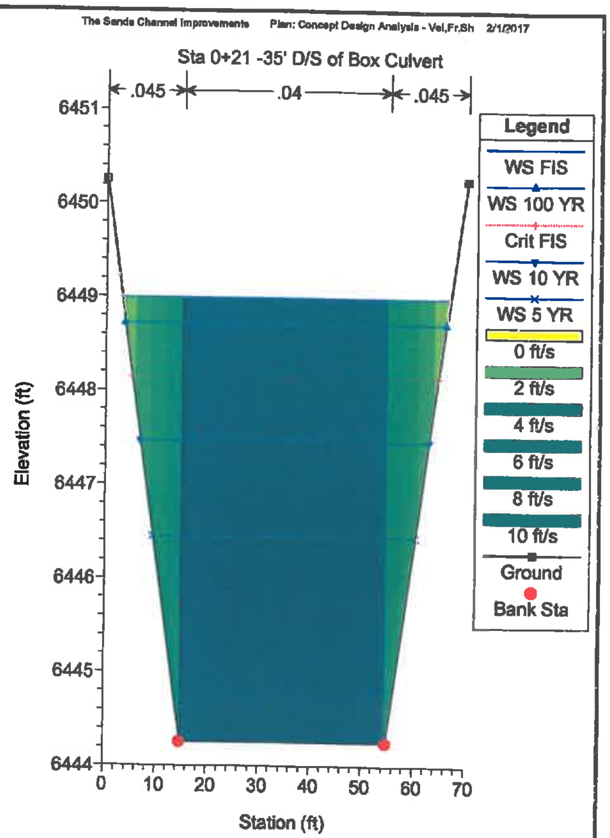
EXIST

Plan: EFSCST-WSE East Fork Sand C Reach 1 RS: 150.00 Culv Group: Constitution Profile: 100 YR

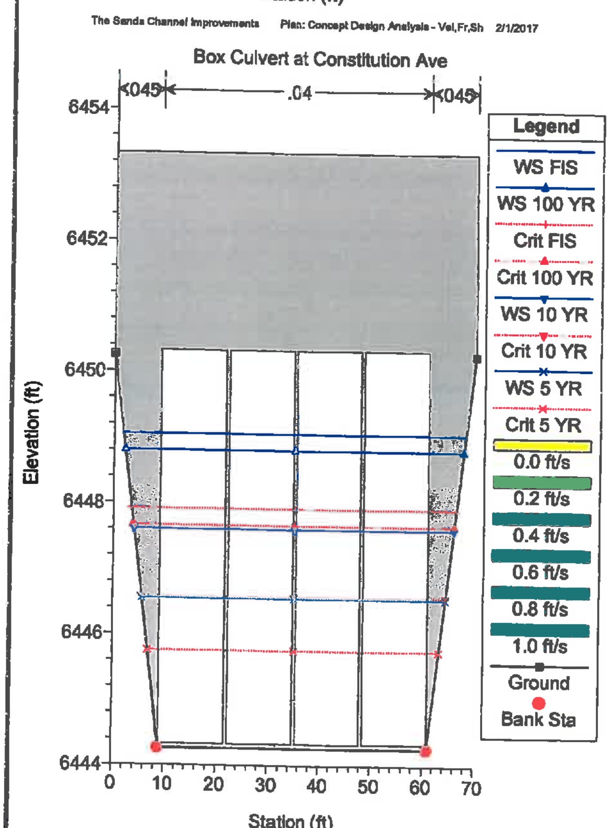
Q Culv Group (cfs)	1720.00	Culv Full Len (ft)	
# Barrels	4	Culv Vel US (ft/s)	8.82
Q Barrel (cfs)	430.00	Culv Vel DS (ft/s)	7.35
E.G. US. (ft)	6450.49	Culv Inv El Up (ft)	6444.90
W.S. US. (ft)	6449.45	Culv Inv El Dn (ft)	6444.33
E.G. DS (ft)	6449.84	Culv Frctn Ls (ft)	0.00
W.S. DS (ft)	6448.98	Culv Exit Loss (ft)	0.00
Delta EG (ft)	0.65	Culv Entr Loss (ft)	0.48
Delta WS (ft)	0.46	Q Weir (cfs)	
E.G. IC (ft)	6450.24	Weir Sta Lft (ft)	
E.G. OC (ft)	6450.49	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	6448.80	Weir Max Depth (ft)	
Culv WS Outlet (ft)	6449.01	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	2.76	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	3.33	Min El Weir Flow (ft)	6453.99



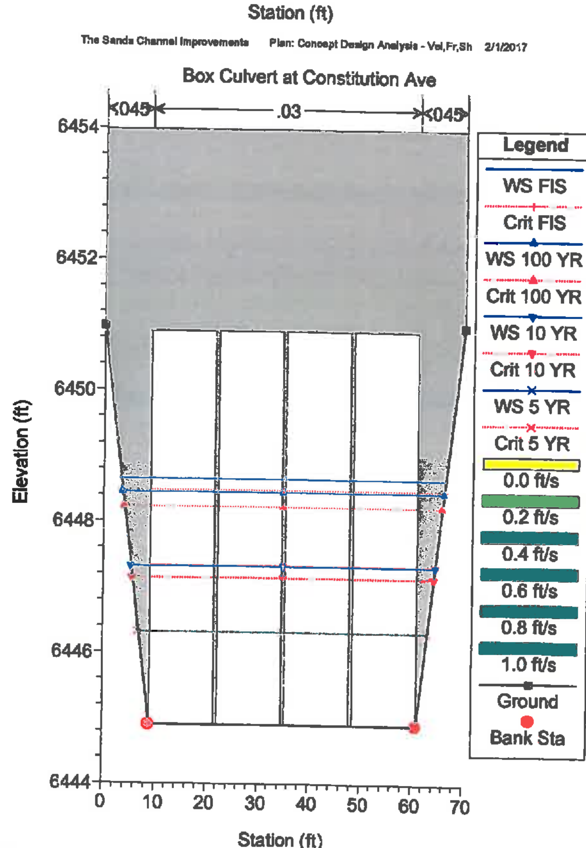
The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta -0+14 - 69' D/S of Box Culvert
.045
.04
.045
Elevation (ft)
Station (ft)
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta



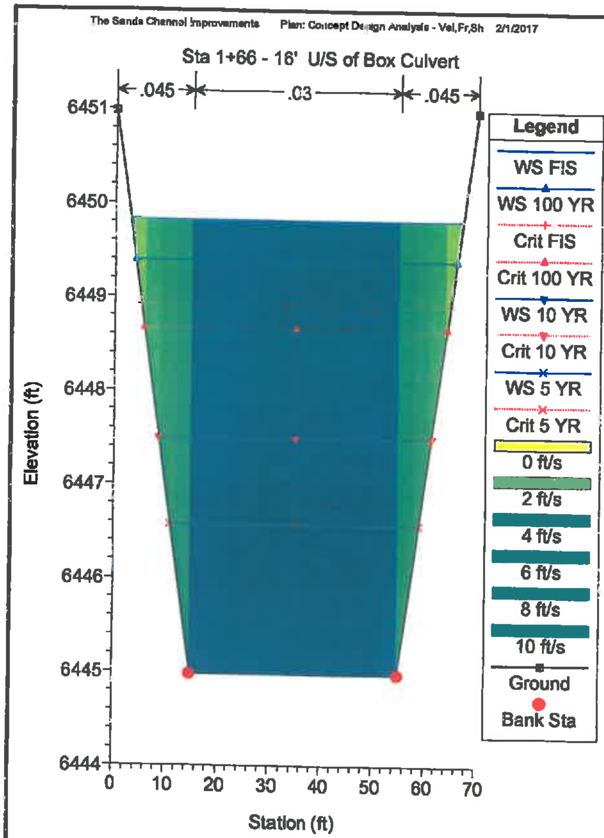
The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 0+21 -35' D/S of Box Culvert
.045
.04
.045
Elevation (ft)
Station (ft)
Legend
WS FIS
WS 100 YR
Crit FIS
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta

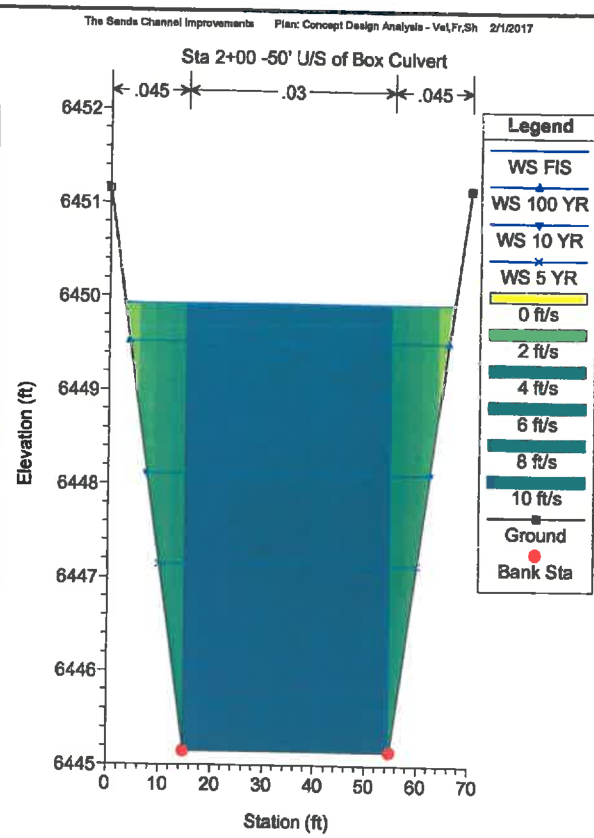


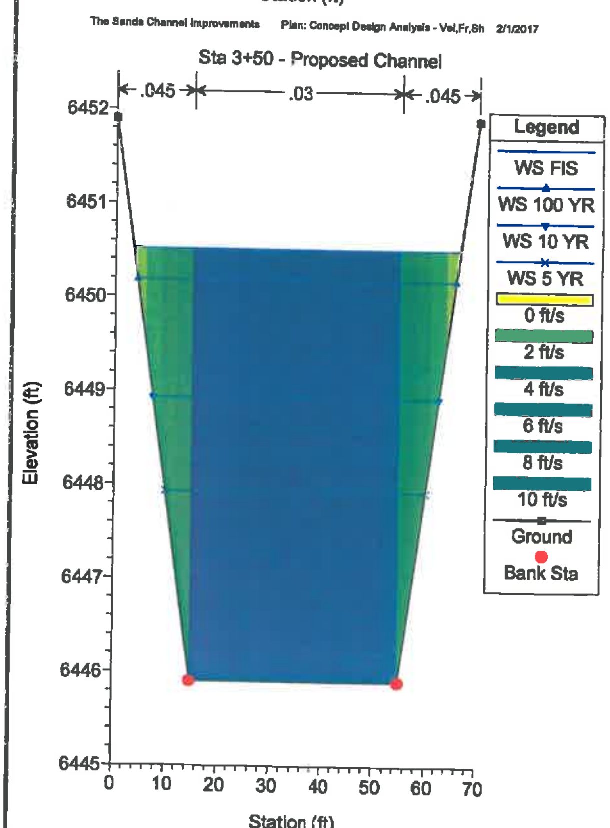
The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Box Culvert at Constitution Ave
.045
.04
.045
Elevation (ft)
Station (ft)
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

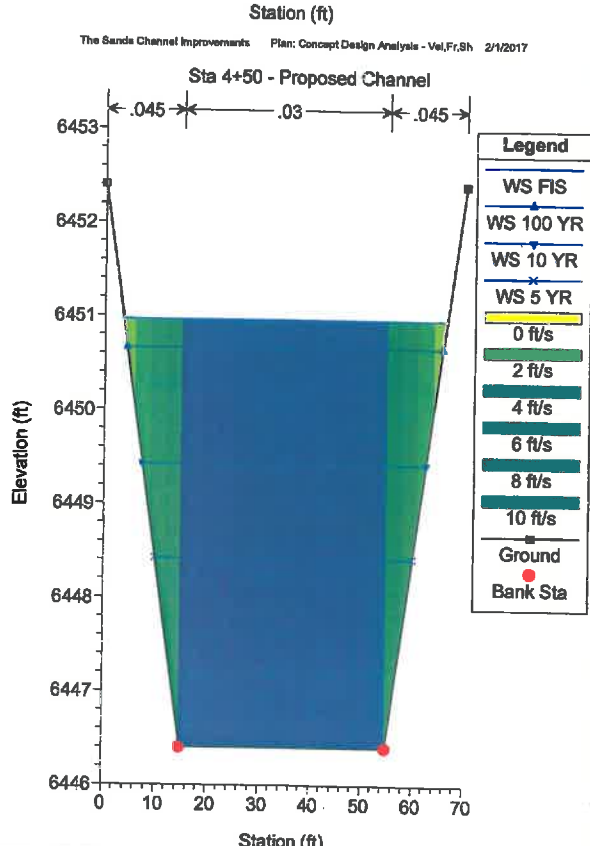


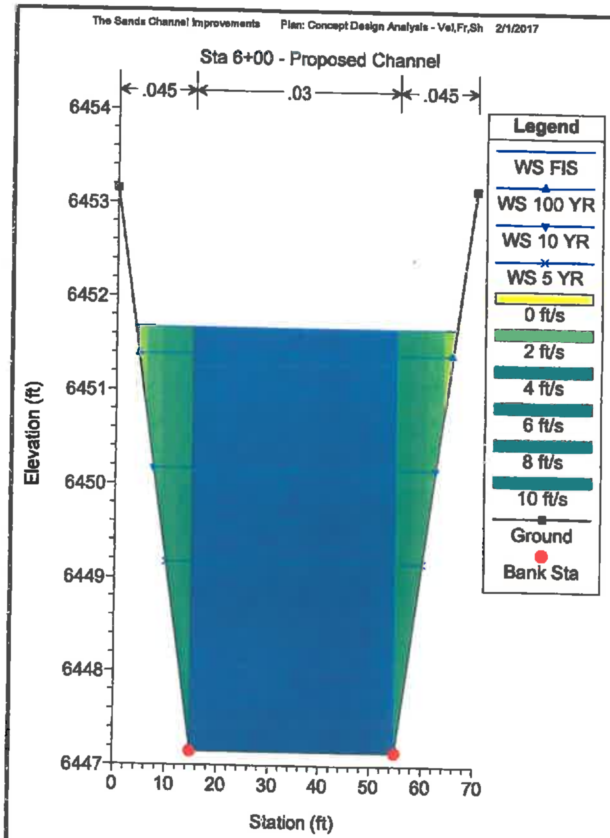
The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Box Culvert at Constitution Ave
.045
.03
.045
Elevation (ft)
Station (ft)
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
Ground
Bank Sta

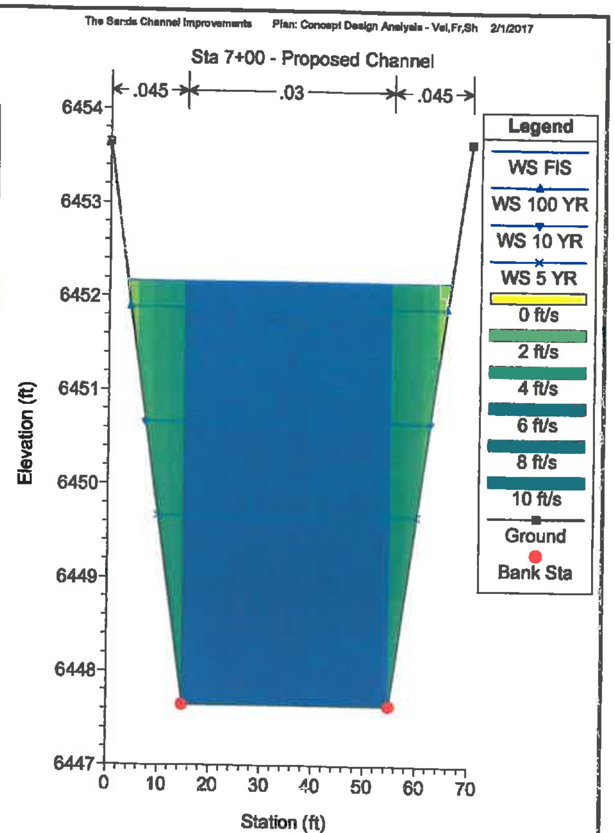

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 1+66 - 16' U/S of Box Culvert
.045
.03
.045
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6451
6450
6449
6448
6447
6446
6445
6444
0
10
20
30
40
50
60
70
Station (ft)

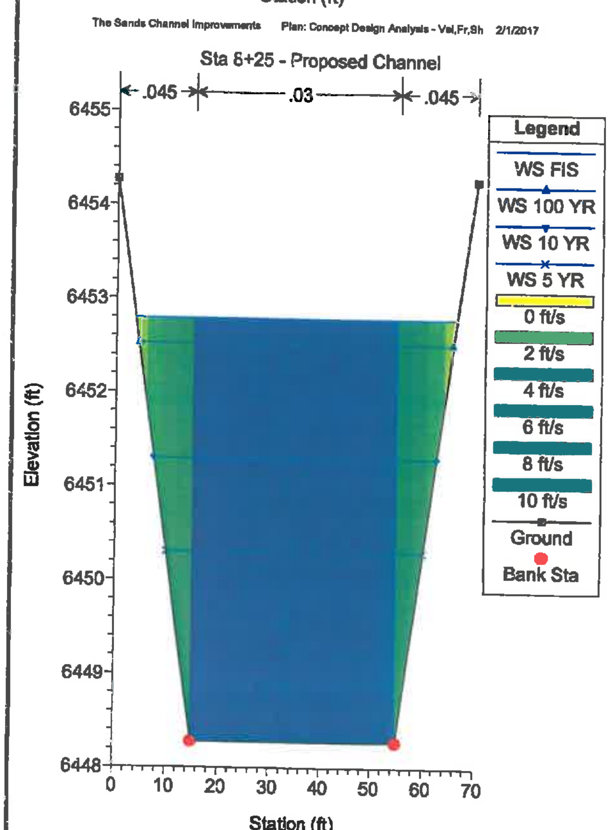

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 2+00 -50' U/S of Box Culvert
.045
.03
.045
Legend
WS FIS
WS 100 YR
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6452
6451
6450
6449
6448
6447
6446
6445
0
10
20
30
40
50
60
70
Station (ft)

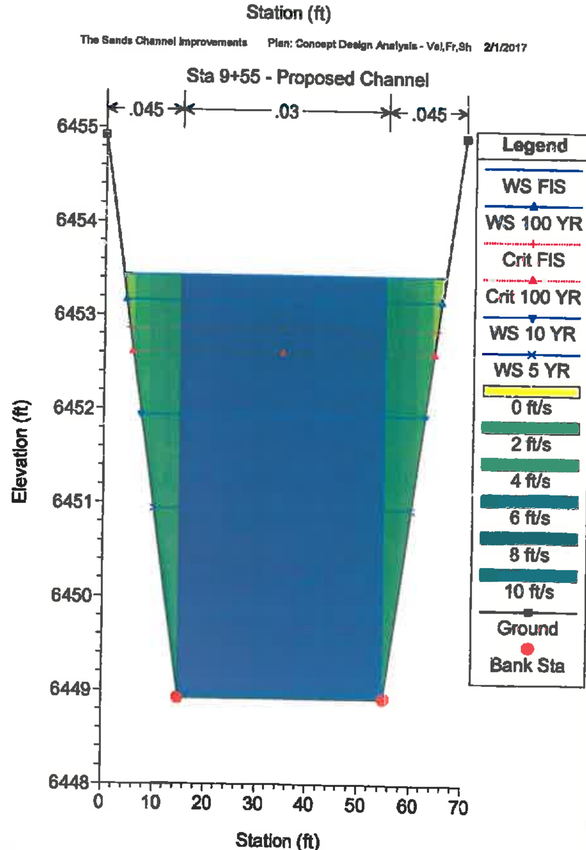

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 3+50 - Proposed Channel
.045
.03
.045
Legend
WS FIS
WS 100 YR
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6452
6451
6450
6449
6448
6447
6446
6445
0
10
20
30
40
50
60
70
Station (ft)


The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 4+50 - Proposed Channel
.045
.03
.045
Legend
WS FIS
WS 100 YR
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6453
6452
6451
6450
6449
6448
6447
6446
0
10
20
30
40
50
60
70
Station (ft)

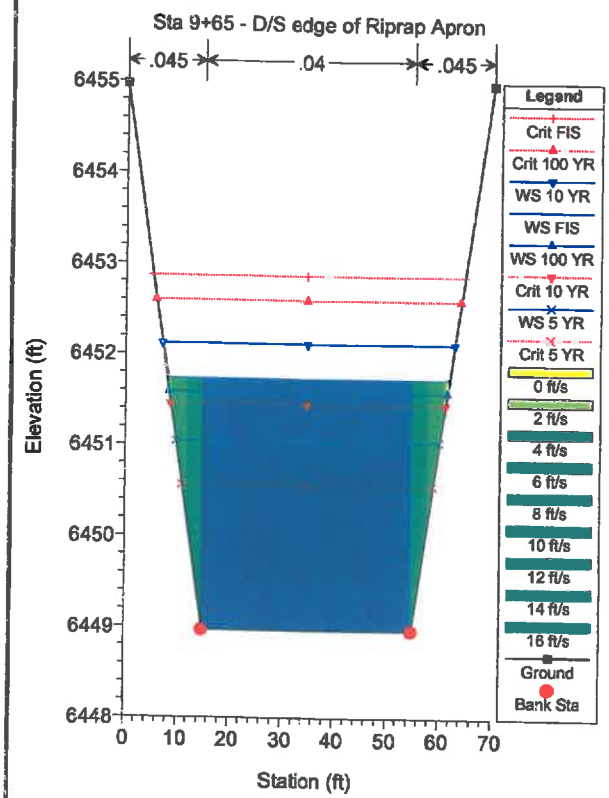

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 6+00 - Proposed Channel
.045
.03
.045
Elevation (ft)
6454
6453
6452
6451
6450
6449
6448
6447
Station (ft)
0
10
20
30
40
50
60
70
Legend
WS FIS
WS 100 YR
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta


The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 7+00 - Proposed Channel
.045
.03
.045
Elevation (ft)
6454
6453
6452
6451
6450
6449
6448
6447
Station (ft)
0
10
20
30
40
50
60
70
Legend
WS FIS
WS 100 YR
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta

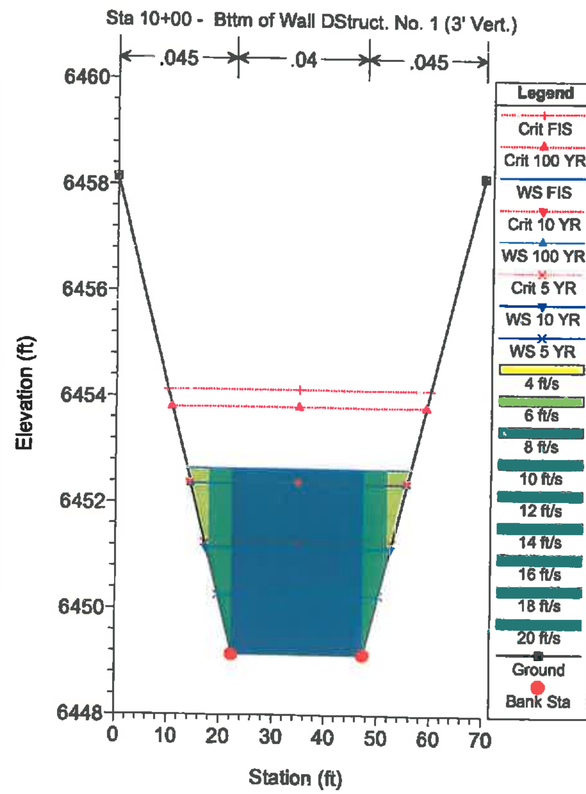

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 8+25 - Proposed Channel
.045
.03
.045
Elevation (ft)
6455
6454
6453
6452
6451
6450
6449
6448
Station (ft)
0
10
20
30
40
50
60
70
Legend
WS FIS
WS 100 YR
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta


The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 9+55 - Proposed Channel
.045
.03
.045
Elevation (ft)
6455
6454
6453
6452
6451
6450
6449
6448
Station (ft)
0
10
20
30
40
50
60
70
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta

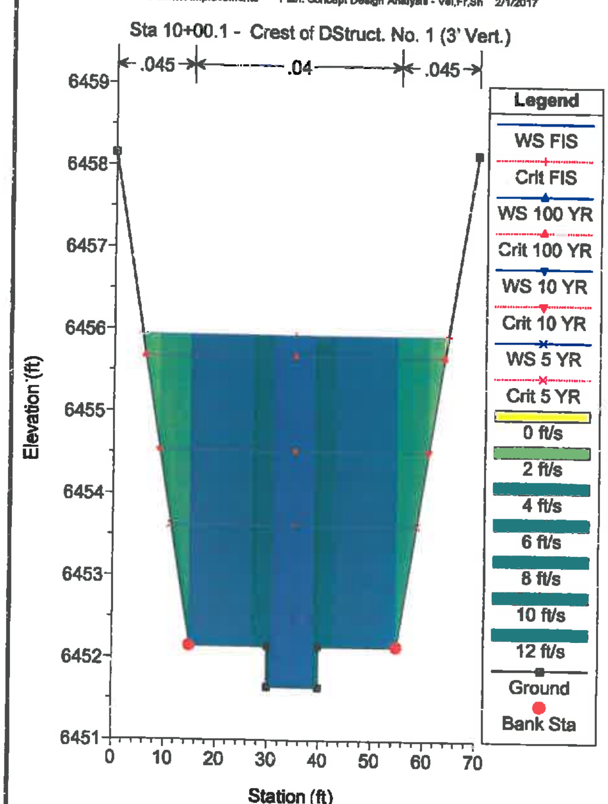
The Sands Channel Improvements   Plan: Concept Design Analysis - Vel,Fr,Sh   2/1/2017



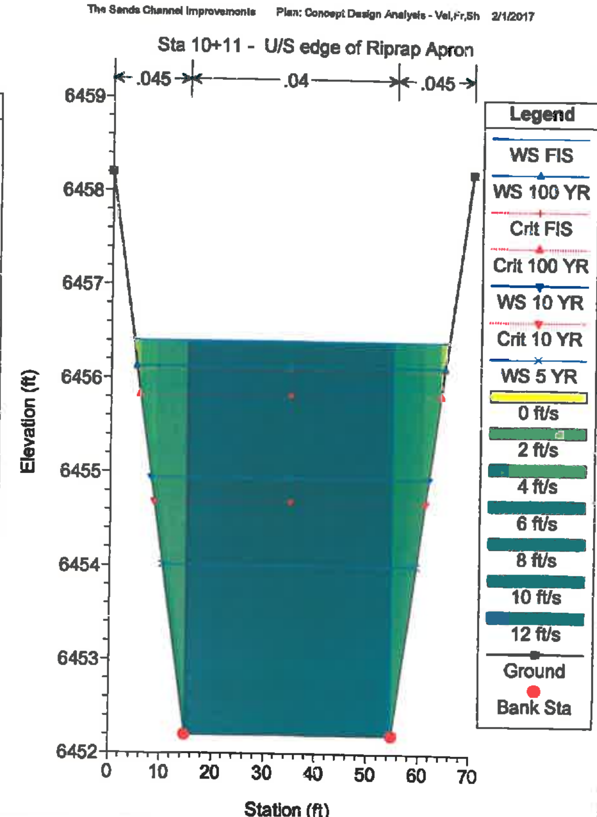
The Sands Channel Improvements   Plan: Concept Design Analysis - Vel,Fr,Sh   2/1/2017

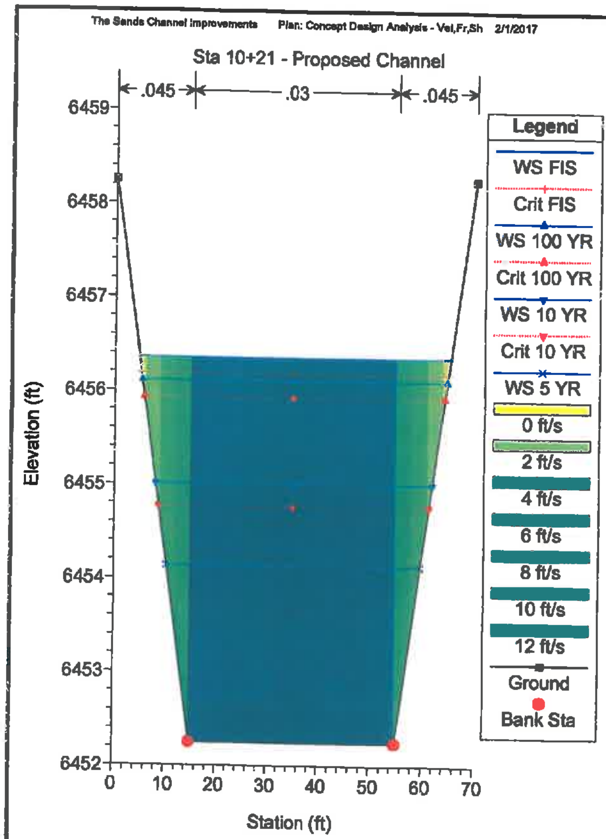


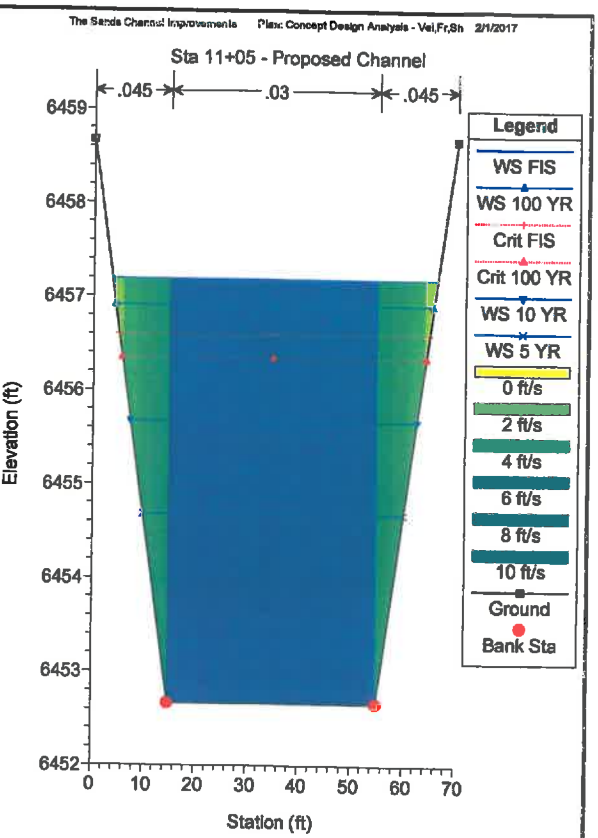
The Sands Channel Improvements   Plan: Concept Design Analysis - Vel,Fr,Sh   2/1/2017

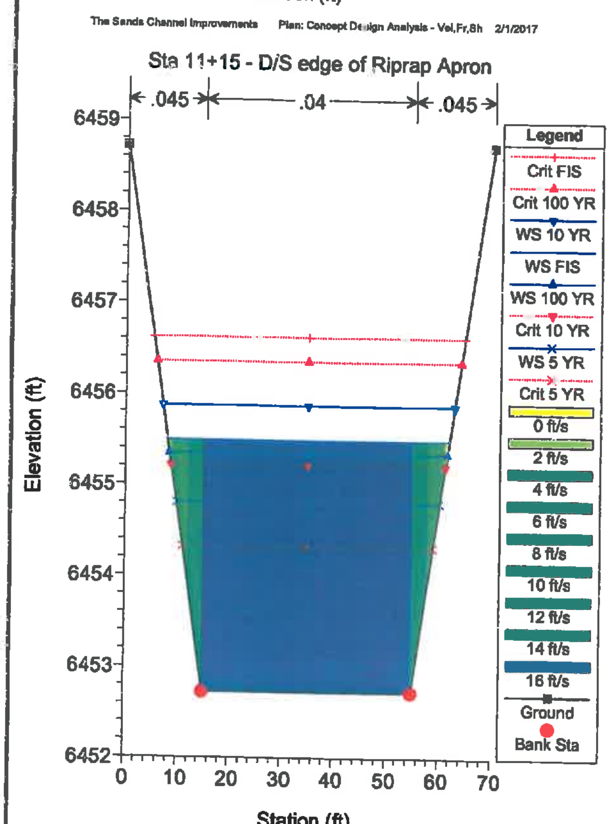


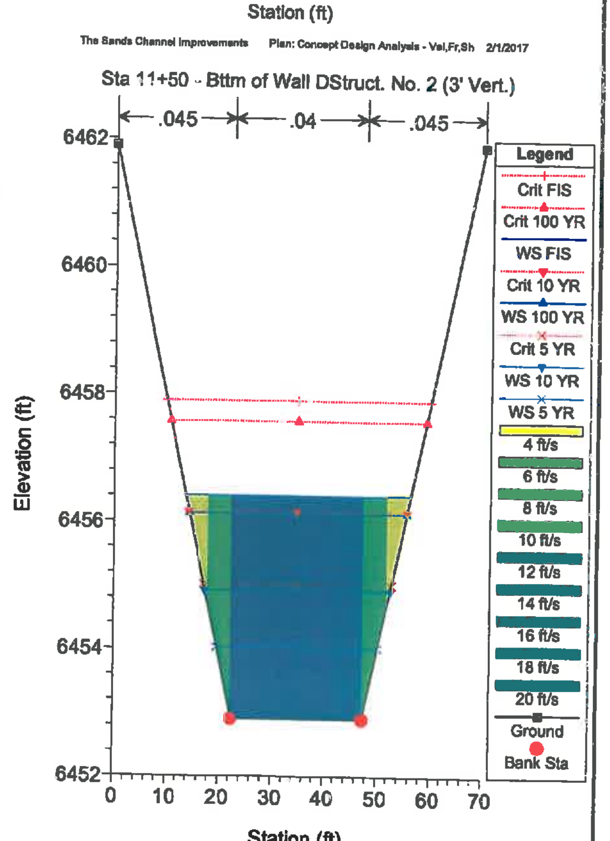
The Sands Channel Improvements   Plan: Concept Design Analysis - Vel,Fr,Sh   2/1/2017

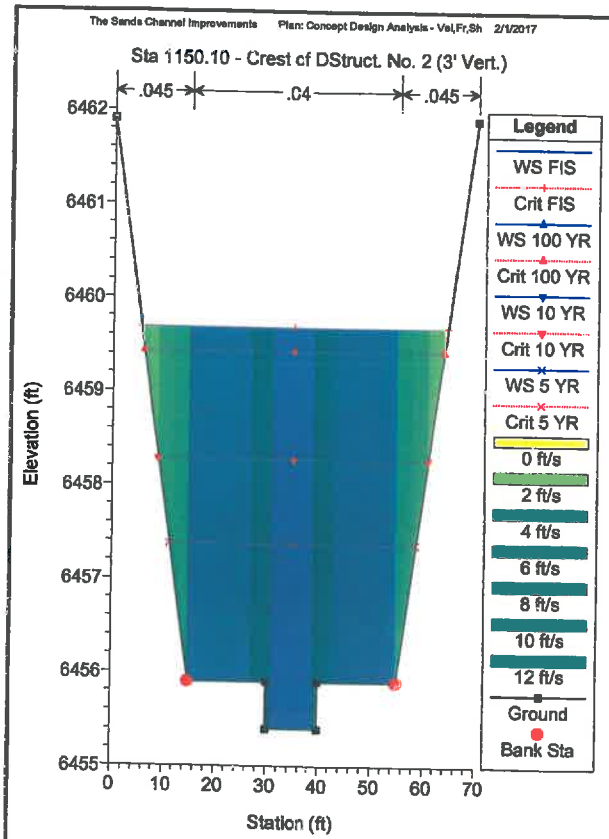


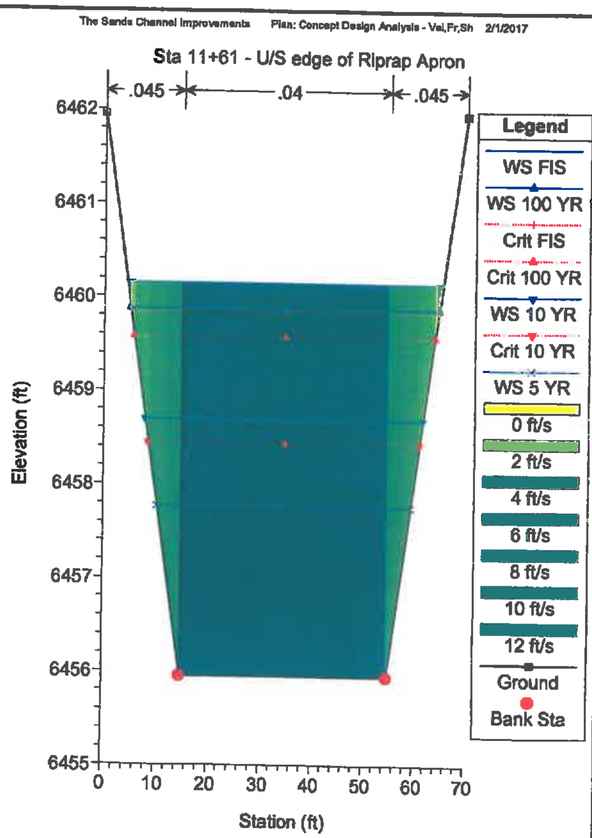

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 10+21 - Proposed Channel
.045
.03
.045
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
6459
6458
6457
6456
6455
6454
6453
6452
0
10
20
30
40
50
60
70
Station (ft)

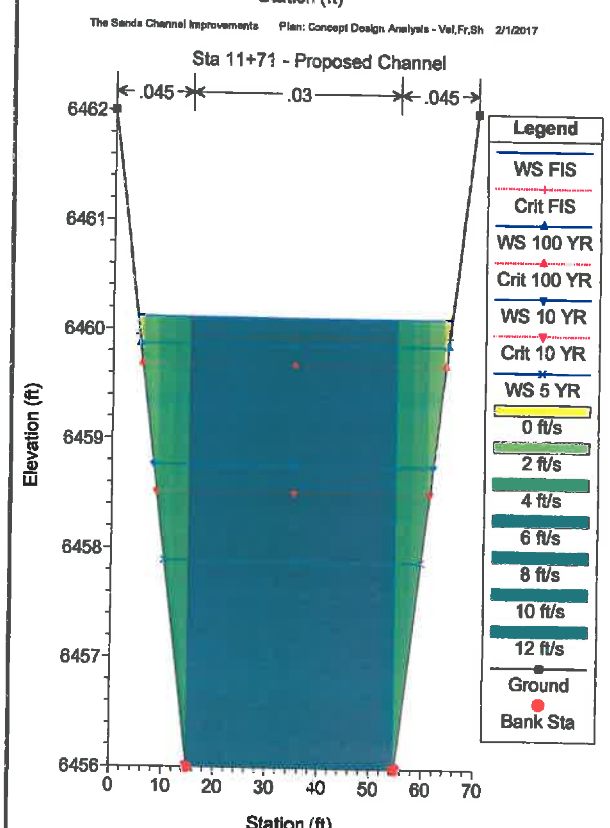

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 11+05 - Proposed Channel
.045
.03
.045
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6459
6458
6457
6456
6455
6454
6453
6452
0
10
20
30
40
50
60
70
Station (ft)

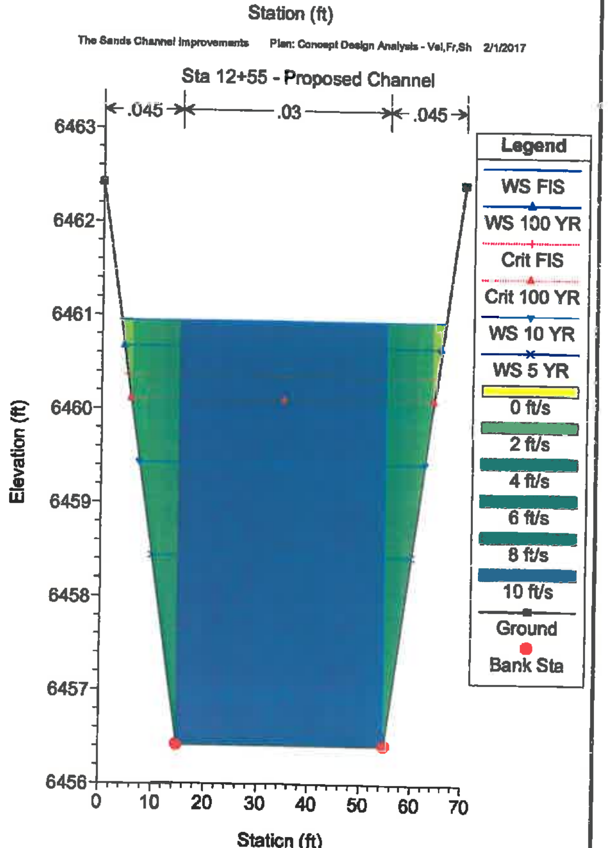

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 11+15 - D/S edge of Riprap Apron
.045
.04
.045
Legend
Crit FIS
Crit 100 YR
WS 10 YR
WS FIS
WS 100 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
Ground
Bank Sta
Elevation (ft)
6459
6458
6457
6456
6455
6454
6453
6452
0
10
20
30
40
50
60
70
Station (ft)

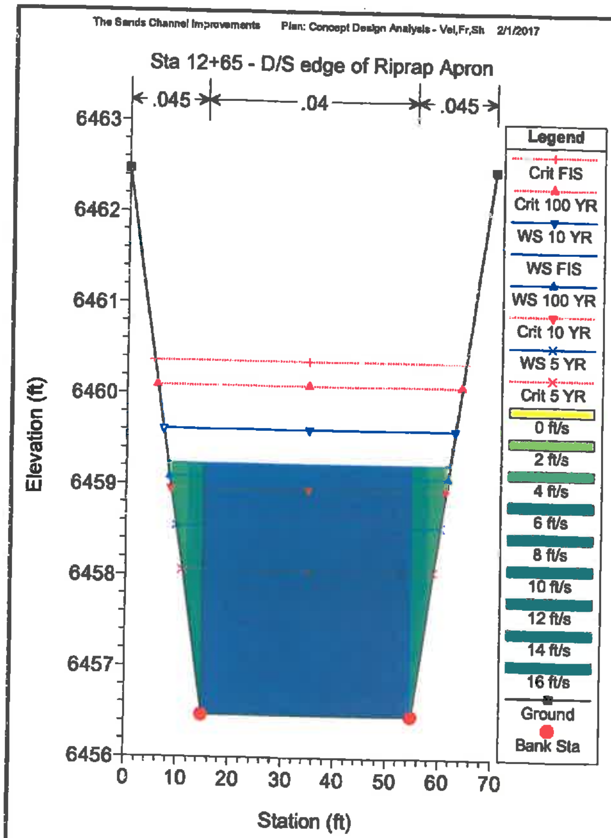

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 11+50 - Bttm of Wall DStruct. No. 2 (3' Vert.)
.045
.04
.045
Legend
Crit FIS
Crit 100 YR
WS FIS
Crit 10 YR
WS 100 YR
Crit 5 YR
WS 10 YR
WS 5 YR
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
Ground
Bank Sta
Elevation (ft)
6462
6460
6458
6456
6454
6452
0
10
20
30
40
50
60
70
Station (ft)

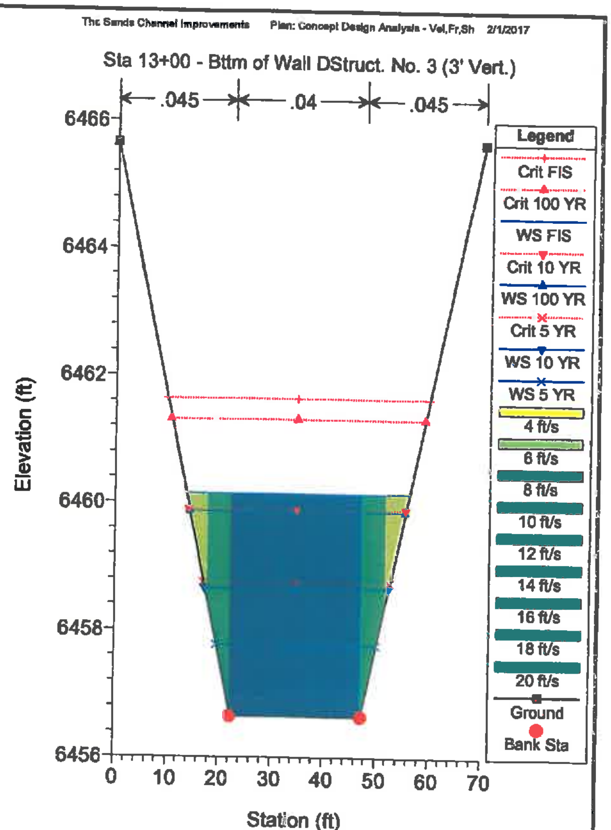

The Sands Channel Improvements
Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 1150.10 - Crest of DStruct. No. 2 (3' Vert.)
.045
.04
.045
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
6462
6461
6460
6459
6458
6457
6456
6455
0
10
20
30
40
50
60
70
Station (ft)

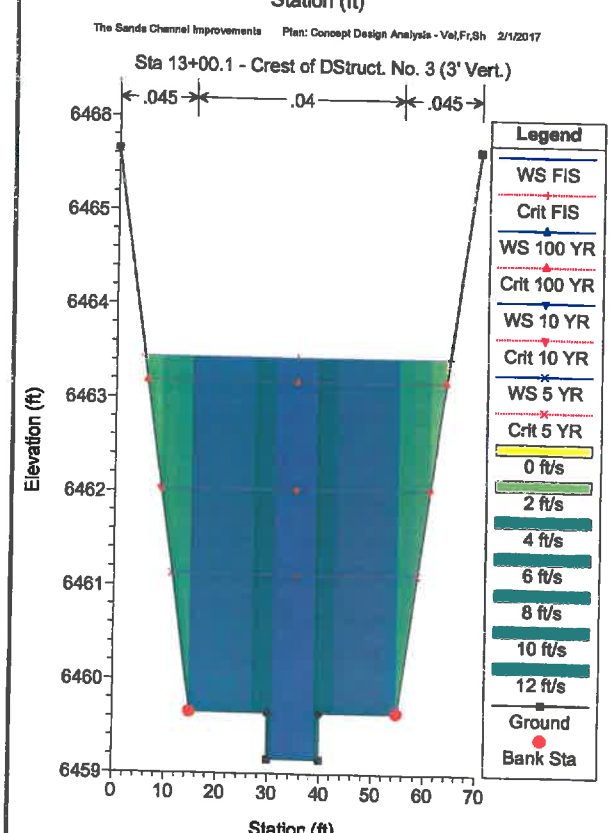

The Sands Channel Improvements
Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 11+61 - U/S edge of Riprap Apron
.045
.04
.045
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
6462
6461
6460
6459
6458
6457
6456
6455
0
10
20
30
40
50
60
70
Station (ft)

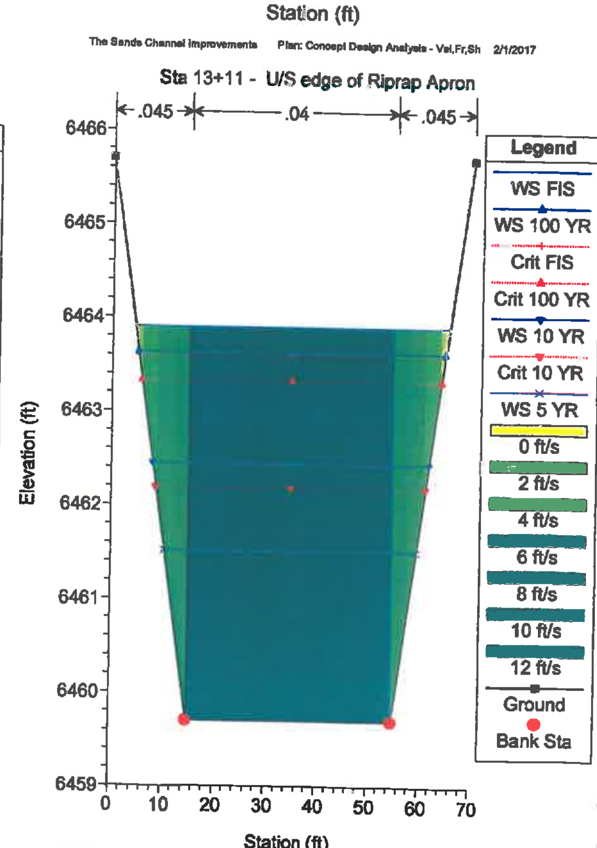

The Sands Channel Improvements
Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 11+71 - Proposed Channel
.045
.03
.045
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
6462
6461
6460
6459
6458
6457
6456
0
10
20
30
40
50
60
70
Station (ft)

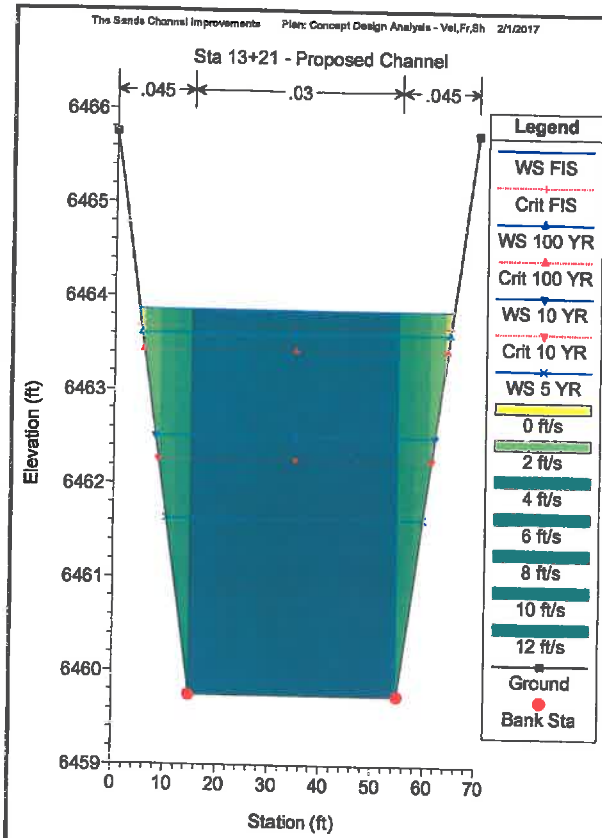

The Sands Channel Improvements
Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 12+55 - Proposed Channel
.045
.03
.045
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6463
6462
6461
6460
6459
6458
6457
6456
0
10
20
30
40
50
60
70
Station (ft)

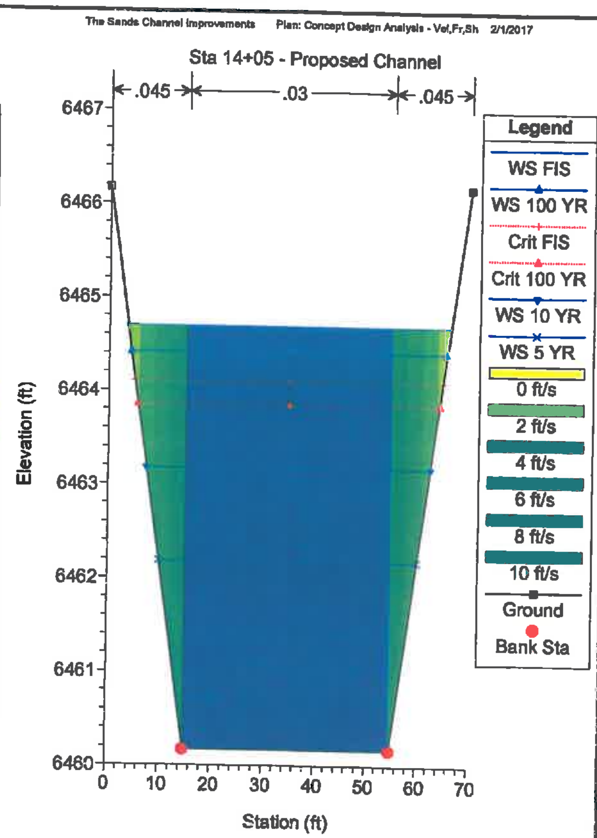

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 12+65 - D/S edge of Riprap Apron
.045
.04
.045
Legend
Crit FIS
Crit 100 YR
WS 10 YR
WS FIS
WS 100 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

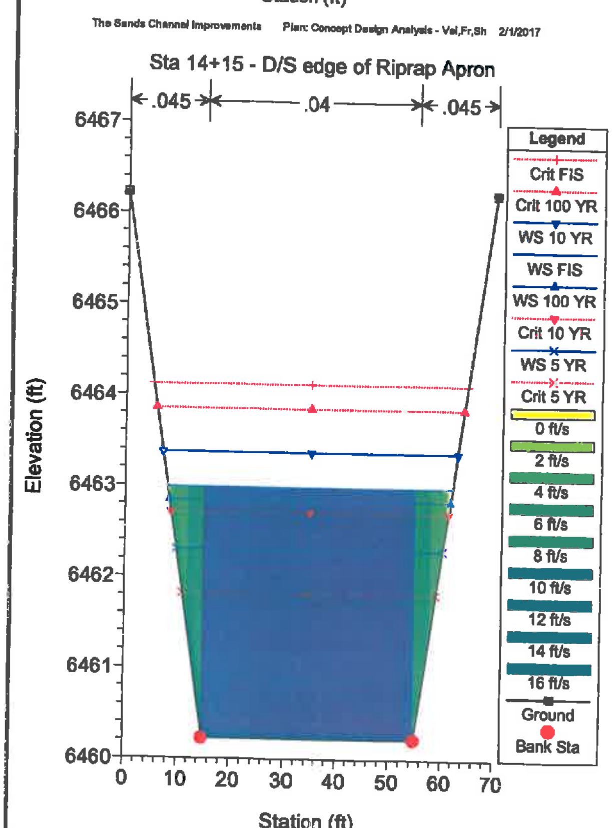

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 13+00 - Bttm of Wall DStruct. No. 3 (3' Vert.)
.045
.04
.045
Legend
Crit FIS
Crit 100 YR
WS FIS
Crit 10 YR
WS 100 YR
Crit 5 YR
WS 10 YR
WS 5 YR
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

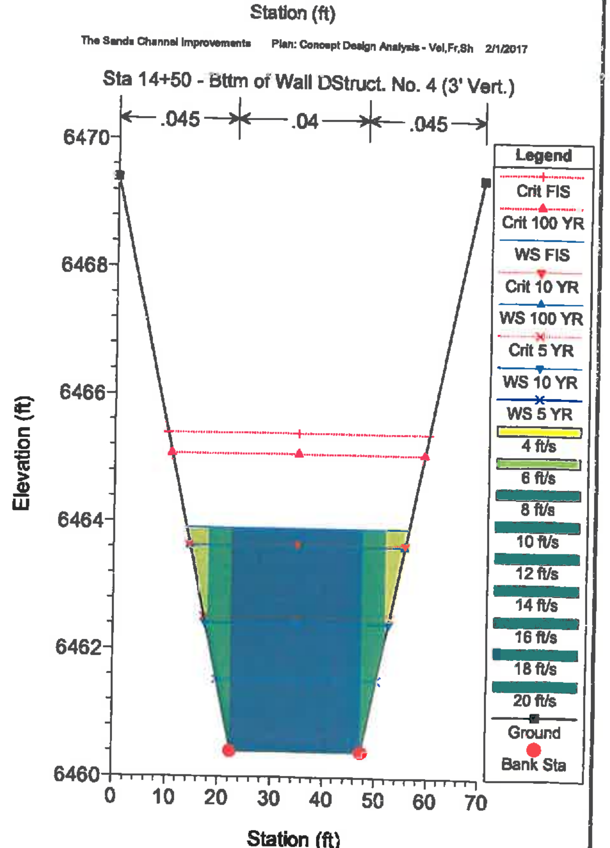

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 13+00.1 - Crest of DStruct. No. 3 (3' Vert.)
.045
.04
.045
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

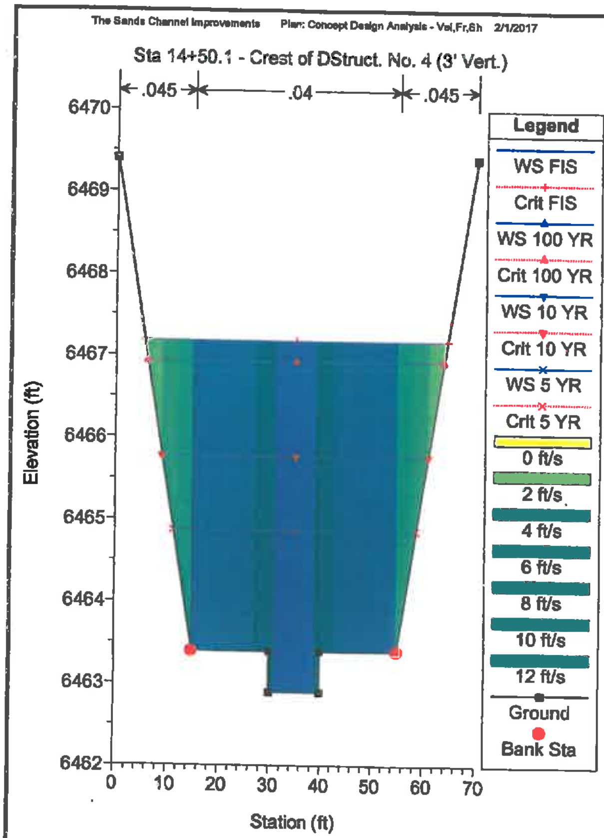

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 13+11 - U/S edge of Riprap Apron
.045
.04
.045
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

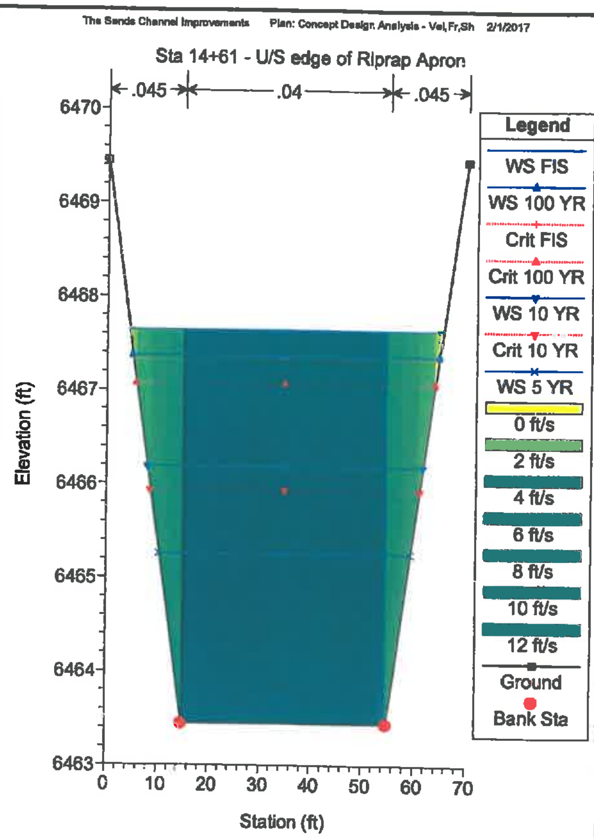

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 13+21 - Proposed Channel
.045
.03
.045
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
6459
6460
6461
6462
6463
6464
6465
6466
Station (ft)
0 10 20 30 40 50 60 70

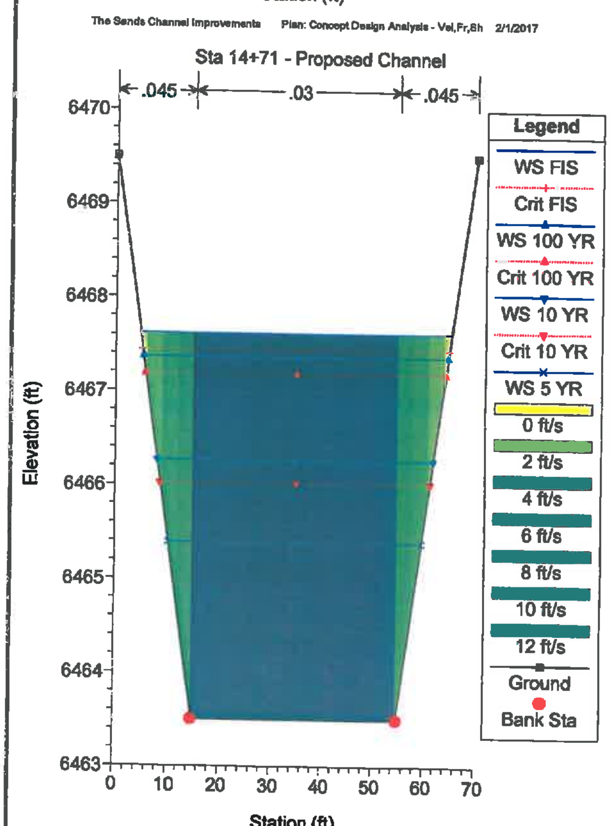

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 14+05 - Proposed Channel
.045
.03
.045
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6460
6461
6462
6463
6464
6465
6466
6467
Station (ft)
0 10 20 30 40 50 60 70

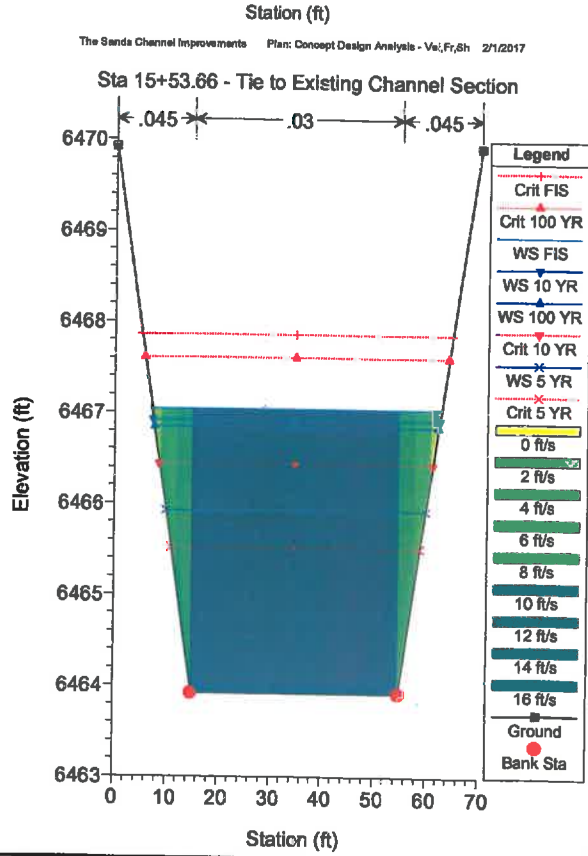

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 14+15 - D/S edge of Riprap Apron
.045
.04
.045
Legend
Crit FIS
Crit 100 YR
WS 10 YR
WS FIS
WS 100 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
Ground
Bank Sta
Elevation (ft)
6460
6461
6462
6463
6464
6465
6466
6467
Station (ft)
0 10 20 30 40 50 60 70

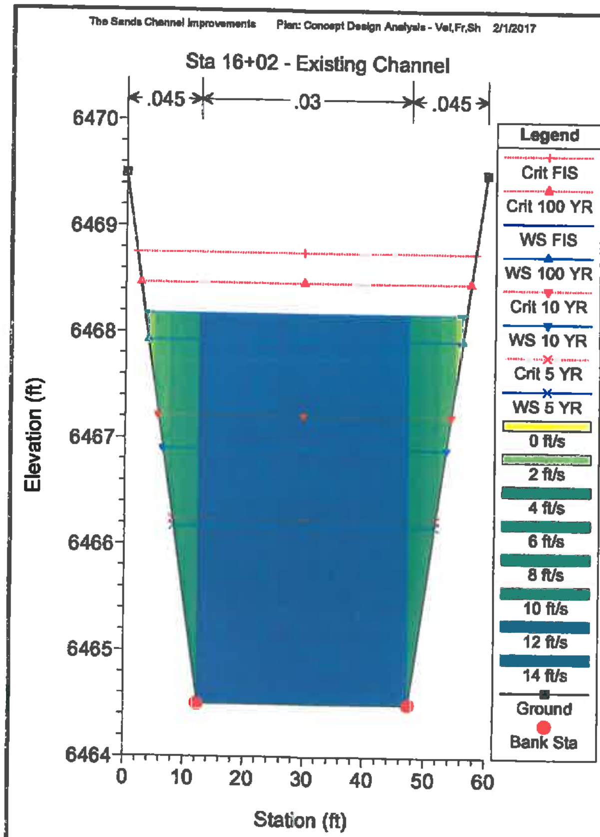

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 14+50 - Bttm of Wall DStruct. No. 4 (3' Vert.)
.045
.04
.045
Legend
Crit FIS
Crit 100 YR
WS FIS
Crit 10 YR
WS 100 YR
Crit 5 YR
WS 10 YR
WS 5 YR
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
Ground
Bank Sta
Elevation (ft)
6460
6462
6464
6466
6468
6470
Station (ft)
0 10 20 30 40 50 60 70

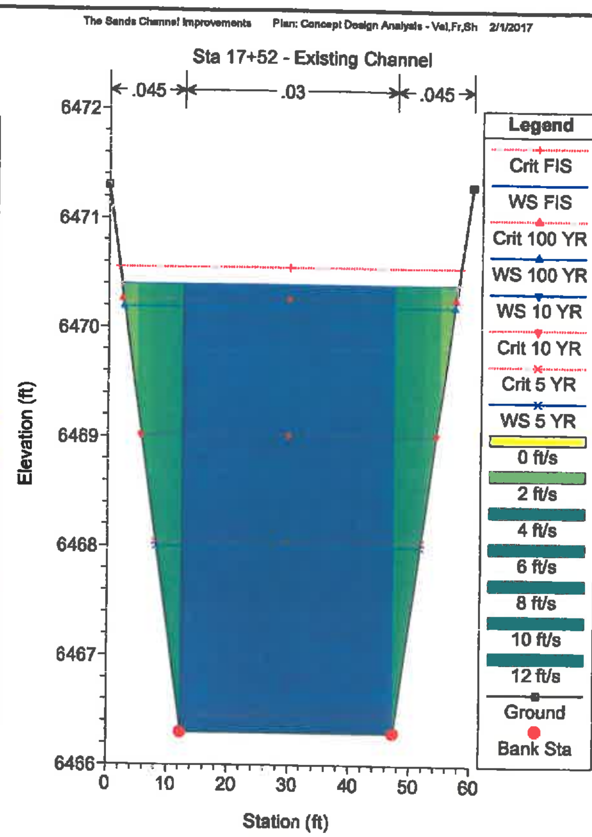

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 14+50.1 - Crest of DStruct. No. 4 (3' Vert.)
.045
.04
.045
Elevation (ft)
Station (ft)
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta

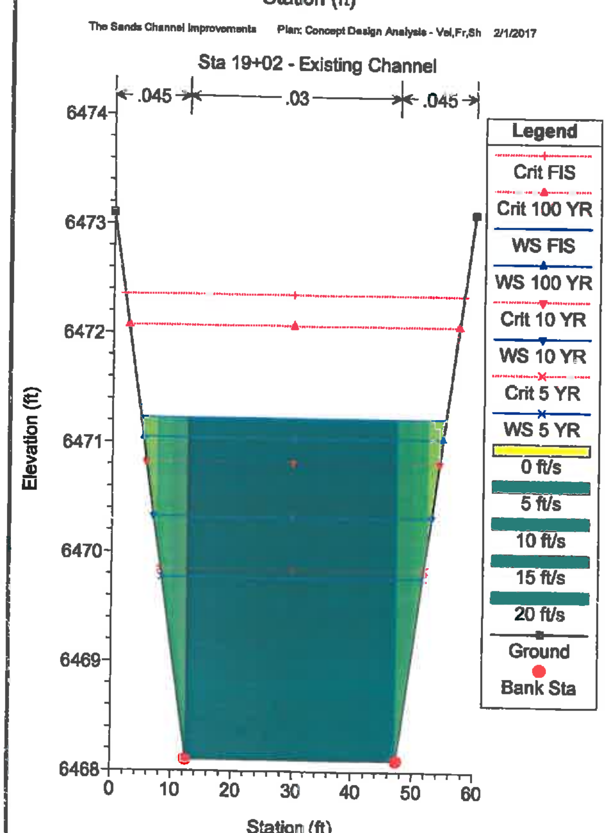

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 14+61 - U/S edge of Riprap Apron
.045
.04
.045
Elevation (ft)
Station (ft)
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta

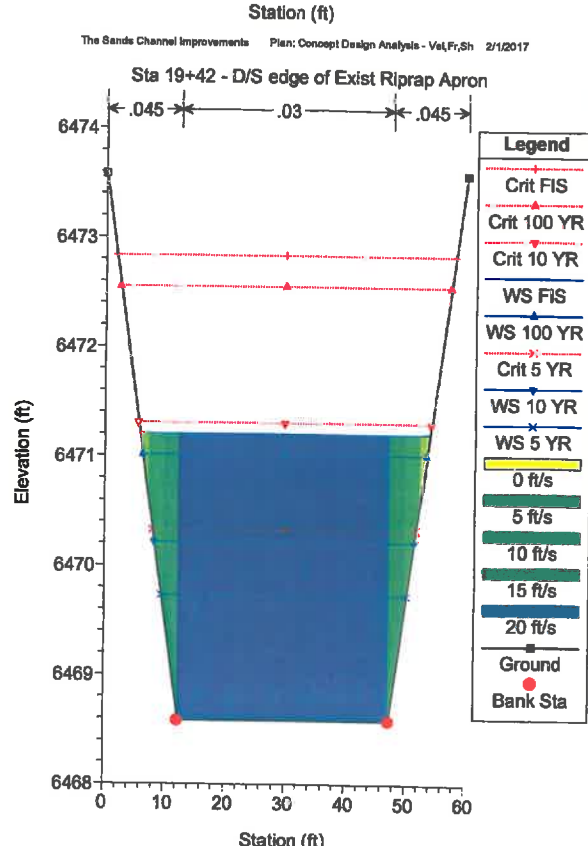

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 14+71 - Proposed Channel
.045
.03
.045
Elevation (ft)
Station (ft)
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta

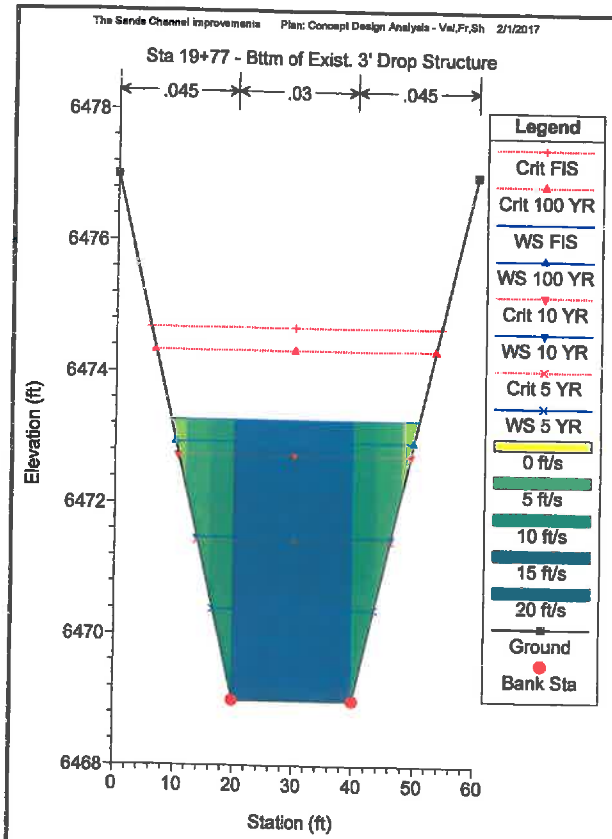

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 15+53.66 - Tie to Existing Channel Section
.045
.03
.045
Elevation (ft)
Station (ft)
Legend
Crit FIS
Crit 100 YR
WS FIS
WS 10 YR
WS 100 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
Ground
Bank Sta

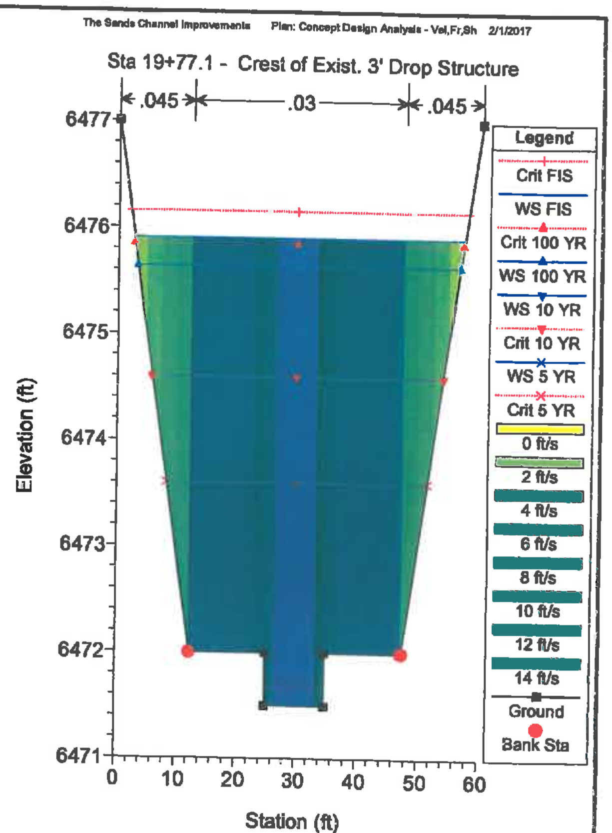

The Sands Channel Improvements
Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 16+02 - Existing Channel
.045
.03
.045
Elevation (ft)
Station (ft)
Legend
Crit FIS
Crit 100 YR
WS FIS
WS 100 YR
Crit 10 YR
WS 10 YR
Crit 5 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta

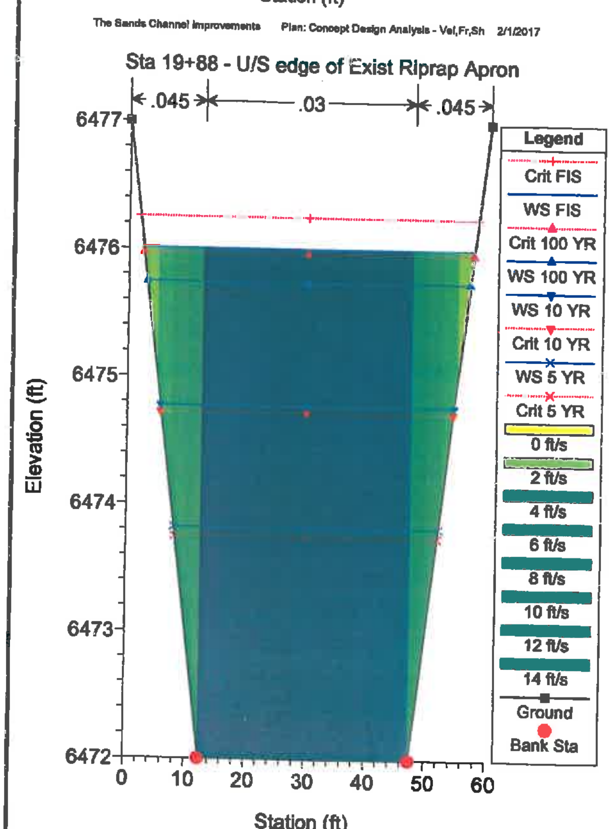

The Sands Channel Improvements
Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 17+52 - Existing Channel
.045
.03
.045
Elevation (ft)
Station (ft)
Legend
Crit FIS
WS FIS
Crit 100 YR
WS 100 YR
WS 10 YR
Crit 10 YR
Crit 5 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta

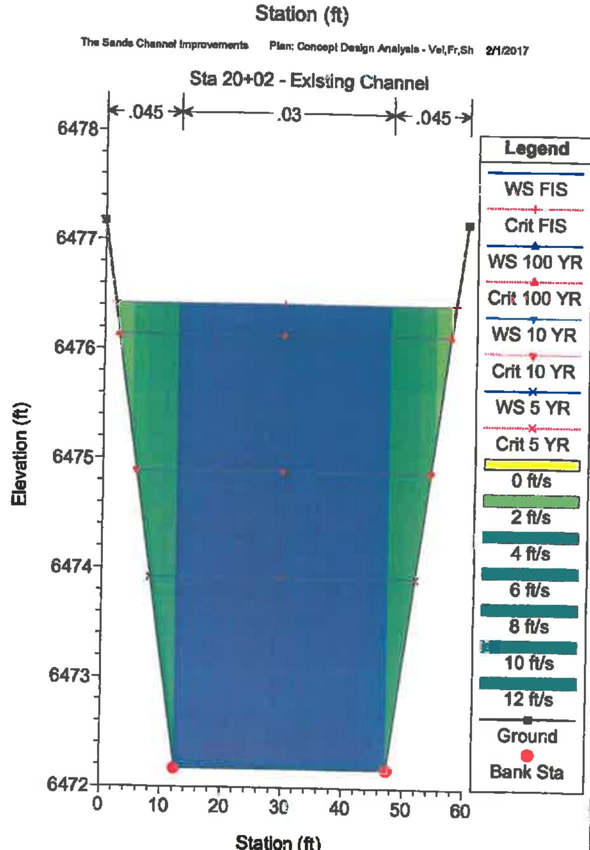

The Sands Channel Improvements
Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 19+02 - Existing Channel
.045
.03
.045
Elevation (ft)
Station (ft)
Legend
Crit FIS
Crit 100 YR
WS FIS
WS 100 YR
Crit 10 YR
WS 10 YR
Crit 5 YR
WS 5 YR
0 ft/s
5 ft/s
10 ft/s
15 ft/s
20 ft/s
Ground
Bank Sta

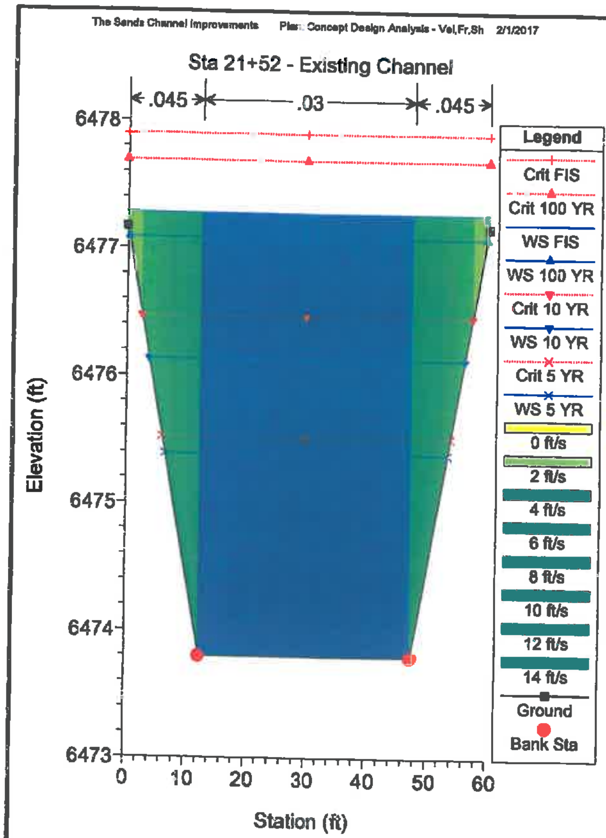

The Sands Channel Improvements
Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 19+42 - D/S edge of Exist Riprap Apron
.045
.03
.045
Elevation (ft)
Station (ft)
Legend
Crit FIS
Crit 100 YR
Crit 10 YR
WS FIS
WS 100 YR
Crit 5 YR
WS 10 YR
WS 5 YR
0 ft/s
5 ft/s
10 ft/s
15 ft/s
20 ft/s
Ground
Bank Sta

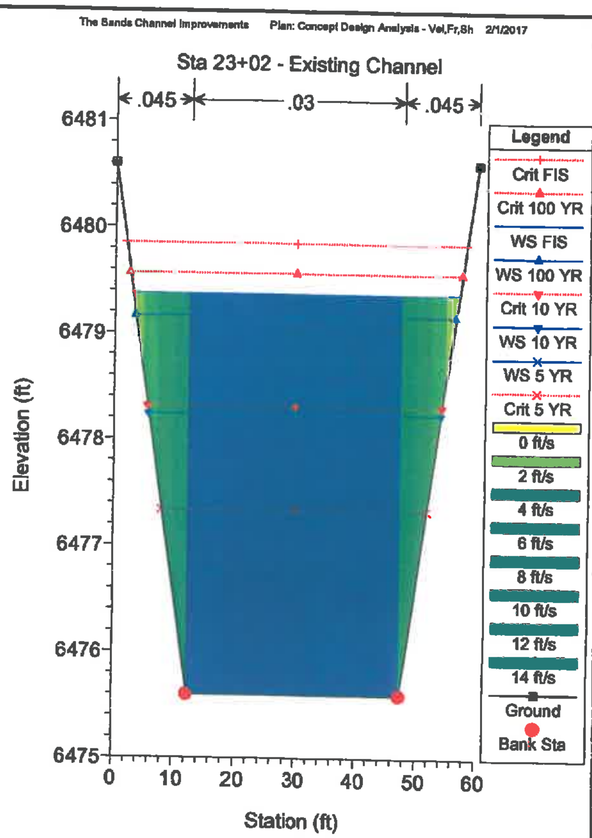

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 19+77 - Bttm of Exist. 3' Drop Structure
.045
.03
.045
Elevation (ft)
Station (ft)
Legend
Crit FIS
Crit 100 YR
WS FIS
WS 100 YR
Crit 10 YR
WS 10 YR
Crit 5 YR
WS 5 YR
0 ft/s
5 ft/s
10 ft/s
15 ft/s
20 ft/s
Ground
Bank Sta

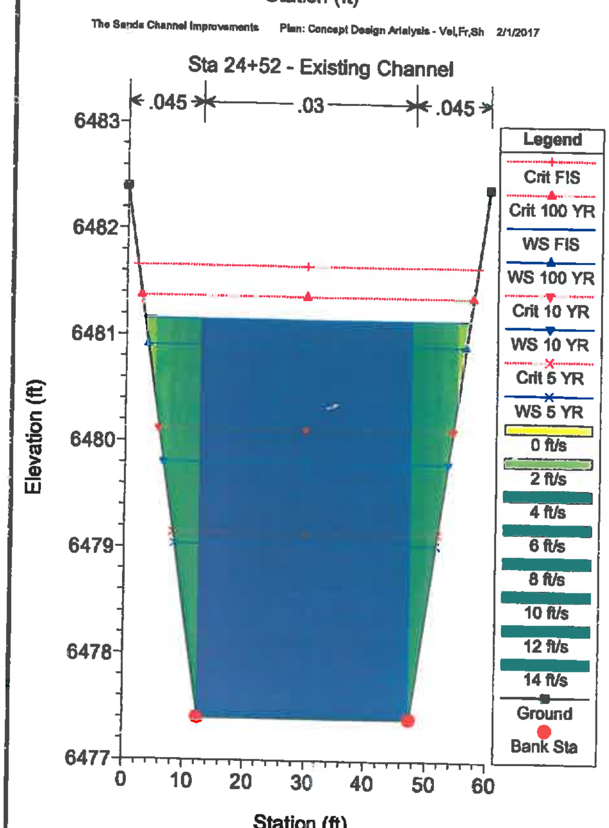

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 19+77.1 - Crest of Exist. 3' Drop Structure
.045
.03
.045
Elevation (ft)
Station (ft)
Legend
Crit FIS
WS FIS
Crit 100 YR
WS 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta

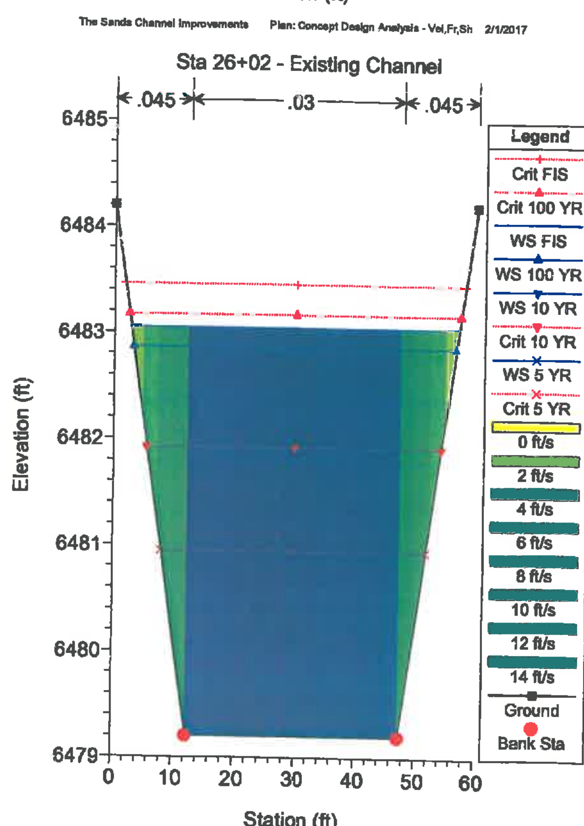

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 19+88 - U/S edge of Exist Riprap Apron
.045
.03
.045
Elevation (ft)
Station (ft)
Legend
Crit FIS
WS FIS
Crit 100 YR
WS 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta

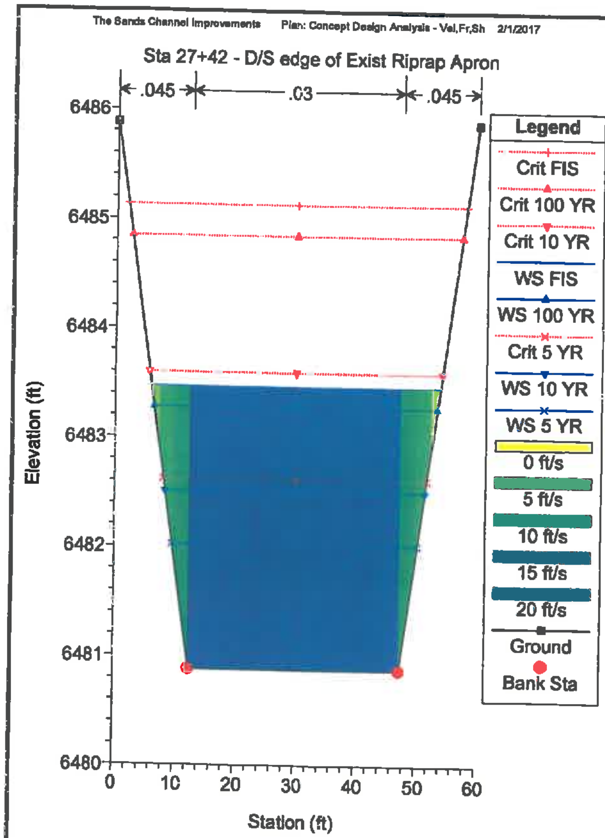

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 20+02 - Existing Channel
.045
.03
.045
Elevation (ft)
Station (ft)
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta

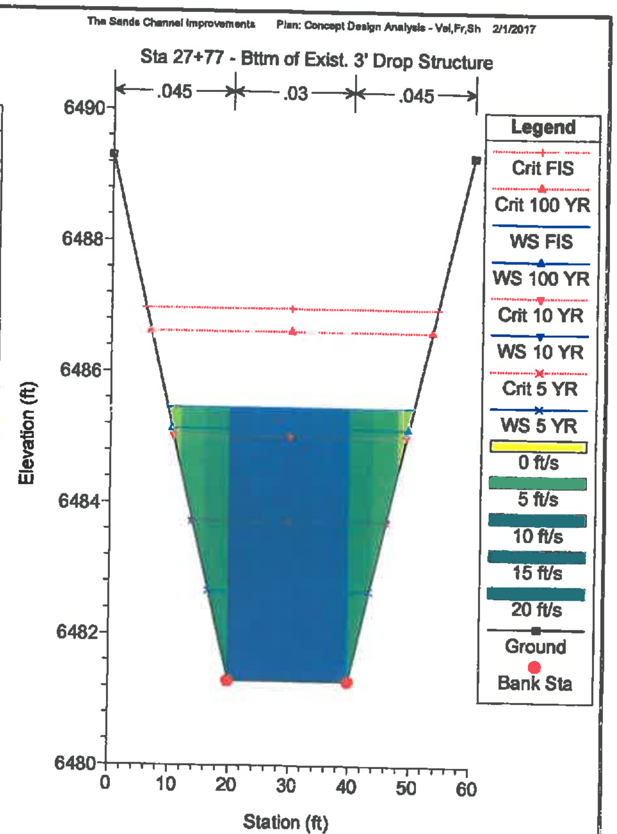

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 21+52 - Existing Channel
.045
.03
.045
Elevation (ft)
Station (ft)
Legend
Crit FIS
Crit 100 YR
WS FIS
WS 100 YR
Crit 10 YR
WS 10 YR
Crit 5 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta

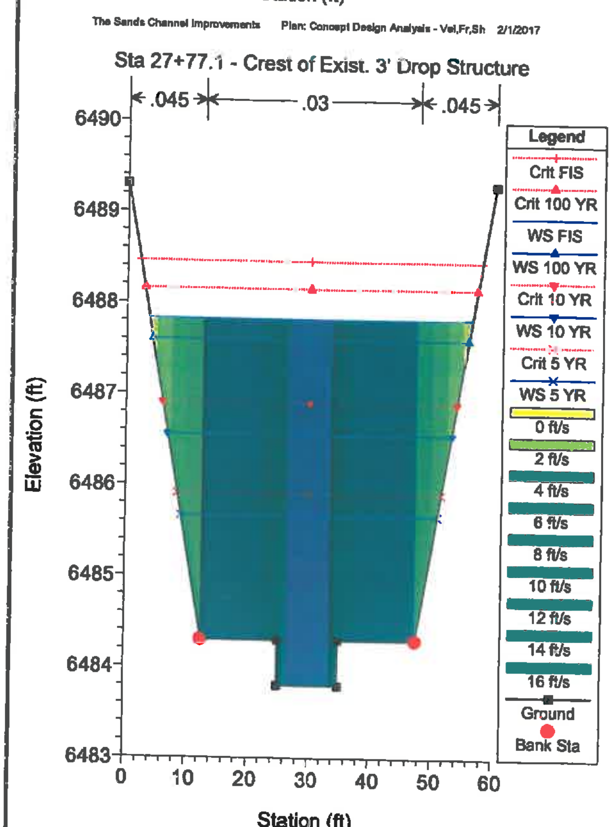

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 23+02 - Existing Channel
.045
.03
.045
Elevation (ft)
Station (ft)
Legend
Crit FIS
Crit 100 YR
WS FIS
WS 100 YR
Crit 10 YR
WS 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta

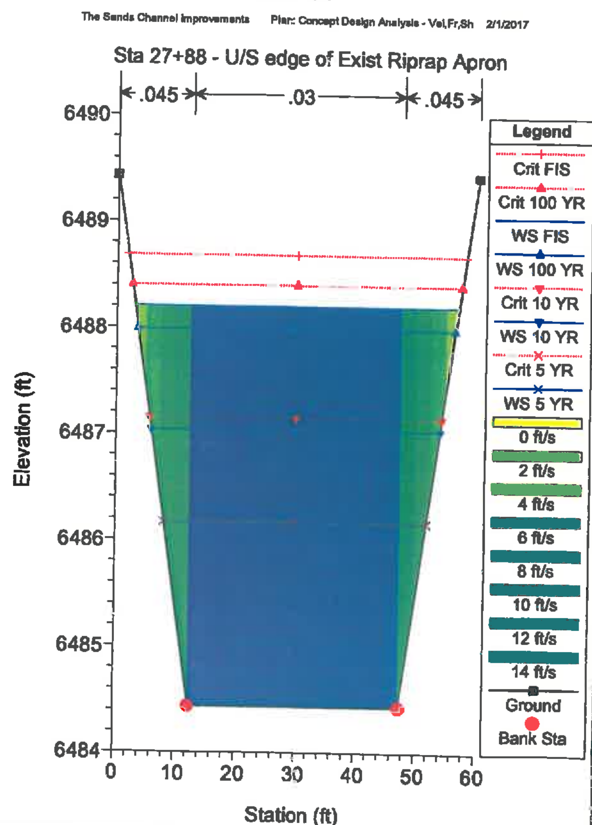

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 24+52 - Existing Channel
.045
.03
.045
Elevation (ft)
Station (ft)
Legend
Crit FIS
Crit 100 YR
WS FIS
WS 100 YR
Crit 10 YR
WS 10 YR
Crit 5 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta

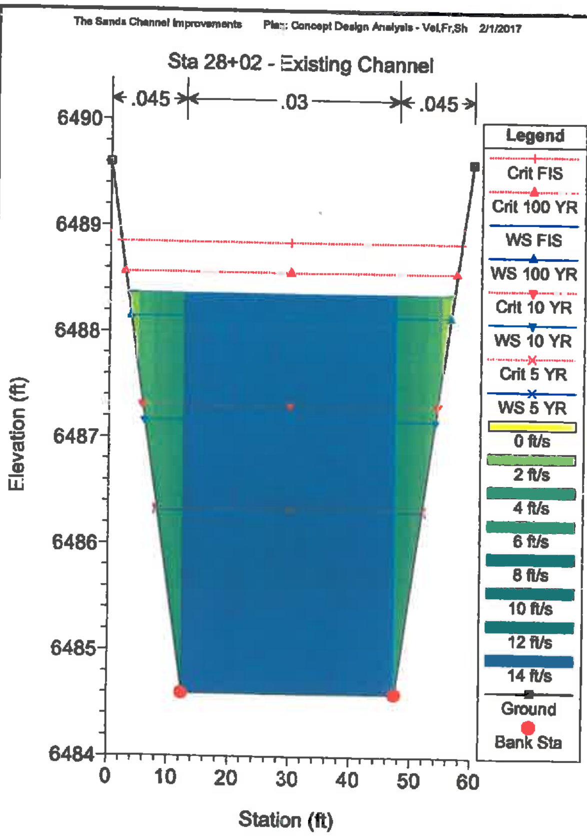

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 26+02 - Existing Channel
.045
.03
.045
Elevation (ft)
Station (ft)
Legend
Crit FIS
Crit 100 YR
WS FIS
WS 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta

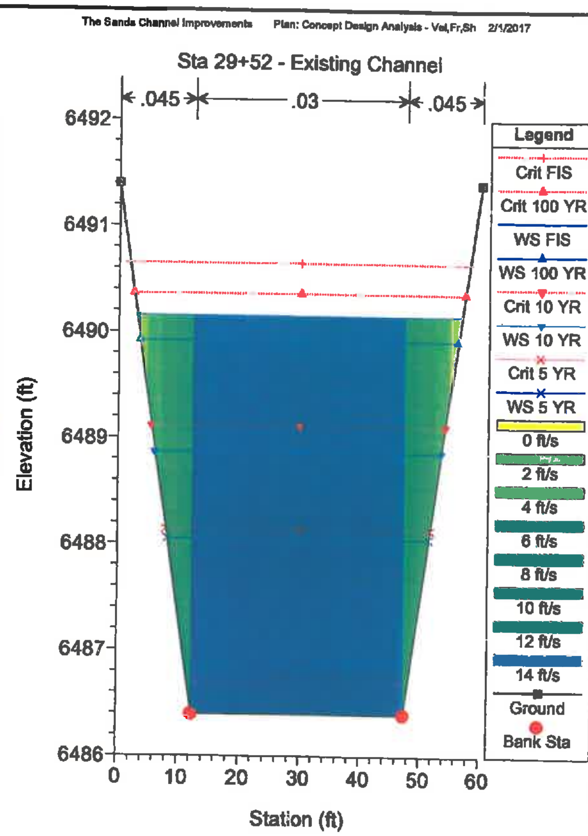

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 27+42 - D/S edge of Exist Riprap Apron
.045
.03
.045
Legend
Crit FIS
Crit 100 YR
Crit 10 YR
WS FIS
WS 100 YR
Crit 5 YR
WS 10 YR
WS 5 YR
0 ft/s
5 ft/s
10 ft/s
15 ft/s
20 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

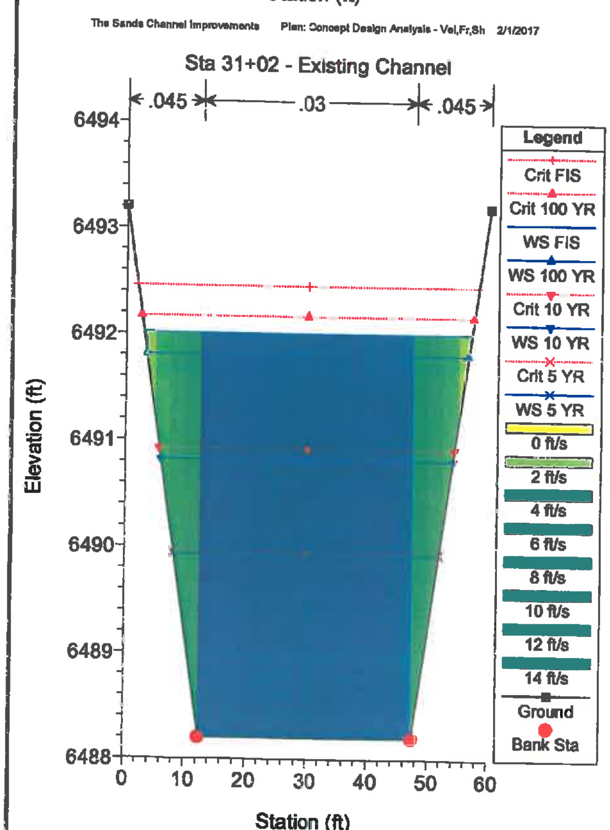

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 27+77 - Bttm of Exist. 3' Drop Structure
.045
.03
.045
Legend
Crit FIS
Crit 100 YR
WS FIS
WS 100 YR
Crit 10 YR
WS 10 YR
Crit 5 YR
WS 5 YR
0 ft/s
5 ft/s
10 ft/s
15 ft/s
20 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

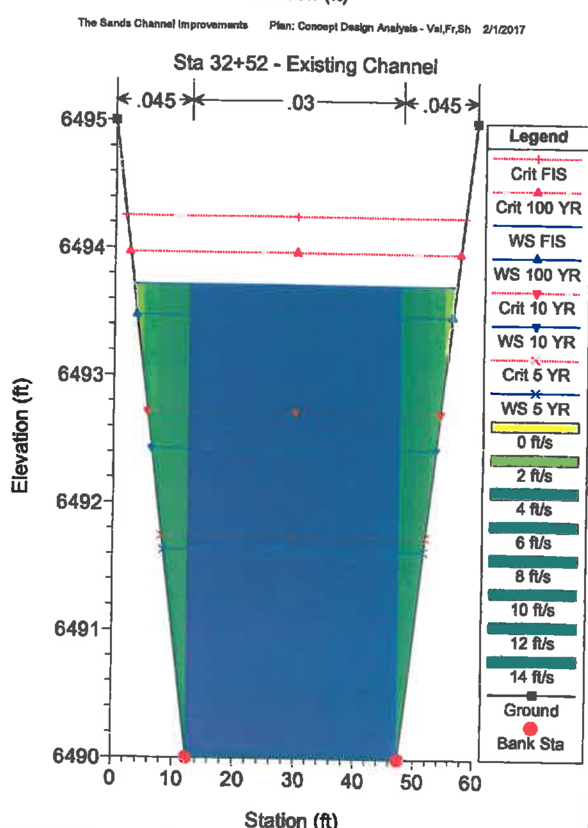

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 27+77.1 - Crest of Exist. 3' Drop Structure
.045
.03
.045
Legend
Crit FIS
Crit 100 YR
WS FIS
WS 100 YR
Crit 10 YR
WS 10 YR
Crit 5 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

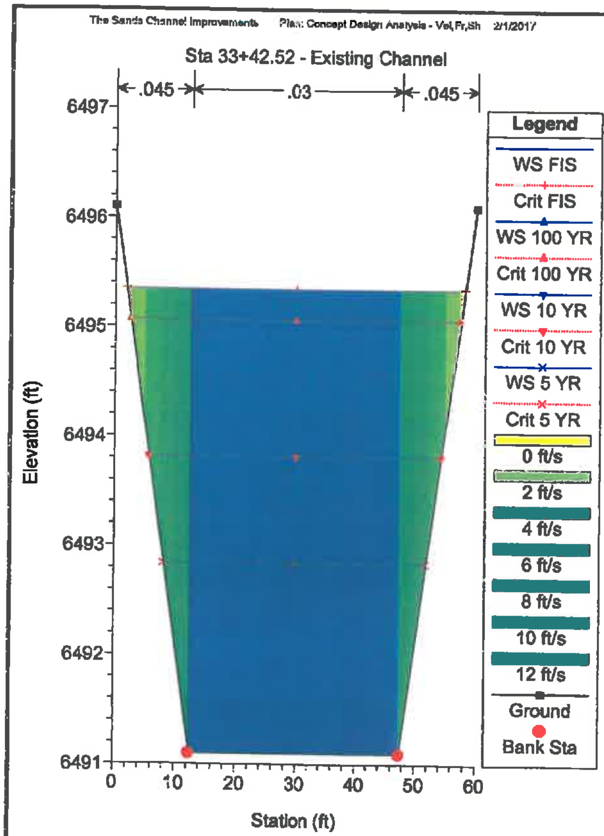

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 27+88 - U/S edge of Exist Riprap Apron
.045
.03
.045
Legend
Crit FIS
Crit 100 YR
WS FIS
WS 100 YR
Crit 10 YR
WS 10 YR
Crit 5 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

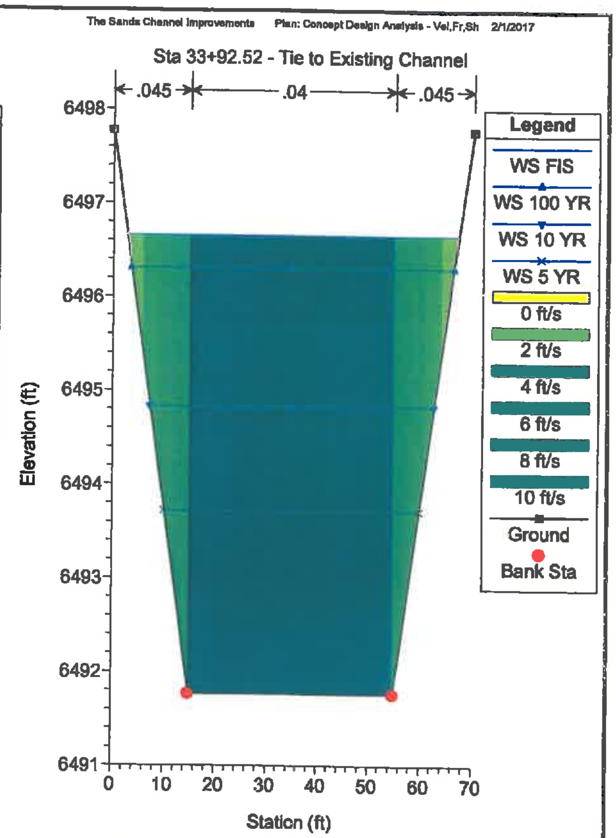

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 28+02 - Existing Channel
.045
.03
.045
Legend
Crit FIS
Crit 100 YR
WS FIS
WS 100 YR
Crit 10 YR
WS 10 YR
Crit 5 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

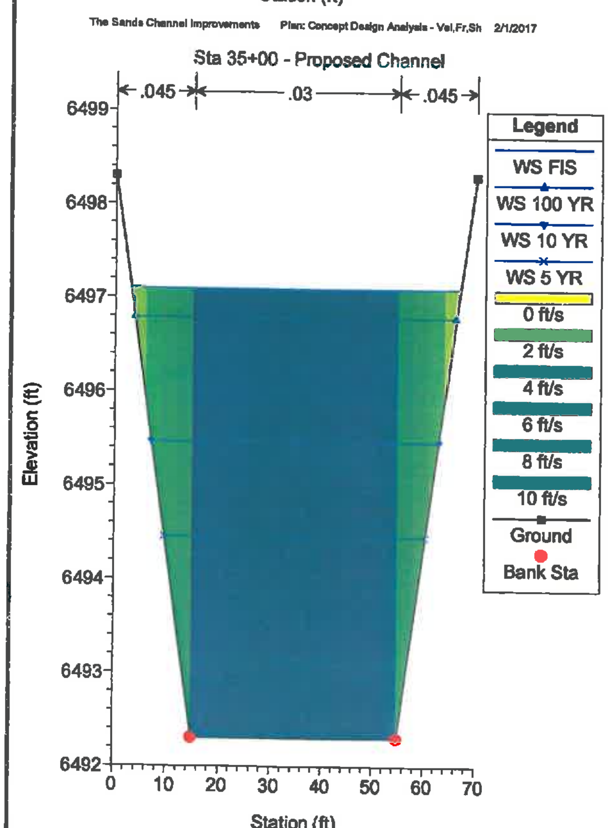

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 29+52 - Existing Channel
.045
.03
.045
Legend
Crit FIS
Crit 100 YR
WS FIS
WS 100 YR
Crit 10 YR
WS 10 YR
Crit 5 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

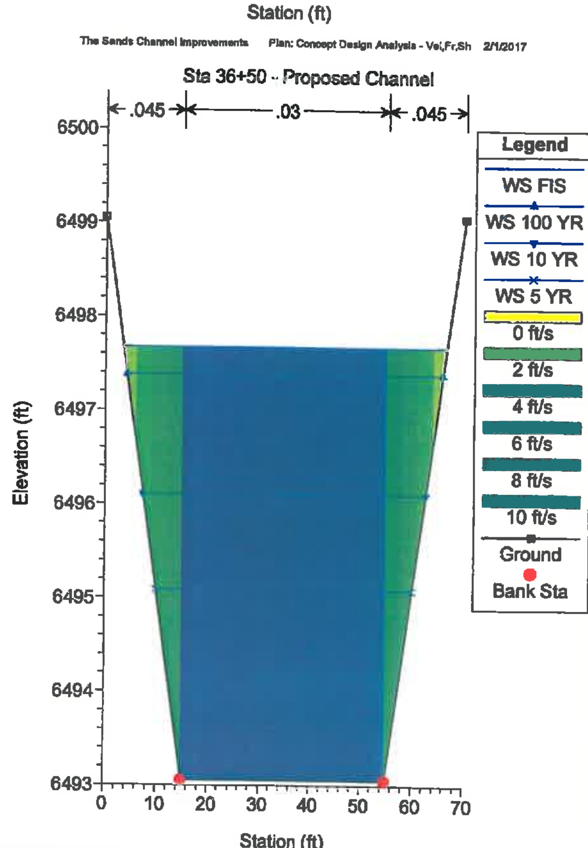

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 31+02 - Existing Channel
.045
.03
.045
Legend
Crit FIS
Crit 100 YR
WS FIS
WS 100 YR
Crit 10 YR
WS 10 YR
Crit 5 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

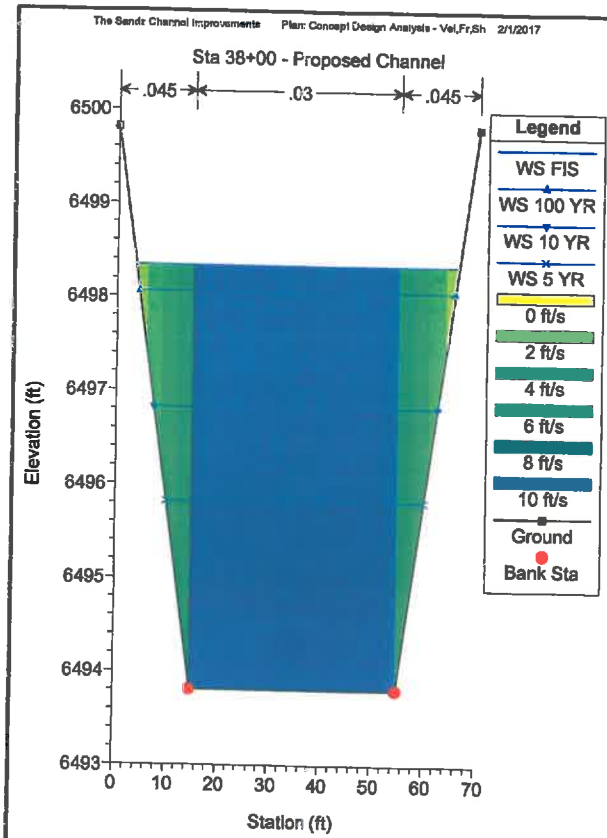

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 32+52 - Existing Channel
.045
.03
.045
Legend
Crit FIS
Crit 100 YR
WS FIS
WS 100 YR
Crit 10 YR
WS 10 YR
Crit 5 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

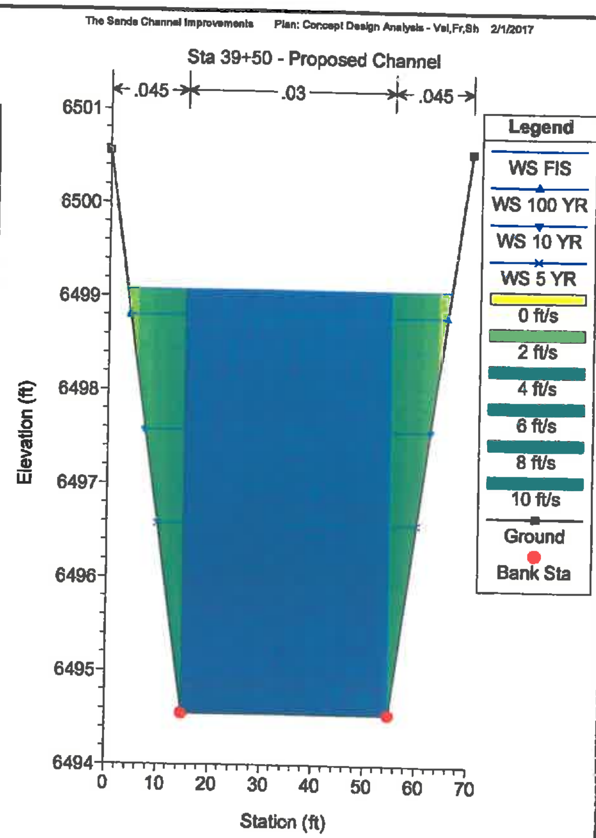

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 33+42.52 - Existing Channel
.045
.03
.045
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
6497
6496
6495
6494
6493
6492
6491
0
10
20
30
40
50
60
Station (ft)

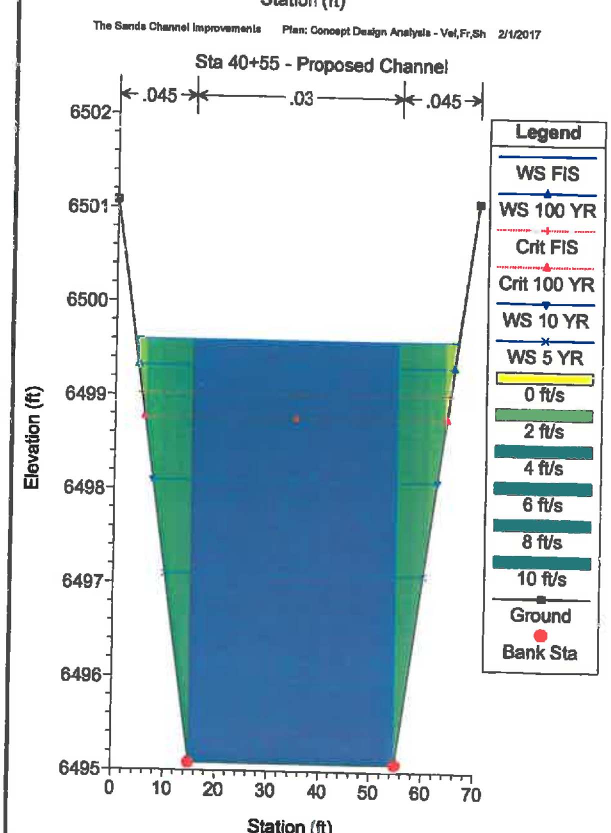

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 33+92.52 - Tie to Existing Channel
.045
.04
.045
Legend
WS FIS
WS 100 YR
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6498
6497
6496
6495
6494
6493
6492
6491
0
10
20
30
40
50
60
70
Station (ft)

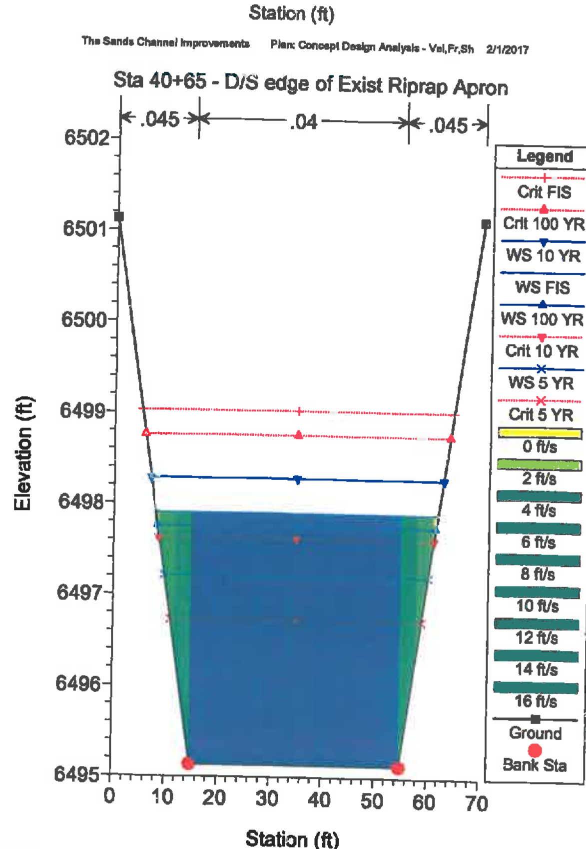

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 35+00 - Proposed Channel
.045
.03
.045
Legend
WS FIS
WS 100 YR
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6499
6498
6497
6496
6495
6494
6493
6492
0
10
20
30
40
50
60
70
Station (ft)

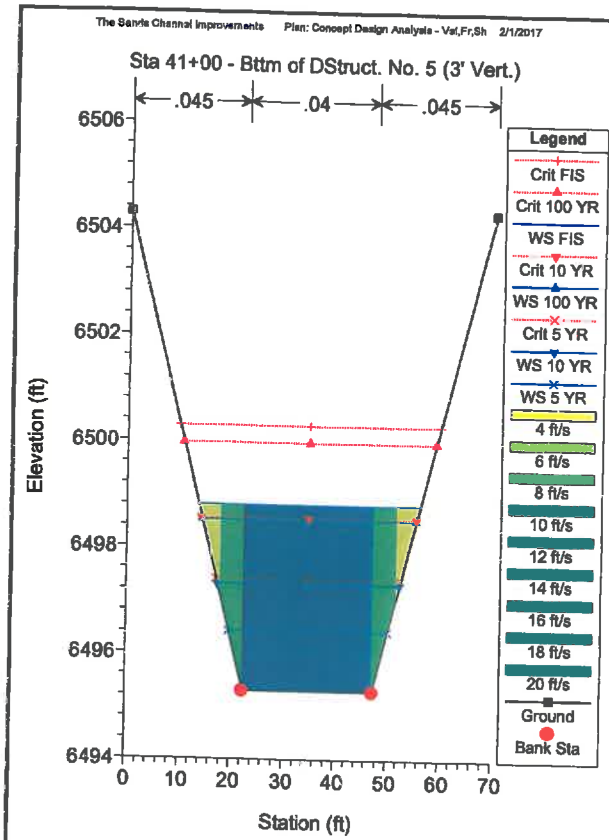

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 36+50 - Proposed Channel
.045
.03
.045
Legend
WS FIS
WS 100 YR
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6500
6499
6498
6497
6496
6495
6494
6493
0
10
20
30
40
50
60
70
Station (ft)

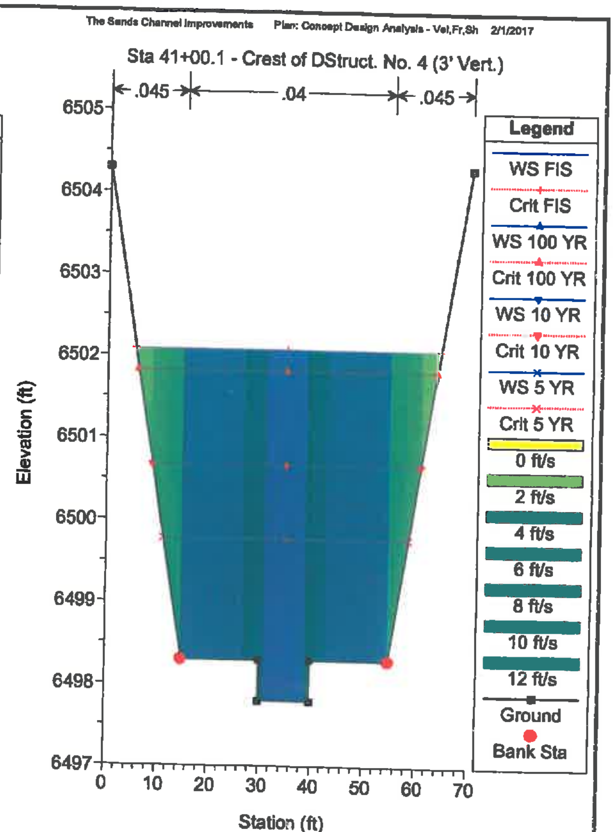

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 38+00 - Proposed Channel
.045 .03 .045
Legend
WS FIS
WS 100 YR
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6500
6499
6498
6497
6496
6495
6494
6493
0 10 20 30 40 50 60 70
Station (ft)

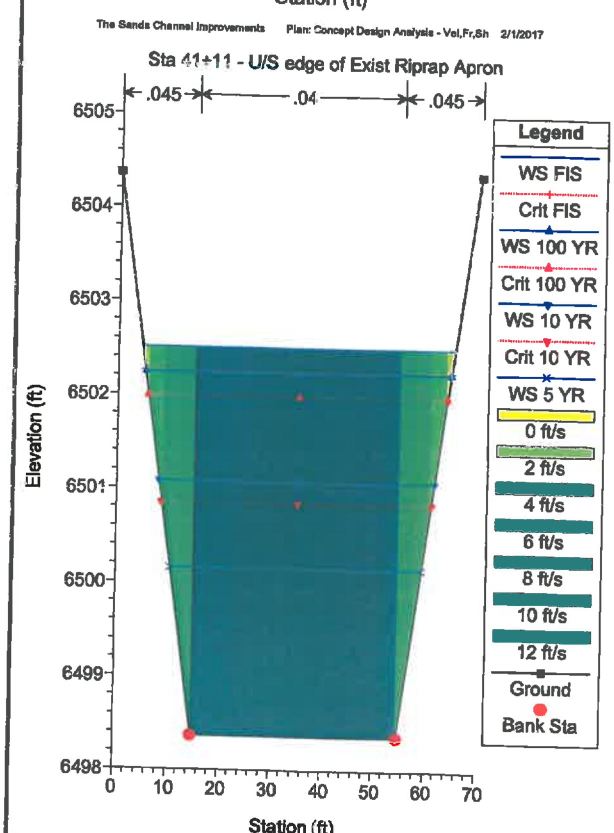

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 39+50 - Proposed Channel
.045 .03 .045
Legend
WS FIS
WS 100 YR
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6501
6500
6499
6498
6497
6496
6495
6494
0 10 20 30 40 50 60 70
Station (ft)

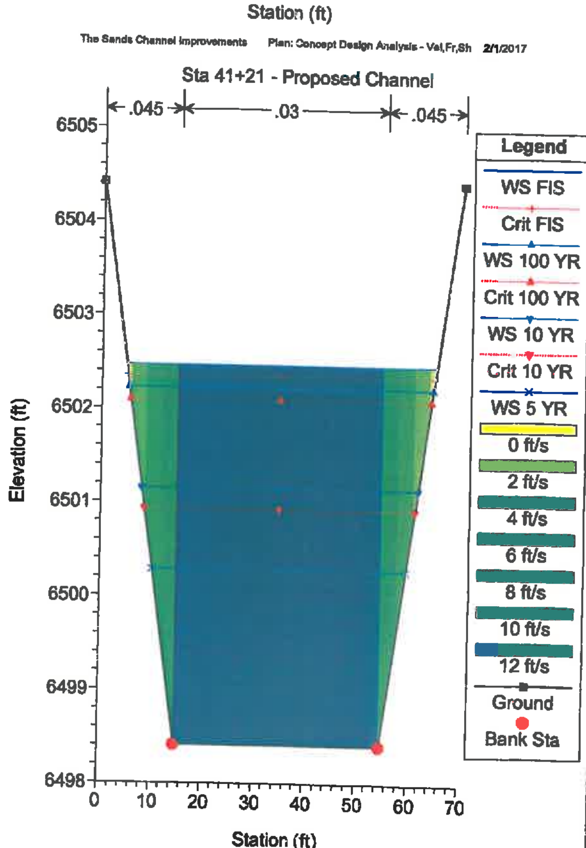

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 40+55 - Proposed Channel
.045 .03 .045
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6502
6501
6500
6499
6498
6497
6496
6495
0 10 20 30 40 50 60 70
Station (ft)

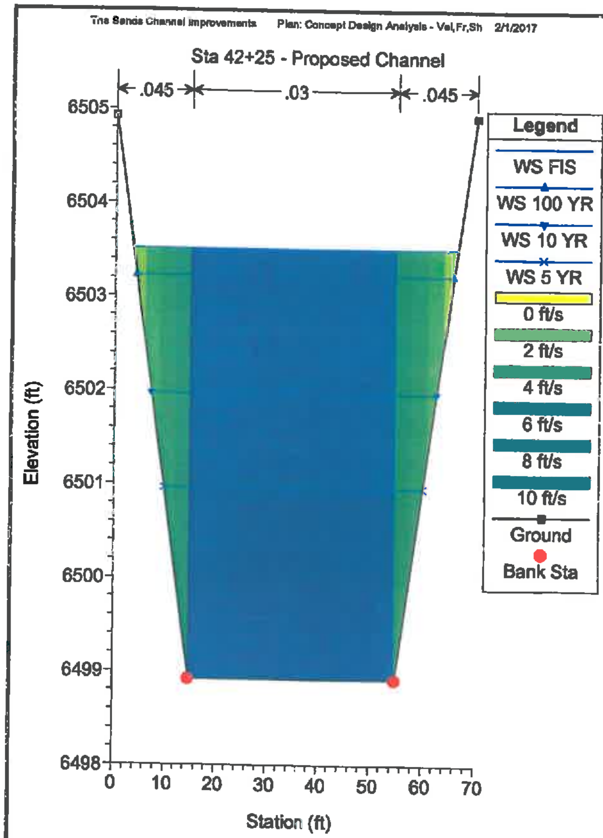

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 40+65 - D/S edge of Exist Riprap Apron
.045 .04 .045
Legend
Crit FIS
Crit 100 YR
WS 10 YR
WS FIS
WS 100 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
Ground
Bank Sta
Elevation (ft)
6502
6501
6500
6499
6498
6497
6496
6495
0 10 20 30 40 50 60 70
Station (ft)

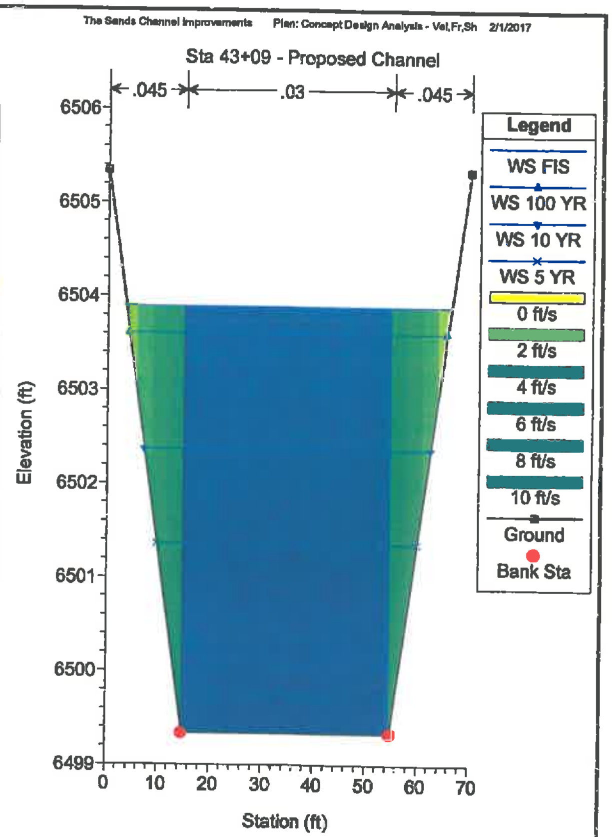

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 41+00 - Bttm of DStruct. No. 5 (3' Vert.)
.045
.04
.045
Legend
Crit FIS
Crit 100 YR
WS FIS
Crit 10 YR
WS 100 YR
Crit 5 YR
WS 10 YR
WS 5 YR
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
16 ft/s
18 ft/s
20 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

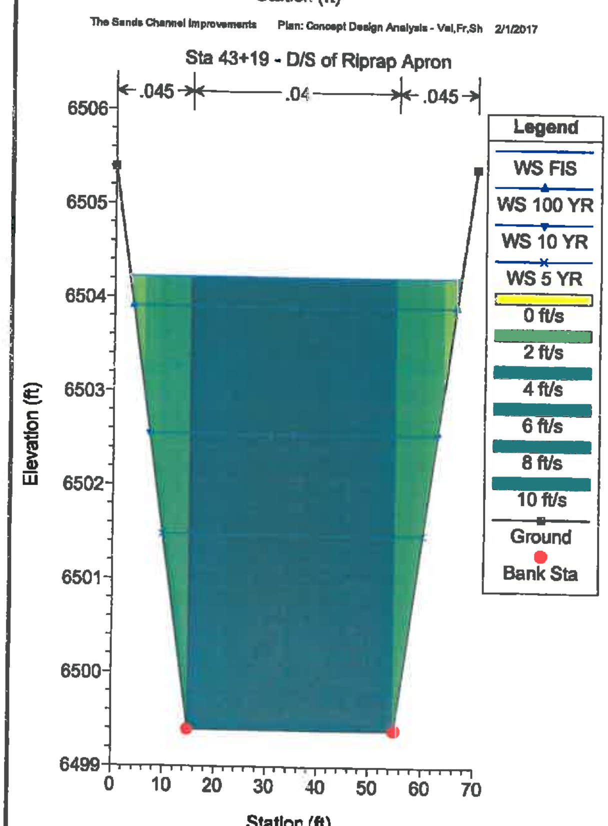

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 41+00.1 - Crest of DStruct. No. 4 (3' Vert.)
.045
.04
.045
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

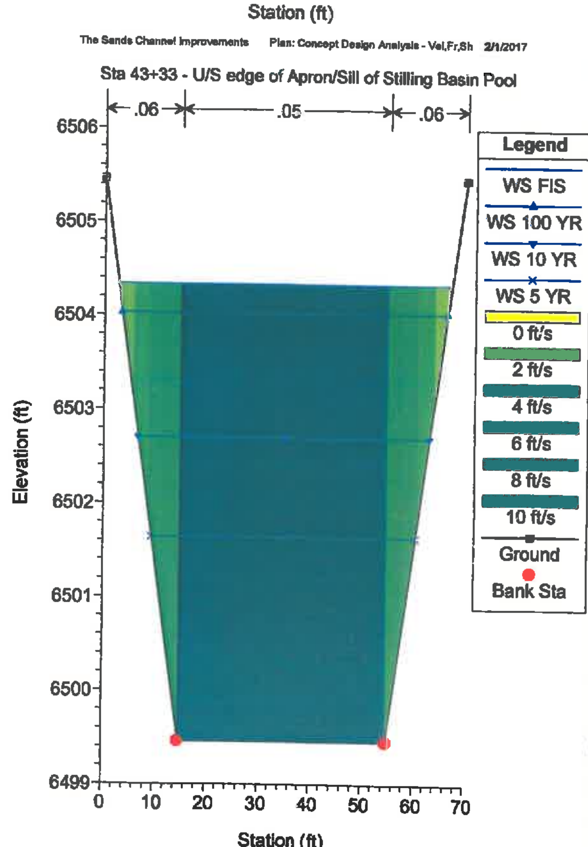

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 41+11 - U/S edge of Exist Riprap Apron
.045
.04
.045
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

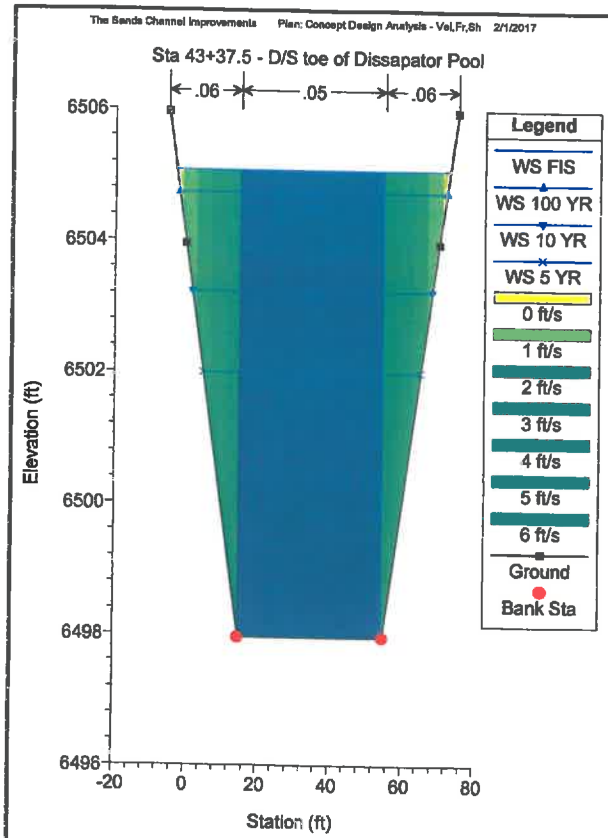

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 41+21 - Proposed Channel
.045
.03
.045
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

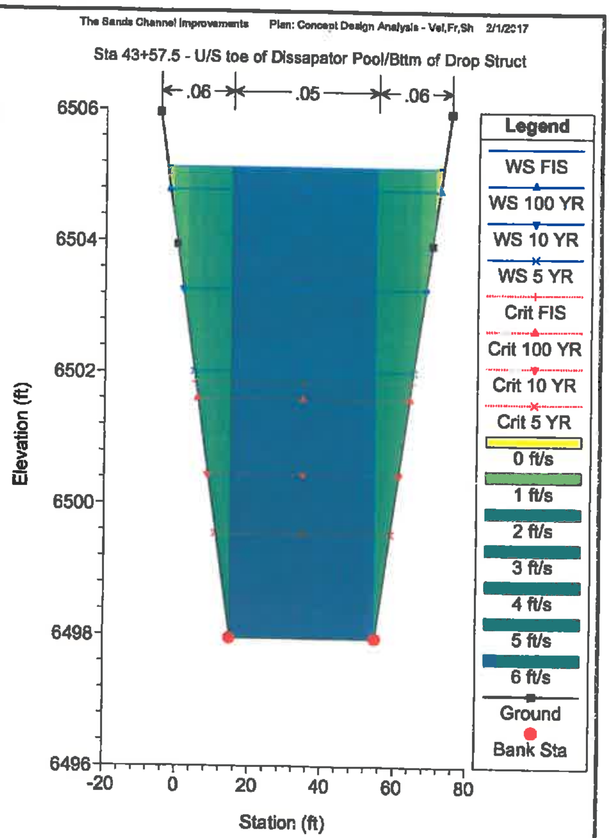

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 42+25 - Proposed Channel
.045
.03
.045
Legend
WS FIS
WS 100 YR
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

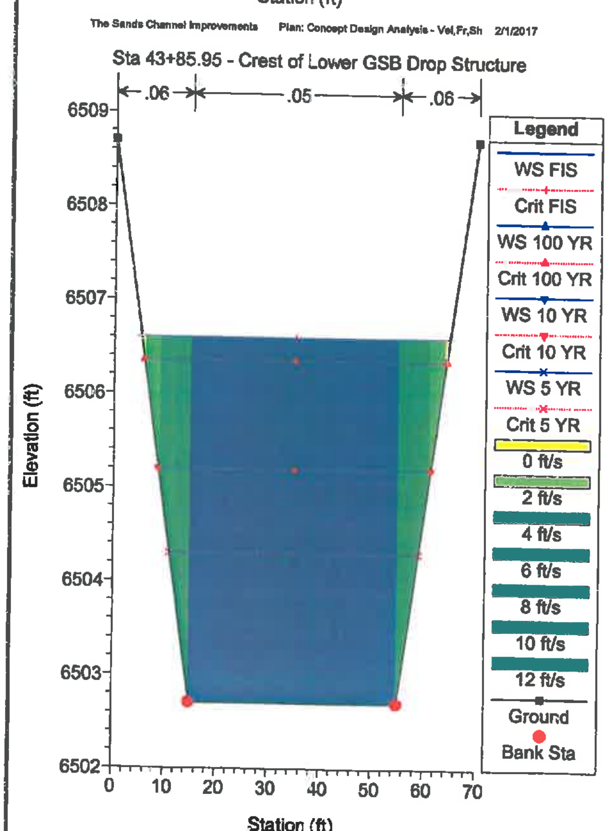

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 43+09 - Proposed Channel
.045
.03
.045
Legend
WS FIS
WS 100 YR
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

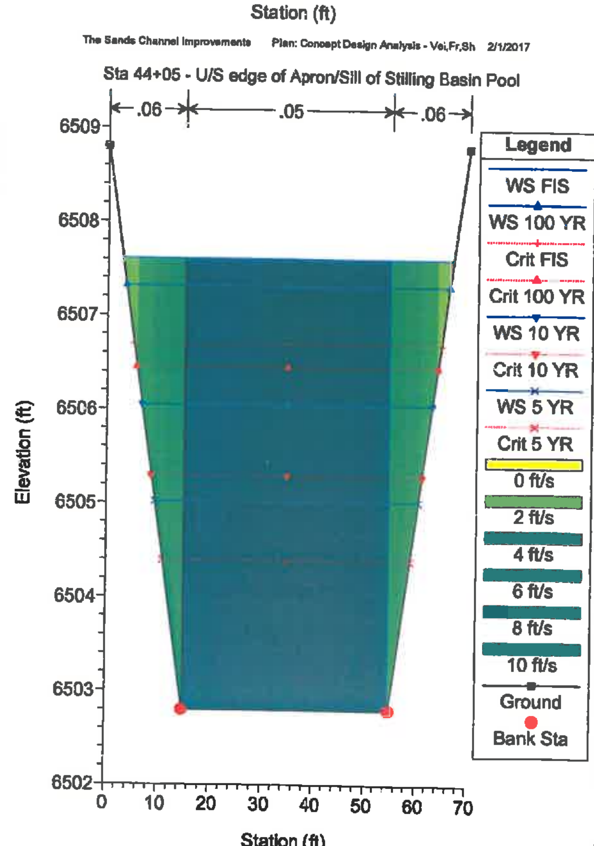

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 43+19 - D/S of Riprap Apron
.045
.04
.045
Legend
WS FIS
WS 100 YR
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

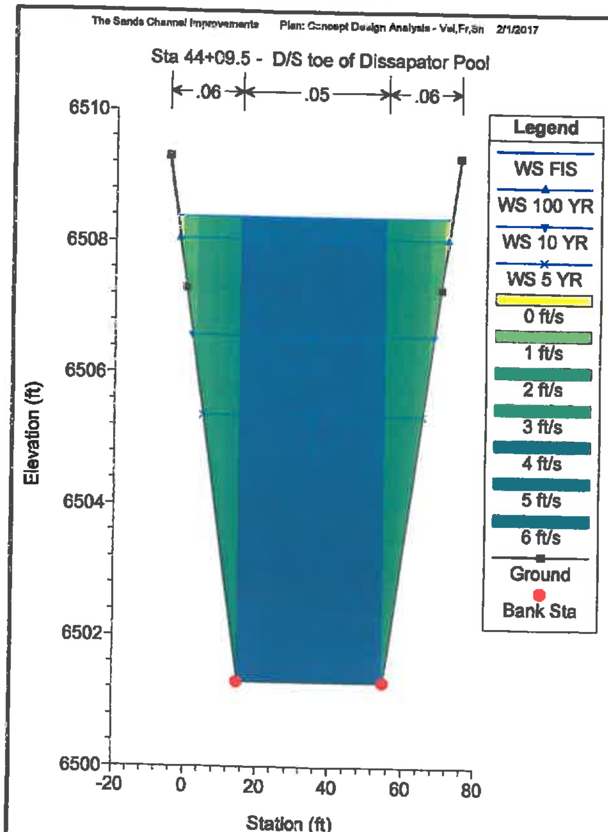

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 43+33 - U/S edge of Apron/Sill of Stilling Basin Pool
.06
.05
.06
Legend
WS FIS
WS 100 YR
WS 10 YR
WS 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

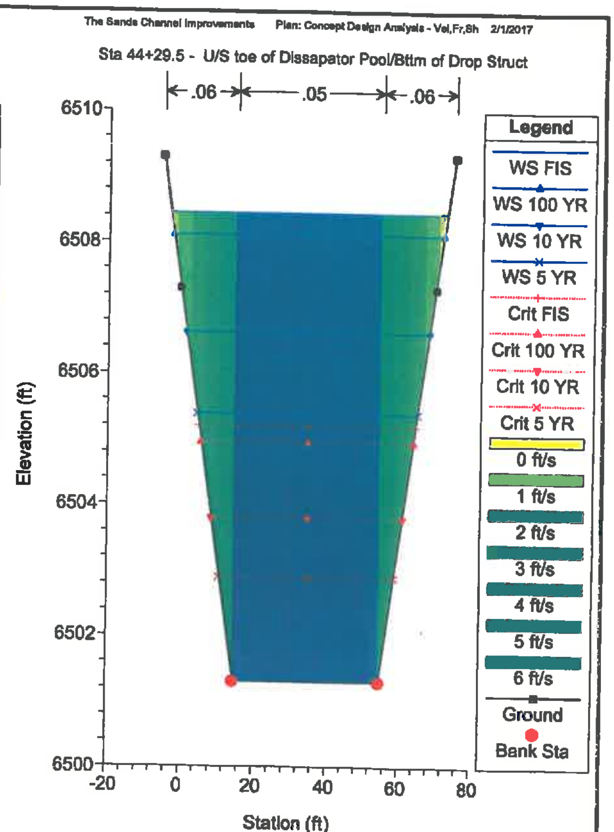

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 43+37.5 - D/S toe of Dissapator Pool
.06
.05
.06
Legend
WS FIS
WS 100 YR
WS 10 YR
WS 5 YR
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
Ground
Bank Sta
Elevation (ft)
6506
6504
6502
6500
6498
6496
-20
0
20
40
60
80
Station (ft)

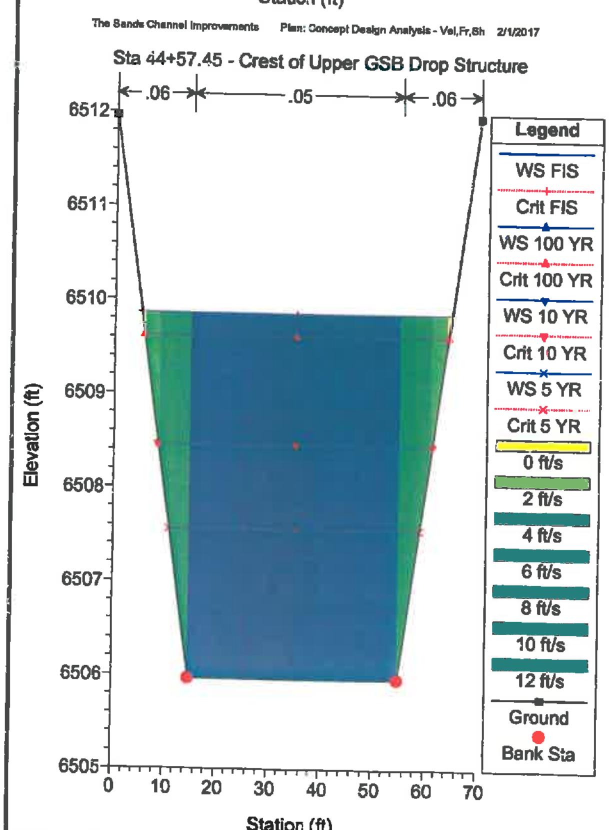

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 43+57.5 - U/S toe of Dissapator Pool/Bttm of Drop Struct
.06
.05
.06
Legend
WS FIS
WS 100 YR
WS 10 YR
WS 5 YR
Crit FIS
Crit 100 YR
Crit 10 YR
Crit 5 YR
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
Ground
Bank Sta
Elevation (ft)
6506
6504
6502
6500
6498
6496
-20
0
20
40
60
80
Station (ft)

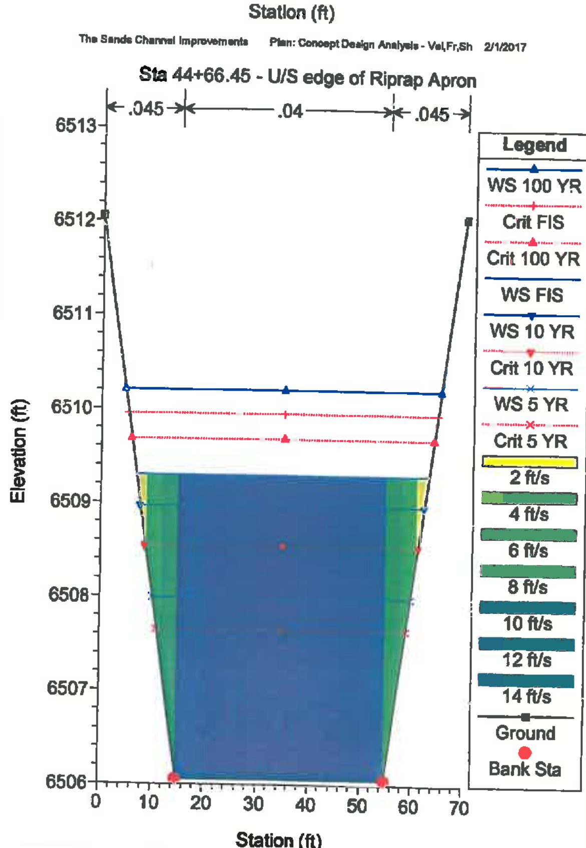

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 43+85.95 - Crest of Lower GSB Drop Structure
.06
.05
.06
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
6509
6508
6507
6506
6505
6504
6503
6502
0
10
20
30
40
50
60
70
Station (ft)

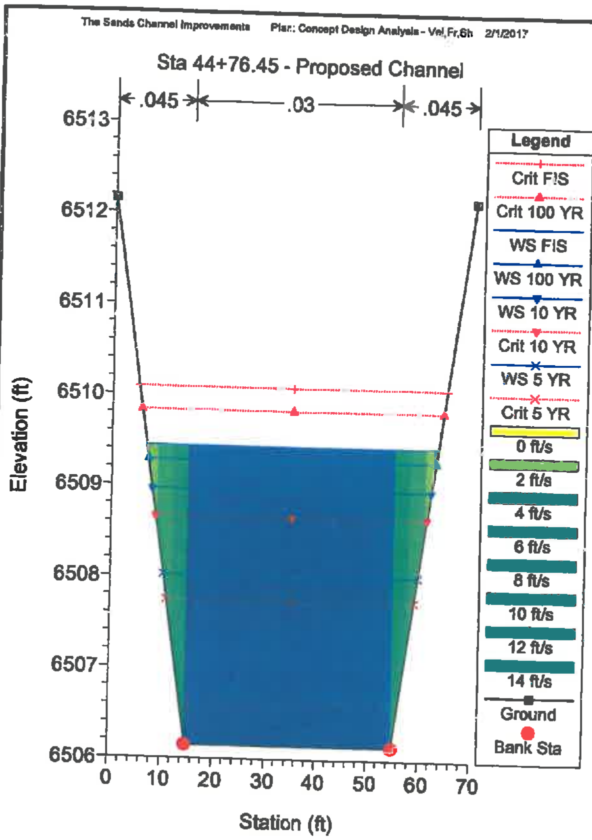

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 44+05 - U/S edge of Apron/Sill of Stilling Basin Pool
.06
.05
.06
Legend
WS FIS
WS 100 YR
Crit FIS
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
Ground
Bank Sta
Elevation (ft)
6509
6508
6507
6506
6505
6504
6503
6502
0
10
20
30
40
50
60
70
Station (ft)

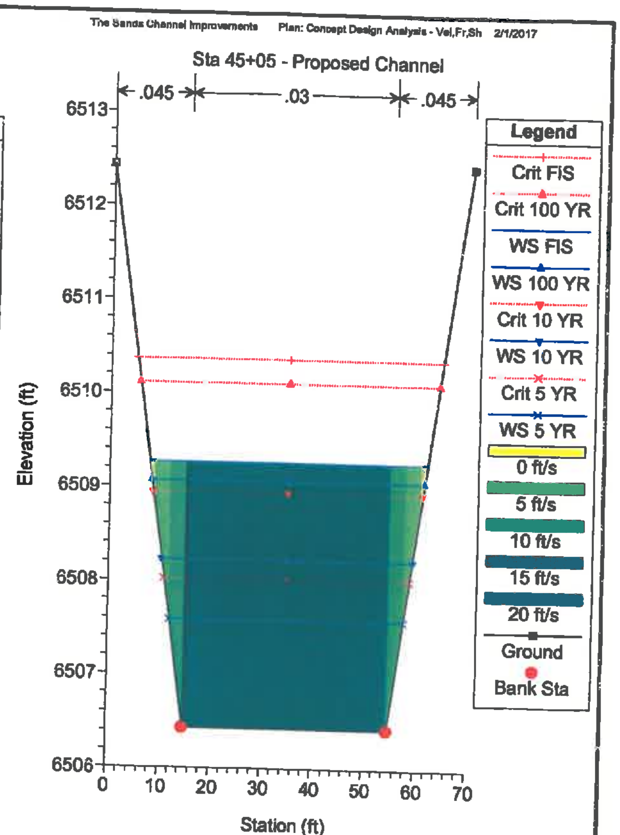

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 44+09.5 - D/S toe of Dissapator Pool
.06
.05
.06
Legend
WS FIS
WS 100 YR
WS 10 YR
WS 5 YR
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

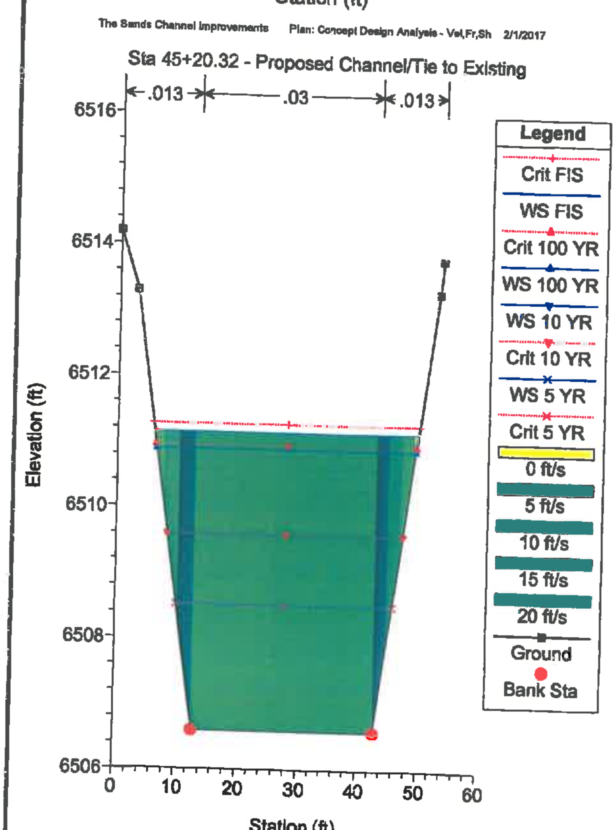

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 44+29.5 - U/S toe of Dissapator Pool/Bttm of Drop Struct
.06
.05
.06
Legend
WS FIS
WS 100 YR
WS 10 YR
WS 5 YR
Crit FIS
Crit 100 YR
Crit 10 YR
Crit 5 YR
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

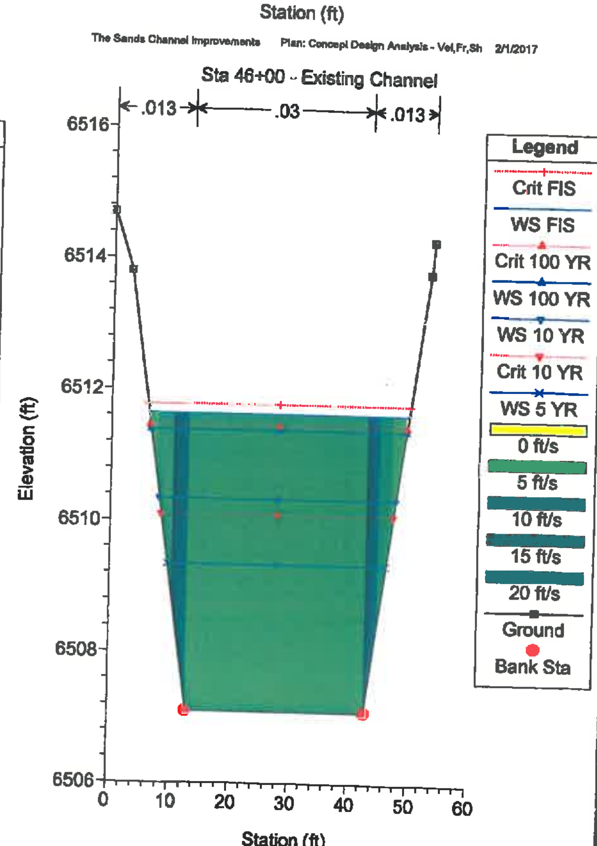

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 44+57.45 - Crest of Upper GSB Drop Structure
.06
.05
.06
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)


The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 44+66.45 - U/S edge of Riprap Apron
.045
.04
.045
Legend
WS 100 YR
Crit FIS
Crit 100 YR
WS FIS
WS 10 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

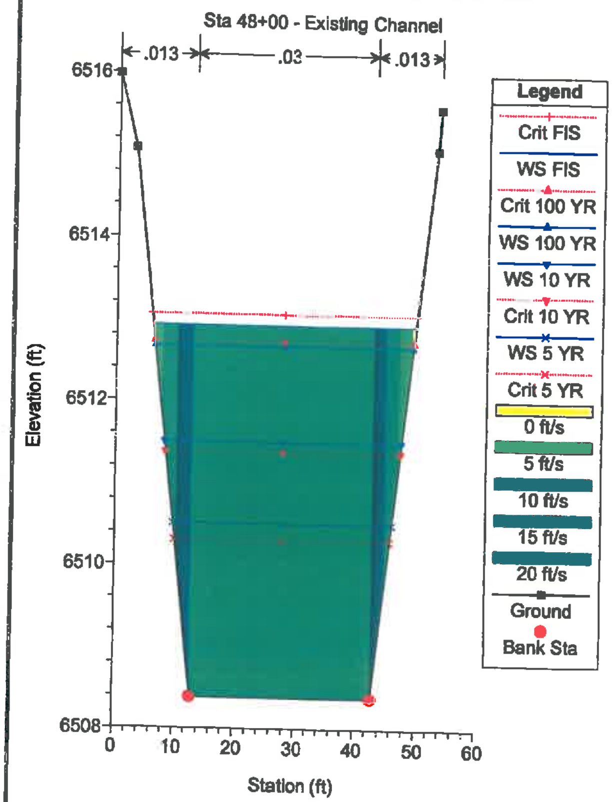

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 44+76.45 - Proposed Channel
.045
.03
.045
Legend
Crit FIS
Crit 100 YR
WS FIS
WS 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
2 ft/s
4 ft/s
6 ft/s
8 ft/s
10 ft/s
12 ft/s
14 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

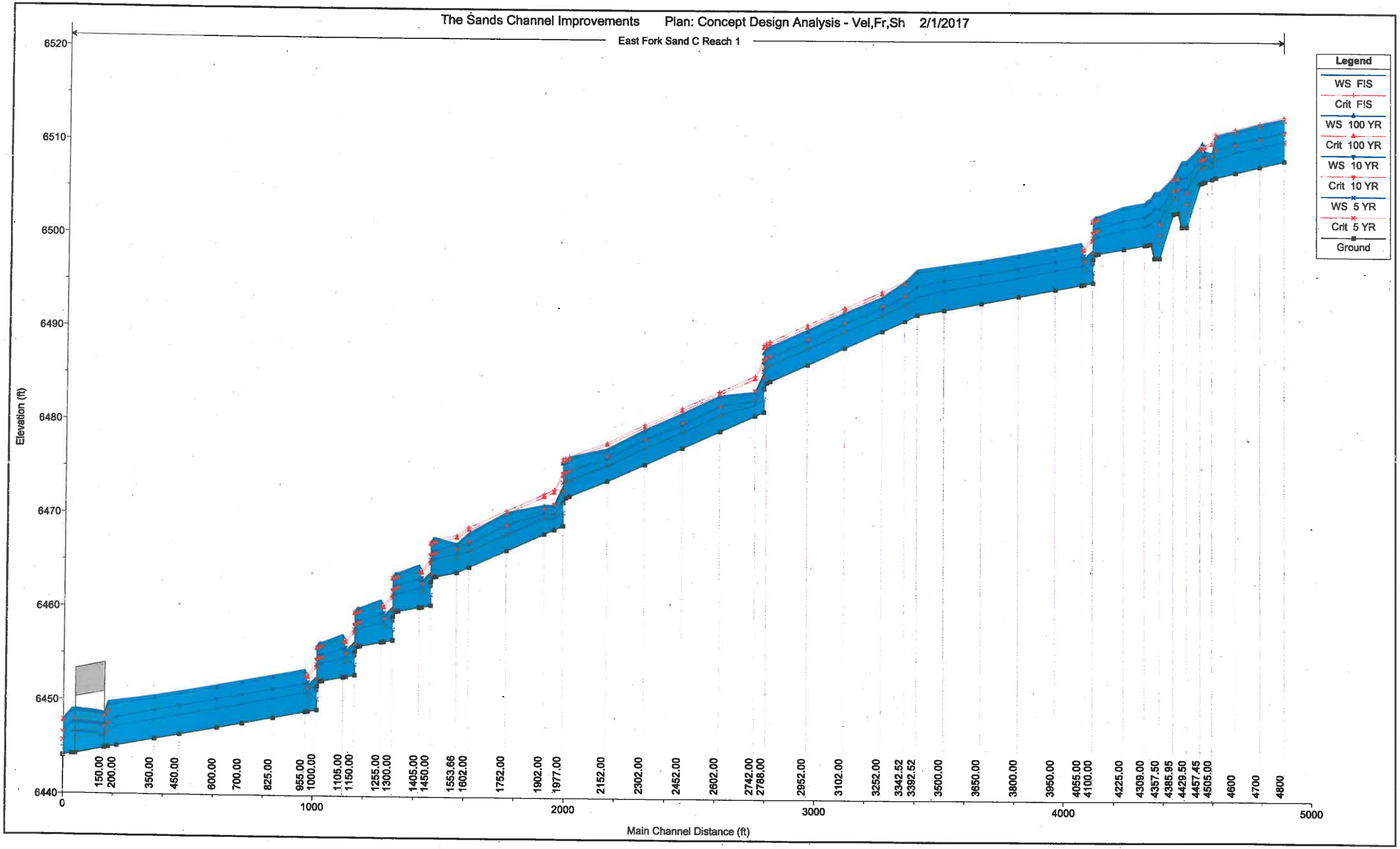

The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 45+05 - Proposed Channel
.045
.03
.045
Legend
Crit FIS
Crit 100 YR
WS FIS
WS 100 YR
Crit 10 YR
WS 10 YR
Crit 5 YR
WS 5 YR
0 ft/s
5 ft/s
10 ft/s
15 ft/s
20 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)


The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 45+20.32 - Proposed Channel/Tie to Existing
.013
.03
.013
Legend
Crit FIS
WS FIS
Crit 100 YR
WS 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
0 ft/s
5 ft/s
10 ft/s
15 ft/s
20 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)


The Sands Channel Improvements Plan: Concept Design Analysis - Vel,Fr,Sh 2/1/2017
Sta 46+00 - Existing Channel
.013
.03
.013
Legend
Crit FIS
WS FIS
Crit 100 YR
WS 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
0 ft/s
5 ft/s
10 ft/s
15 ft/s
20 ft/s
Ground
Bank Sta
Elevation (ft)
Station (ft)

The Sands Channel Improvements   Plan: Concept Design Analysis - Vel,Fr,Sh   2/1/2017



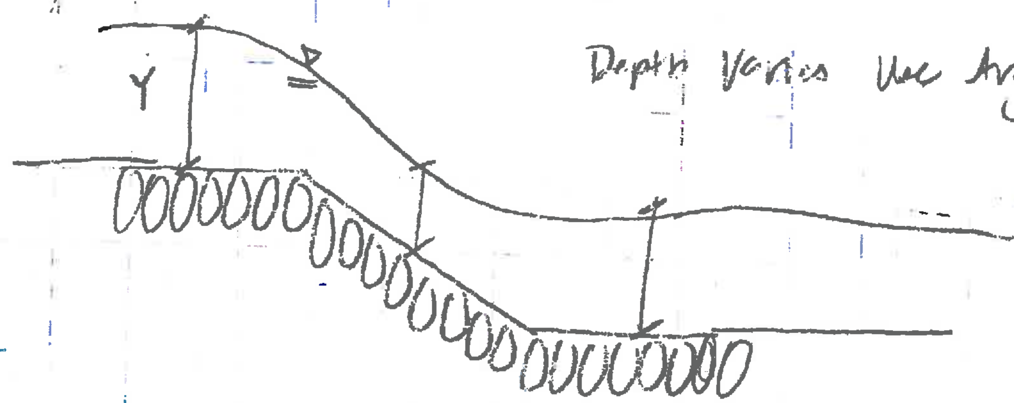


The Sands Channel Improvements
Plan: Concept Design Analysis - Vel,Fr,Sh
2/1/2017
East Fork Sand C Reach 1
Legend
WS FIS
Crit FIS
WS 100 YR
Crit 100 YR
WS 10 YR
Crit 10 YR
WS 5 YR
Crit 5 YR
Ground
Elevation (ft)
Main Channel Distance (ft)
6440
6450
6460
6470
6480
6490
6500
6510
6520
0
1000
2000
3000
4000
5000
150.00
200.00
350.00
450.00
600.00
700.00
825.00
955.00
1000.00
1105.00
1150.00
1255.00
1300.00
1405.00
1450.00
1553.66
1602.00
1752.00
1902.00
1977.00
2152.00
2302.00
2452.00
2602.00
2742.00
2788.00
2952.00
3102.00
3252.00
3342.52
3392.52
3500.00
3650.00
3800.00
3950.00
4055.00
4100.00
4225.00
4309.00
4357.50
4385.95
4429.50
4457.45
4505.00
4600
4700
4800

MS CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT, STE 110
COLORADO SPRINGS, CO 80903
(719) 955-5485

PROJECT: The Sands - Concept Design
DATE: HEC-RAS Analysis

Assumptions for "n" value for Grouted Boulder drops



Depth Varies Use Avg.

$$*\; n = \frac{0.097\,(y/D)^{0.16}}{\ln(2.55\,y/D)} =$$

Assume D = 18"
y varies

Y = 5.0	n = 0.054
Y = 4.5	n = 0.056
Y = 4.0	n = 0.059
Y = 3.5	n = 0.062
Y = 3.0	n = 0.066
Y = 2.5	n = 0.072

Avg = n = 0.06

good value for G.B for concept Design

Use n = 0.06 for sides and n = 0.05 for btm in velocity analysis

Use n = 0.07 for sides and n = 0.06 for btm in depth analysis.

* Assumes ½ boulder is grouted.

CIVIL CONSULTANTS, INC.

20 BOULDER CRESCENT, STE 110
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PROJECT: The Sands - Concept Design

DATE: HEC-RAS Analysis

Assumptions for n value for Riprap channel lining.

$n = 0.0395\ D_{50}^{1/6}$ Assuming Type "m" = 1.0 = D

$n = 0.0395\,(1)^{1/6} = 0.0395 \sim 0.04$

Use n = 0.04 for riprap on channel bottoms
n = 0.045 for riprap on channel sides for vel. analysis

Use n = 0.05 for riprap on channel bottoms
n = 0.055 for riprap on channel sides for depth analysis

Assumptions for Sand bed . ... ent

Table 8.5 UDFCD

Sand or Clay bed = 0.03 velocity analysis

Sand or Clay bed = 0.04 WSE/depth analysis

CONCEPT CONSTRUCTION DRAWINGS

THE SANDS

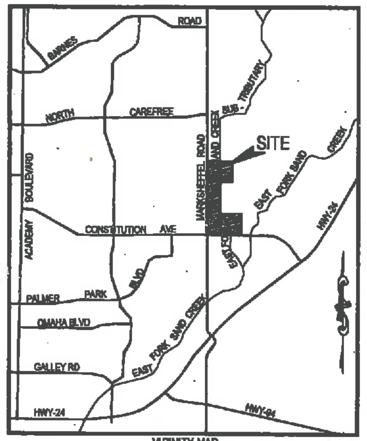
COUNTY OF EL PASO, STATE OF COLORADO

CHANNEL IMPROVEMENTS

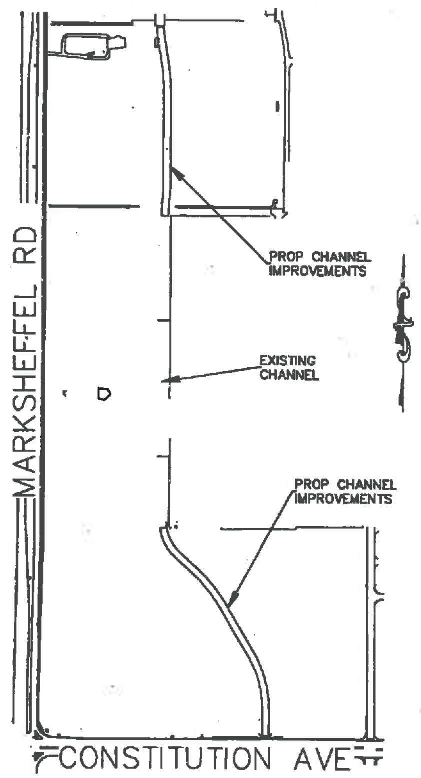
OCTOBER 2016

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
COUNTY ENGINEERING:	EL PASO COUNTY DEVELOPMENT SERVICES 2880 INTERNATIONAL CIRCLE, SUITE 110 COLORADO SPRINGS, CO 80910 JENNIFER IRVINE, P.E. (719) 520-6300
TRAFFIC ENGINEERING:	EL PASO COUNTY PUBLIC SERVICES & TRANS. DEPT. 3275 AKERS DRIVE COLORADO SPRINGS, CO 80922 JENNIFER IRVINE, P.E. (719) 520-6460
WATER RESOURCES:	COLORADO SPRINGS UTILITIES 7710 DURANT DR. COLORADO SPRINGS, CO 80947 TIM WENDT (719) 668-3556
GAS DEPARTMENT:	COLORADO SPRINGS UTILITIES 7710 DURANT DR. COLORADO SPRINGS, CO 80947 TIM WENDT (719) 668-3556
ELECTRIC DEPARTMENT:	MOUNTAIN VIEW ELECTRIC 11140 E. WOODMEN ROAD FALCON, CO 80831 (719) 495-2283
COMMUNICATIONS:	QWEST COMMUNICATIONS (U.N.C.C. LOCATORS) (800) 922-1987 AT&T (LOCATORS) (719) 635-3874



VICINITY MAP
N.T.S.



SITE MAP
N.T.S.

BENCHMARKS

1. THE TOP OF AN ALUMINUM SURVEYORS CAP, DESCRIPTION
   NORTHING = XXXXXX.XXX
   EASTING = XXXXXX.XXX
   ELEVATION = 70XX.XX
2. THE TOP OF AN ALUMINUM SURVEYORS CAP, DESCRIPTION
   NORTHING = XXXXXX.XXX
   EASTING = XXXXXX.XXX
   ELEVATION = 70XX.XX
2. THE TOP OF AN ALUMINUM SURVEYORS CAP, DESCRIPTION
   NORTHING = XXXXXX.XXX
   EASTING = XXXXXX.XXX
   ELEVATION = 70XX.XX

SHEET INDEX

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 CRITERIA ESTABLISHED BY THE COUNTY 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 IMPROVEMENT PLANS AND SPECIFICATIONS.

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

GRADING AND EROSION CONTROL PLAN ENGINEER'S STATEMENT:
THIS EROSION AND STORMWATER QUALITY CONTROL/GRADING PLAN WAS PREPARED UNDER MY DIRECTION AND SUPERVISION AND IS CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF. IF SUCH WORK IS PERFORMED IN ACCORDANCE WITH THE GRADING AND EROSION CONTROL PLAN, THE WORK WILL NOT BECOME A HAZARD TO LIFE AND LIMB, ENDANGER PROPERTY, OR ADVERSELY AFFECT THE SAFETY, USE, OR STABILITY OF A PUBLIC WAY, DRAINAGE CHANNEL, OR OTHER PROPERTY.

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

OWNER/DEVELOPER STATEMENT:

THE OWNER WILL COMPLY WITH THE REQUIREMENTS OF THE DRAINAGE REPORT AND PLAN AND THIS SET OF CONSTRUCTION DOCUMENTS. THE OWNER WILL COMPLY WITH THE REQUIREMENTS OF THE EROSION 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 ACTIVITY.

JEFF MARK, LANDHUIS COMPANY
PRESIDENT
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 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

ABBREVIATIONS

ACT	ACTUAL	FL	FLOW LINE	PT	POINT OF TANGENCY
BCR	BACK OF CURB RETURN	FT	FEET, FOOT	PROP	PROPOSED
BOV	BLOWOFF VALVE ASSEMBLY	FUT	FUTURE	REM	REMOVE
BRK	BREAK	GRD	GRADE	ROW	RIGHT OF WAY
BT	BEGINNING OF TRANSITION	HORZ	HORIZONTAL	RSNTS	RESTRAINTS
CATV	CABLE TV	HP	HIGH POINT ELEVATION	RT	RIGHT
CL	CLASS, CENTERLINE	INT	INTERSECTION	SAN	SANITARY SEWER
CLR	CLEARANCE	LP	LOW POINT ELEVATION	SD	STANDARD DETAIL
CONST	CONSTRUCT	LT	LEFT	STA	STATION
CSU	COLORADO SPRINGS UTILITIES	LOC	LOCATION	STM	STORM
ECR	END CURB RETURN	MIN	MINIMUM	COB	TOP CORNER OF BOX
EL	ELEVATION	N,S,E,W	NORTH,SOUTH,EAST,WEST	TELE	TELEPHONE
EOA	EDGE OF ASPHALT	NTS	NOT TO SCALE	TYP	TYPICAL
EOP	END OF PAVEMENT	PC	POINT OF VERTICAL CURVATURE	UNK	UNKNOWN
EPC	EL PASO COUNTY	PCC	POINT OF COMPOUND CURVE	UP	UNDERGROUND POWER
ESMT	EASMENT	PCR	POINT OF CURB RETURN	UTL	UTILITY
ET	END TRANSITION	PL	PROPERTY LINE	VERT	VERTICAL
EX	EXISTING	PRC	POINT OF REVERSE CURVE	WTR	WATER LINE
G	GAS	PUB	PUBLIC	XING	CROSSING
GB	GRADE BREAK	PVI	POINT OF VERTICAL INTERSECTION	YD	YARD (CUBIC)
		PVC	POINT OF VERTICAL CURVE		
		PVT	POINT OF VERTICAL TANGENT		

LEGEND

AIR & VACUUM VALVE STA
ANCHOR, CONC. REVERSE
ANODE
CENTERLINE
FENCE
EXISTING SANITARY SEWER
EXISTING GAS
EXISTING ELECTRIC (OH OR UG)
EXISTING TELEPHONE
EXISTING TELEVISION
EXISTING FIBER OPTIC
EXISTING WATER

PROPOSED GAS
PROPOSED SANITARY SEWER
PROPOSED WATER
RIGHT-OF-WAY
PROPERTY LINE
FIRE HYDRANT (EXISTING)
FIRE HYDRANT (PROPOSED)
STORM DRAIN
VALVE (PROPOSED)
VALVE (EXISTING)
BLOWOFF ASSY. (PROPOSED)
BLOWOFF ASSY. (EXISTING)
PLUG (PROPOSED)
PLUG (EXISTING)

PRELIMINARY-NOT FOR CONSTRUCTION

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

THE SANDS
CHANNEL IMPROVEMENT PLANS
PROJECT NO. 43-089
DESIGNED BY: DLM
DRAWN BY: JWP
CHECKED BY: VAS
SCALE HORIZ: N/A VERT: N/A
DATE: 09/30/2016
SHEET 1 OF 9
CH01

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. 37100

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

CAUTION
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.

Plotstamp: 10/10/2016 11:44 AM

GRADING AND EROSION CONTROL NOTES:

1. STORMWATER DISCHARGES FROM CONSTRUCTION SITES SHALL NOT CAUSE OR THREATEN TO CAUSE POLLUTION, CONTAMINATION, OR DEGRADATION OF STATE WATERS. ALL WORK AND EARTH DISTURBANCE SHALL BE DONE IN A MANNER THAT MINIMIZES POLLUTION OF ANY ON-SITE OR OFF SITE WATERS, INCLUDING WETLANDS.
2. NOTWITHSTANDING ANYTHING DEPICTED IN THESE PLANS IN WORDS OR GRAPHIC REPRESENTATION, ALL DESIGN AND CONSTRUCTION RELATED TO ROADS, STORM DRAINAGE AND EROSION CONTROL SHALL CONFORM TO THE STANDARDS AND REQUIREMENTS OF THE MOST RECENT VERSION OF THE RELEVANT ADOPTED EL PASO COUNTY STANDARDS, INCLUDING THE LAND DEVELOPMENT CODE, THE ENGINEERING CRITERIA MANUAL, THE DRAINAGE CRITERIA MANUAL, AND THE DRAINAGE CRITERIA MANUAL VOLUME 2. ANY DEVIATIONS TO REGULATIONS AND STANDARDS MUST BE REQUESTED, AND APPROVED, IN WRITING.
3. A SEPARATE STORMWATER MANAGEMENT PLAN (SWMP) FOR THIS PROJECT SHALL BE COMPLETED AND AN EROSION AND STORMWATER QUALITY CONTROL PERMIT (ESQCP) ISSUED PRIOR TO COMMENCING CONSTRUCTION. DURING CONSTRUCTION THE SWMP IS THE RESPONSIBILITY OF THE DESIGNATED STORMWATER MANAGER, SHALL BE LOCATED ON SITE AT ALL TIMES AND SHALL BE KEPT UP TO DATE WITH WORK PROGRESS AND CHANGES IN THE FIELD.
4. ONCE THE ESQCP HAS BEEN ISSUED, THE CONTRACTOR MAY INSTALL THE INITIAL STAGE EROSION AND SEDIMENT CONTROL BMPS AS INDICATED ON THE GEC. A PRECONSTRUCTION MEETING BETWEEN THE CONTRACTOR, ENGINEER, AND EL PASO COUNTY WILL BE HELD PRIOR TO ANY CONSTRUCTION. IT IS THE RESPONSIBILITY OF THE APPLICANT TO COORDINATE THE MEETING TIME AND PLACE WITH COUNTY DSD INSPECTIONS STAFF.
5. SOIL EROSION CONTROL MEASURES FOR ALL SLOPES, CHANNELS, DITCHES, OR ANY DISTURBED LAND AREA SHALL BE COMPLETED WITHIN 21 CALENDAR DAYS AFTER FINAL GRADING, OR FINAL EARTH DISTURBANCE, HAS BEEN COMPLETED. DISTURBED AREAS AND STOCKPILES WHICH ARE NOT AT FINAL GRADE BUT WILL REMAIN DORMANT FOR LONGER THAN 30 DAYS SHALL ALSO BE MULCHED WITHIN 21 DAYS AFTER INTERIM GRADING. AN AREA THAT IS GOING TO REMAIN IN AN INTERIM STATE FOR MORE THAN 60 DAYS SHALL ALSO BE SEEDED. ALL TEMPORARY SOIL EROSION CONTROL MEASURES AND BMPS SHALL BE MAINTAINED UNTIL PERMANENT SOIL EROSION CONTROL MEASURES ARE IMPLEMENTED AND ESTABLISHED.
6. TEMPORARY SOIL EROSION CONTROL FACILITIES SHALL BE REMOVED AND EARTH DISTURBANCE AREAS GRADED AND STABILIZED WITH PERMANENT SOIL EROSION CONTROL MEASURES PURSUANT TO STANDARDS AND SPECIFICATION PRESCRIBED IN THE DCM VOLUME II AND THE ENGINEERING CRITERIA MANUAL (ECM) APPENDIX I.
7. ALL PERSONS ENGAGED IN EARTH DISTURBANCE SHALL IMPLEMENT AND MAINTAIN ACCEPTABLE SOIL EROSION AND SEDIMENT CONTROL MEASURES INCLUDING BMPS IN CONFORMANCE WITH THE EROSION CONTROL TECHNICAL STANDARDS OF THE DRAINAGE CRITERIA MANUAL (DCM) VOLUME II AND IN ACCORDANCE WITH THE STORMWATER MANAGEMENT PLAN (SWMP).
8. ALL TEMPORARY EROSION CONTROL FACILITIES INCLUDING BMPS AND ALL PERMANENT FACILITIES INTENDED TO CONTROL EROSION OF ANY EARTH DISTURBANCE OPERATIONS, SHALL BE INSTALLED AS DEFINED IN THE APPROVED PLANS, THE SWMP AND THE DCM VOLUME II AND MAINTAINED THROUGHOUT THE DURATION OF THE EARTH DISTURBANCE OPERATION.
9. ANY EARTH DISTURBANCE SHALL BE CONDUCTED IN SUCH A MANNER SO AS TO EFFECTIVELY REDUCE ACCELERATED SOIL EROSION AND RESULTING SEDIMENTATION. ALL DISTURBANCES SHALL BE DESIGNED, CONSTRUCTED, AND COMPLETED SO THAT THE EXPOSED AREA OF ANY DISTURBED LAND SHALL BE LIMITED TO THE SHORTEST PRACTICAL PERIOD OF TIME.
10. ANY TEMPORARY OR PERMANENT FACILITY DESIGNED AND CONSTRUCTED FOR THE CONVEYANCE OF STORMWATER AROUND, THROUGH, OR FROM THE EARTH DISTURBANCE AREA SHALL BE DESIGNED TO LIMIT THE DISCHARGE TO A NON-EROSIVE VELOCITY.
11. CONCRETE WASH WATER SHALL BE CONTAINED AND DISPOSED OF IN ACCORDANCE WITH THE SWMP. NO WASH WATER SHALL BE DISCHARGED TO OR ALLOWED TO RUNOFF TO STATE WATERS, INCLUDING ANY SURFACE OR SUBSURFACE STORM DRAINAGE SYSTEM OR FACILITIES.
12. EROSION CONTROL BLANKETING IS TO BE USED ON SLOPES STEEPER THAN 3:1.
13. BUILDING, CONSTRUCTION, EXCAVATION, OR OTHER WASTE MATERIALS SHALL NOT BE TEMPORARILY PLACED OR STORED IN THE STREET, ALLEY, OR OTHER PUBLIC WAY, UNLESS IN ACCORDANCE WITH AN APPROVED TRAFFIC CONTROL PLAN. BMP'S MAY BE REQUIRED BY EL PASO COUNTY ENGINEERING IF DEEMED NECESSARY, BASED ON SPECIFIC CONDITIONS AND CIRCUMSTANCES.
14. VEHICLE TRACKING OF SOILS AND CONSTRUCTION DEBRIS OFF-SITE SHALL BE MINIMIZED. MATERIALS TRACKED OFF-SITE SHALL BE CLEANED UP AND PROPERLY DISPOSED OF IMMEDIATELY.
15. CONTRACTOR SHALL BE RESPONSIBLE FOR THE REMOVAL OF ALL WASTES FROM THE CONSTRUCTION SITE FOR DISPOSAL IN ACCORDANCE WITH LOCAL AND STATE REGULATORY REQUIREMENTS. NO CONSTRUCTION DEBRIS, TREE SLASH, BUILDING MATERIAL WASTES OR UNUSED BUILDING MATERIALS SHALL BE BURIED, DUMPED, OR DISCHARGED AT THE SITE.
16. THE OWNER, SITE DEVELOPER, CONTRACTOR, AND/OR THEIR AUTHORIZED AGENTS SHALL BE RESPONSIBLE FOR THE REMOVAL OF ALL CONSTRUCTION DEBRIS, DIRT, TRASH, ROCK, SEDIMENT, AND SAND THAT MAY ACCUMULATE IN THE STORM SEWER OR OTHER DRAINAGE CONVEYANCE SYSTEM AND STORMWATER APPURTENANCES AS A RESULT OF SITE DEVELOPMENT.
17. THE QUANTITY OF MATERIALS STORED ON THE PROJECT SITE SHALL BE LIMITED, AS MUCH AS PRACTICAL, TO THAT QUANTITY REQUIRED TO PERFORM THE WORK IN AN ORDERLY SEQUENCE. ALL MATERIALS STORED ON-SITE SHALL BE STORED IN A NEAT, ORDERLY MANNER, IN THEIR ORIGINAL CONTAINERS, WITH ORIGINAL MANUFACTURER'S LABELS.
18. NO CHEMICALS ARE TO BE USED BY THE CONTRACTOR, WHICH HAVE THE POTENTIAL TO BE RELEASED IN STORMWATER UNLESS PERMISSION FOR THE USE OF SPECIFIC CHEMICAL IS GRANTED IN WRITING BY THE ECM ADMINISTRATOR. IN GRANTING THE USE OF SUCH CHEMICALS, SPECIAL CONDITIONS AND MONITORING MAY BE REQUIRED.
19. BULK STORAGE STRUCTURES FOR PETROLEUM PRODUCTS AND OTHER CHEMICALS SHALL HAVE ADEQUATE PROTECTION SO AS TO CONTAIN ALL SPILLS AND PREVENT ANY SPILLED MATERIAL FROM ENTERING STATE WATERS, INCLUDING ANY SURFACE OR SUBSURFACE STORM DRAINAGE SYSTEM OR FACILITIES.
20. NO PERSON SHALL CAUSE THE IMPEDIMENT OF STORMWATER FLOW IN THE FLOW LINE OF THE CURB AND GUTTER OR IN THE DITCHLINE.
21. INDIVIDUALS SHALL COMPLY WITH THE "COLORADO WATER QUALITY CONTROL ACT" (TITLE 25, ARTICLE 8, CRS), AND THE "CLEAN WATER ACT" (33 USC 1344), IN ADDITION TO THE REQUIREMENTS INCLUDED IN THE DCM VOLUME II AND THE ECM APPENDIX I. ALL APPROPRIATE PERMITS MUST BE OBTAINED BY THE CONTRACTOR PRIOR TO CONSTRUCTION (NPDES, FLOODPLAIN, 404, FUGITIVE DUST, ETC.). IN THE EVENT OF CONFLICTS BETWEEN THESE REQUIREMENTS AND LAWS, RULES, OR REGULATIONS OF OTHER FEDERAL, STATE, OR COUNTY AGENCIES, THE MORE RESTRICTIVE LAWS, RULES, OR REGULATIONS SHALL APPLY.
22. ALL CONSTRUCTION TRAFFIC MUST ENTER/EXIT THE SITE AT APPROVED CONSTRUCTION ACCESS POINTS.
23. PRIOR TO ACTUAL CONSTRUCTION, THE PERMITEE SHALL VERIFY THE LOCATION OF EXISTING UTILITIES.
24. A WATER SOURCE SHALL BE AVAILABLE ON-SITE DURING EARTHWORK OPERATIONS AND UTILIZED AS REQUIRED TO MINIMIZE DUST FROM EARTHWORK EQUIPMENT AND WIND.
25. THE SOILS REPORT FOR THIS SITE HAS BEEN PREPARED BY CTL THOMPSON, INC. AND SHALL BE CONSIDERED A PART OF THESE PLANS.
26. AT LEAST TEN DAYS PRIOR TO THE ANTICIPATED START OF CONSTRUCTION, FOR PROJECTS THAT WILL DISTURB 1 ACRE OR MORE, THE OWNER OR OPERATOR OF CONTRUCTION ACTIVITY SHALL SUBMIT A PERMIT APPLICATION FOR STORMWATER DISCHARGE TO THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIROMENT, WATER QUALITY DIVISION. THE APPLICATION CONTAINS CERTIFICATION OF COMPLETION OF A STORMWATER MANAGEMENT PLAN (SWMP), OF WHICH THIS GRADING AND EROSION CONTROL PLAN MAY BE A PART. FOR INFORMATION OR APPLICATION MATERIALS CONTACT:
   COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT
   WATER QUALITY CONTROL DIVISION
   WQCD – PERMITS
   4300 CHERRY CREEK DRIVE SOUTH
   DENVER, CO 80246-1530
   ATTN: PERMITS UNIT
27. NO PORTION OF THIS PROPERTY IS LOCATED WITHIN A DESIGNATED FEMA FLOODPLAIN IN ACCORDANCE WITH FLOOD INSURANCE RATE MAPS (FIRM) 08041C0535F, EFFECTIVE DATE MARCH 17, 1997.

EROSION CONTROL NOTES:

1. AT ALL TIMES DURING THE CONSTRUCTION OF THE PROJECT, EROSION AND SEDIMENT CONTROL SYSTEMS SHALL BE MAINTAINED TO PREVENT DAMAGING FLOWS ON THE SITE AND IN THE WATERSHED BELOW THE SITE. CONTROL SYSTEMS SHALL BE INSTALLED PRIOR TO STRIPPING OF NATIVE VEGETATIVE COVER AND AS GRADING PROGRESSES. CONTROL SYSTEMS SHALL INCLUDE, AS A MINIMUM, STRAW BALE SEDIMENT TRAPS (OR EQUAL) ALONG NATURAL DRAINAGEWAYS PRIOR TO GRADING AND UTILIZATION OF DESIGNED STORM DETENTION BASINS PRIOR TO FINAL GRADING REVEGETATION.
2. WHERE AREAS ARE TO BE LEFT BARE FOR EXTENDED PERIODS (TOPSOIL, STOCKPILES, EMPTY LOTS, RIGHTS-OF-WAY, HOMESITES AWAITING PURCHASE, ETC.) MECHANICAL MULCHING (STRAW CRIMP) IN ACCORDANCE WITH CDOT STANDARD SPECIFICATIONS SHALL BE APPLIED WITHIN 30 DAYS AFTER FINAL GRADE IS REACHED ON ANY PORTION OF THE SITE. SOIL STABILIZATION MEASURES SHALL BE APPLIED WITHIN 30 DAYS TO DISTURBED AREAS WHICH MAY NOT BE AT FINAL GRADE BUT WILL BE LEFT DORMANT FOR LONGER THAN 60 DAYS.
3. TOPSOIL WILL BE STOCKPILED AND USED AS A TOPDRESSING OVER CUT AND FILL AREAS TO HELP IN THE ESTABLISHMENT OF ADAPTED VEGETATION. TOPSOIL STOCKPILE WILL BE SEEDED AND/OR MULCHED TO MINIMIZE SOIL LOSS UNTIL TOPSOIL IS USED.
4. AREAS LEFT OPEN FOR 30 DAYS OR MORE, OTHER THAN FOR UTILITY AND DRAINAGE CONSTRUCTION SHALL BE SEEDED AND/OR MULCHED.
5. THE CONTRACTOR IS RESPONSIBLE FOR IMPLEMENTING MEASURES TO PREVENT EROSION OF DISTURBED SOIL BY ABNORMAL WINDS.
6. ADDITIONAL EROSION CONTROL MEASURES MAY BE REQUIRED AT THE TIME OF CONSTRUCTION.
7. PROPERTIES AND ROADWAYS ADJACENT TO THE SITE OF A LAND DISTURBANCE SHALL BE PROTECTED FROM SEDIMENT DEPOSITION.

SEEDING GUIDELINE

1. SEEDBED PREPARATION
   THE SEEDBED SHOULD BE WELL-SETTLED AND FIRM, BUT FRIABLE ENOUGH THAT THE SEED CAN BE PLACED AT THE SPECIFIED DEPTHS. COMPETITIVE STANDS OF WEEDS THAT ARE PRESENT BEFORE SEEDING MUST BE CONTROLLED BY SHALLOW TILLAGE OR BY APPLICATION OF HERBICIDES. SOILS THAT HAVE BEEN ER-COMPACTED BY TRAFFIC OR EQUIPMENT ESPECIALLY WHEN WET, SHOULD BE TILLED TO BREAK UP ROOTING-RESTRICTIVE LAYERS, THAN HARROWED, ROLLED, OR PACKED TO PREPARE THE REQUIRED FIRM SEEDBED.
2. FERTILIZER
   FERTILIZER SHOULD BE APPLIED AT A RATE OF 50 POUNDS OF AVAILABLE NITROGEN PER ACRE AND 40 POUNDS OF AVAILABLE PHOSPHATE PER ACRE. THE TIME OF APPLICATION SHOULD BE IMMEDIATELY PRIOR TO SEEDING, AT THE TIME OF SEEDING, OR IMMEDIATELY FOLLOWING SEEDING, DEPENDING ON THE KIND OF FERTILIZER AND TYPE OF EQUIPMENT USED.
3. SEEDING
   SEED SHOULD BE PLANTED WITH A GRASS DRILL ON ALL SLOPES OF 33% (3:1) OR FLATTER. SEED MAY BE BROADCAST BY HAND, BY MECHANICAL SPREADER, OR BY HYDRAULIC EQUIPMENT ON AREAS THAT ARE SMALL, TOO STEEP, OR NOT ACCESSIBLE FOR SEED DRILL OPERATIONS.

   SEED PLANTED WITH A DRILL SHOULD BE COVERED WITH SOIL TO A DEPTH OF 1/4 TO 3/4 INCH. SEED PLANTED BY THE BROADCAST METHOD SHALL BE INCORPORATED INTO THE SOIL SURFACE, NOT TO EXCEED A DEPTH OF 3/4 INCH, BY RAKING, HARROWING, OR OTHER PROVEN METHOD.

   THE TIME OF SEEDING IS FROM OCTOBER 15TH – MAY 31ST. SEED PLANTED IN THE LATE FALL WILL REMAIN DORMANT UNTIL SPRING, WHEN IT WILL GERMINATE.
4. MULCHING
   SEEDED AREAS SHOULD BE MULCHED TO CONSERVE MOISTURE; PREVENT SURFACE COMPACTION OR CRUSTING; REDUCE RUNOFF AND EROSION; CONTROL INSECTS; AND HELP ESTABLISH PLANT COVER.

   NATIVE HAY OR STRAW SHOULD BE APPLIED AT A RATE OF 4,000 POUNDS PER ACRE AND CRIMPED INTO THE GROUND. ON SLOPES GREATER THAN 3:1, AN AGRONOMY BLANKET SHOULD BE USED.
5. SUPPLEMENTAL WATER
   IN LOW RAINFALL AREAS, WHERE WATER IS AVAILABLE AND WHERE RAPID ESTABLISHMENT IS NEEDED, IRRIGATION OF NEW SEEDING SHOULD BE PERFORMED DURING THE FIRST GROWING SEASON. WATER SHOULD BE APPLIED AT APPROXIMATELY ONE WEEK INTERVALS, AT A RATE OF 3/4 TO 1 INCH PER APPLICATION, WHEN RAINFALL IS DEFICIENT FOR PLANT DEVELOPMENT.

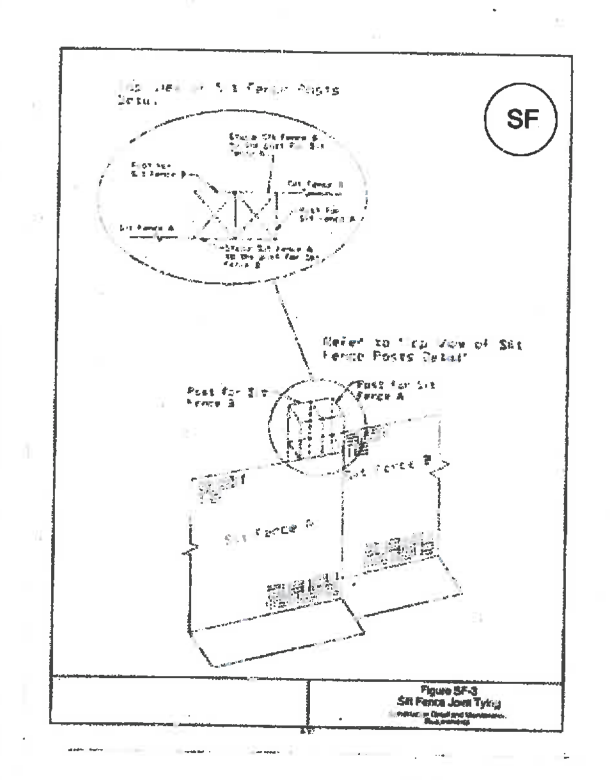


Figure SF-3
Silt Fence Joint Tying

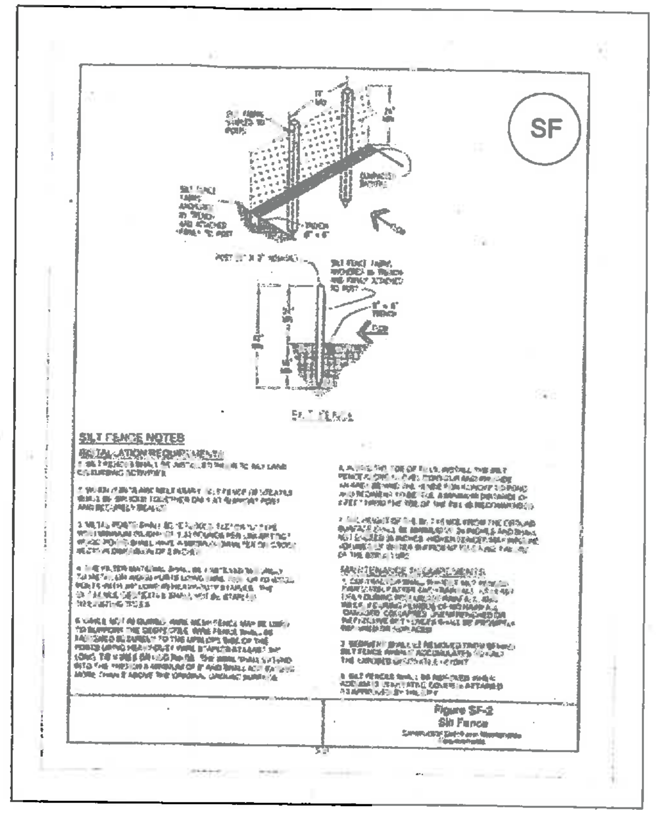
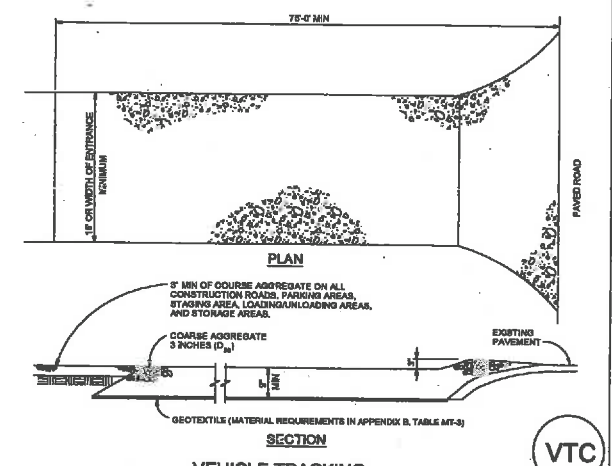


Figure SF-2
Silt Fence



VEHICLE TRACKING
NTS

VEHICLE TRACKING NOTES

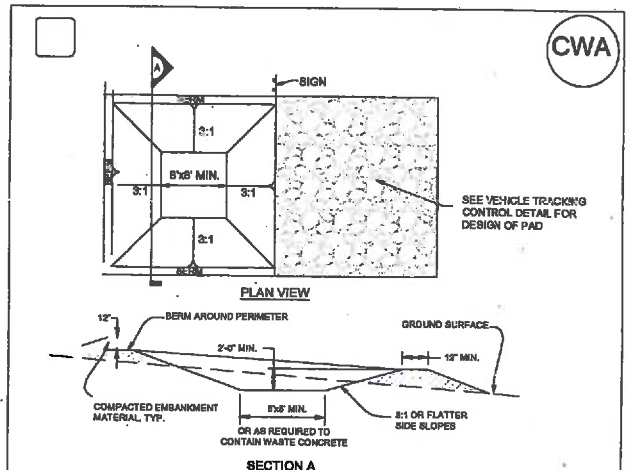
INSTALLATION REQUIREMENTS

1. ALL ENTRANCES TO THE CONSTRUCTION SITE ARE TO BE STABILIZED PRIOR TO CONSTRUCTION BEGINNING.
2. CONSTRUCTION ENTRANCES ARE TO BE BUILT WITH AN APRON TO ALLOW FOR TURNING TRAFFIC, BUT SHOULD NOT BE BUILT OVER EXISTING PAVEMENT EXCEPT FOR A SLIGHT OVERLAP.
3. AREAS TO BE STABILIZED ARE TO BE PROPERLY GRADED AND COMPACTED PRIOR TO LAYING DOWN GEOTEXTILE AND STONE.
4. CONSTRUCTION ROADS, PARKING AREAS, LOADING/UNLOADING ZONES, STORAGE AREAS, AND STAGING AREAS ARE TO BE STABILIZED.
5. CONSTRUCTION ROADS ARE TO BE BUILT TO CONFORM TO SITE GRADES, BUT SHOULD NOT HAVE SIDE SLOPES OR ROAD GRADES THAT ARE EXCESSIVELY STEEP.

MAINTENANCE REQUIREMENTS

1. REGULAR INSPECTIONS ARE TO BE MADE OF ALL STABILIZED AREAS, ESPECIALLY AFTER STORM EVENTS.
2. STONES ARE TO BE REAPPLIED PERIODICALLY AND WHEN REPAIR IS NECESSARY.
3. SEDIMENT TRACKED ONTO PAVED ROADS IS TO BE REMOVED DAILY BY SHOVELING OR SWEEPING. SEDIMENT IS NOT TO BE WASHED DOWN STORM SEWER DRAINS.
4. STORM SEWER INLET PROTECTION IS TO BE IN PLACE, INSPECTED, AND CLEANED IF NECESSARY.
5. OTHER ASSOCIATED SEDIMENT CONTROL MEASURES ARE TO BE INSPECTED TO ENSURE GOOD WORKING CONDITION.

Figure VT-2
Vehicle Tracking
Application Examples



SECTION A

CONCRETE WASHOUT AREA INSTALLATION NOTES

1. SEE PLAN VIEW FOR LOCATIONS OF CONCRETE WASHOUT AREA
2. THE CONCRETE WASHOUT AREA SHALL BE INSTALLED PRIOR TO ANY CONCRETE PLACEMENT ON SITE.
3. VEHICLE TRACKING CONTROL IS REQUIRED AT THE ACCESS POINT.
4. SIGNS SHALL BE PLACED AT THE CONSTRUCTION ENTRANCE, AT THE WASHOUT AREA, AND ELSEWHERE AS NECESSARY TO CLEARLY INDICATE THE LOCATION OF THE CONCRETE WASHOUT AREA TO OPERATORS OF CONCRETE TRUCKS AND PUMP RIGS.
5. EXCAVATED MATERIAL SHALL BE UTILIZED IN PERIMETER BERM CONSTRUCTION

CONCRETE WASHOUT AREA MAINTENANCE NOTES

1. THE CONCRETE WASHOUT AREA SHALL BE REPAIRED AND ENLARGED OR CLEANED OUT AS NECESSARY TO MAINTAIN CAPACITY FOR WASTED CONCRETE.
2. AT THE END OF CONSTRUCTION, ALL CONCRETE SHALL BE REMOVED FROM THE SITE AND DISPOSED OF AT AN APPROVED WASTE SITE.
3. WHEN THE CONCRETE WASHOUT AREA IS REMOVED, COVER THE DISTURBED AREA WITH TOP SOIL, DRILL SEED AND CRIMP MULCH OR OTHERWISE STABILIZE IN A MANNER APPROVED BY THE LOCAL JURISDICTION.
4. INSPECT WEEKLY, DURING AND AFTER ANY STORM EVENT.

DETAIL BASED ON DETAILS PROVIDED BY DOUGLAS COUNTY

Figure C3-2
CONCRETE WASHOUT AREA

EROSION PROTECTION & REVEGETATION REQUIREMENTS "PER U.S.D.A. SOIL CONSERVATION SERVICE GUIDELINES"

1. PRACTICE NO. & NAME ______ 342 – CRITICAL AREA TREATMENT
   RANGE SITE ______ SANDY FOOTHILLS
2. PLANNED:

SEEDED PREP:
A METHOD ______
B DATES ______ OCT 15 – MAY 31
C CLEAN TILLED ______ XX
FIRM SEEDBED ______ XX
STUBBLE COVER ______
INTERSEED ______
OTHER ______

SEEDING OPERATION:
A METHOD:
DRILL ______ XX
INTERSEED ______
BROADCAST ______
B DRILL SPACING ______ 6-12"
TYPE ______ GRASS W/AGITATOR
C DATE ______ OCT 15 – MAY 31
D PLANTING DEPTH ______ 1/4 – 1/2"

FERTILIZER:
POUNDS ACTUAL PER ACRE N2 ______
(AVAILABLE)
P205 ______

WEED CONTROL: N/A
MOWING ______
CHEMICAL ______
DATES ______

K ______

SEE S.C.S. FOR SPECIFIC RECOMMENDATIONS AT HERBICIDE APPLICATION TIME.

MULCH:
KIND ______ LONG – STEM NATIVE HAY
AMOUNT ______ 4,000 POUNDS/ACRE
HOW APPLIED ______ N/A
HOW ANCHORED ______ CRIMPED
ANCHORAGE DEPTH ______ 4"

SEED:

VARIETY	SPECIES	REQUIRED PLS RATES PER ACRES (100%)	(2) % OF SPECIES IN MIXTURE	PLS SEEDING RATE PER SPECIES/ACRE (1) X (2)	(4) PLANNED ACRE	(5) TOTAL PLS LBS/ (3) X (4)
GOSHEN	PRAIRIE SANDREED	6.5	15	0.98	XX.X	XX.X
VAUGHN	SIDEOATS GRAMMA	9.0	25	2.25	XX.X	XX.X
LOVINGTON	BLUE GRAMMA	3.0	15	0.45	XX.X	XX.X
BLACKWELL	SWITCH GRASS	4.5	20	0.90	XX.X	XX.X
PASTURA	LITTLE BLUESTEM	7.0	25	1.75	XX.X	XX.X

THE SANDS
GENERAL NOTES AND DETAILS

PROJECT NO. 43-089	FILE: \dwg\Const Dwg\Storm – District\CH02.dwg	DATE: 09/30/2016	
DESIGNED BY: DLM	SCALE	SHEET 2 OF 9	CH02
DRAWN BY: JNP	HORIZ: N/A		
CHECKED BY: VAS	VERT: N/A		

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

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

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

CAUTION: 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.

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RIPRAP

1. CONTRACTOR SHALL COOPERATE WITH ENGINEER IN OBTAINING AND PROVIDED SAMPLES OF ALL SPECIFIED MATERIALS.
2. THE RIPRAP DESIGNATION AND TOTAL THICKNESS OF RIPRAP SHALL BE AS SHOWN ON THE DRAWINGS. THE MAXIMUM STONE SIZE SHALL NOT LARGER THAN THE THICKNESS OF THE RIPRAP.
3. NEITHER WIDTH NOR THICKNESS OF A SINGLE STONE OF RIPRAP SHALL BE LESS THAN ONE–THIRD (⅓) OF ITS LENGTH.
4. THE SPECIFIC GRAVITY OF THE RIPRAP SHALL BE TWO AND ONE–HALF (2.5) OR GREATER.
5. MINIMUM DENSITY FOR ACCEPTABLE RIPRAP SHALL BE ONE HUNDRED AND SIXTY FIVE (165) POUNDS PER CUBIC FOOT.
6. RIPRAP SPECIFIC GRAVITY SHALL BE ACCORDING TO THE BULK–SATURATED, SURFACE–DRY BASIS, IN ACCORDANCE WITH AASHTO T85.
7. BROKEN CONCRETE OR ASPHALT PAVEMENT SHALL NOT BE ACCEPTABLE FOR USE IN THE WORK.
8. ROUNDED RIPRAP (RIVER ROCK) IS NOT ACCEPTABLE, UNLESS SPECIFICALLY DESIGNATED ON THE DRAWINGS.

STRUCTURAL CONCRETE NOTES:

ALL CONSTRUCTION INVOLVING THE PLACEMENT OF STRUCTURAL CONCRETE SHALL BE COMPLETED IN ACCORDANCE WITH STANDARD SPECIFICATIONS, AND AS SUPPLEMENTED BY THE COLORADO DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR ROADWAY AND BRIDGE CONSTRUCTION.

STEEL REINFORCING SHALL BE GRADE 60 FOR ALL REINFORCING STEEL GREATER THAN #4. A TABLE SPECIFYING MINIMUM SPLICE LENGTHS HAS BEEN PROVIDED ON THE STRUCTURAL DETAIL SHEETS.
ALL REINFORCING SHALL HAVE A 2–INCH MINIMUM COVER UNLESS OTHERWISE SPECIFIED. ALL REINFORCED STEEL TO BE EPOXY COATED.

CAST–IN–PLACE CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH (fc) OF 4,000 PSI AT 28 DAYS. ALL CONCRETE PLACED AGAINST SOIL SHALL BE TYPE II PORTLAND CEMENT. ALL EXPOSED CORNERS SHALL BE FORMED WITH A 3/4" CHAMFER UNLESS OTHERWISE SPECIFIED.

EXPANSION JOINT MATERIAL SHALL MEET AASHTO SPECIFICATION M–213.

BACKFILL AGAINST STRUCTURES SHALL NOT COMMENCE UNTIL ALL SUPPORTING DIAPHRAGMS ARE IN PLACE AND CONCRETE HAS OBTAINED ITS FULL SEVEN DAY STRENGTH. BACKFILL SHALL BE PLACED EQUALLY ON EACH SIDE OF RETAINING WALL STRUCTURES AND CUTOFF WALLS UNTIL THE FINAL GRADE IS REACHED.

FOOTING EXCAVATIONS SHALL BE EXAMINED BY THE GEOTECHNICAL ENGINEER WITH A 24–HOUR MINIMUM NOTIFICATION FOR SOIL AND/OR CONCRETE TESTING. PLACEMENT OF CONCRETE IN THE ABSENCE OF TESTING SHALL BE COMPLETED AT THE SOLE RISK OF THE CONTRACTOR.

ABBREVIATIONS
EC –– EPOXY COATED   O.F. –– OUTSIDE FACE   E.F. –– EACH FACE
E.W. –– EACH WAY   I.F. –– INSIDE FACE   N.F. –– NEAR FACE
T.O.C. –– TOP OF CONCRETE   B.O.C. –– BOTTOM OF CONCRETE
CONT. –– CONTINUOUS

PRIOR TO THE PLACEMENT OF CONCRETE IN AREAS WHERE SOIL IS PRESENT, THE SOIL SHALL BE SCARIFIED TO A MINIMUM DEPTH OF 6–INCHES. THE MOISTURE CONTENT SHALL BE ADJUSTED TO WITHIN PLUS OR MINUS 2 PERCENT OF THE OPTIMUM MOISTURE CONTENT AND RECOMPACTED TO AT LEAST 95 PERCENT RELATIVE COMPACTION (AASHTO–T–180).

STANDARD CONSTRUCTION NOTES:

1. ALL DRAINAGE AND ROADWAY CONSTRUCTION SHALL MEET THE STANDARDS AND SPECIFICATIONS OF THE CITY OF COLORADO SPRINGS/EL PASO COUNTY DRAINAGE CRITERIA MANUAL VOLUMES 1 AND 2, AND THE EL PASO COUNTY ENGINEERING CRITERIA MANUAL.
2. CONTRACTOR SHALL BE RESPONSIBLE FOR THE NOTIFICATION AND FIELD LOCATION OF ALL EXISTING UTILITIES, WHETHER SHOWN ON THE PLANS OR NOT, BEFORE BEGINNING CONSTRUCTION. LOCATION OF EXISTING UTILITIES SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION. CALL 811 TO CONTACT THE UTILITY NOTIFICATION CENTER OF COLORADO SPRINGS.
3. CONTRACTOR SHALL KEEP A COPY OF THESE APPROVED PLANS, THE GRADING AND EROSION CONTROL PLAN, THE STORMWATER MANAGEMENT PLAN (SWMP), THE SOILS AND GEOTECHNICAL REPORT AND THE APPROPRIATE DESIGN AND CONSTRUCTION STANDARDS AND SPECIFICATIONS AT THE JOB SITE AT ALL TIME INCLUDING THE FOLLOWING:
   3.1 EL PASO COUNTY ENGINEERING CRITERIA MANUAL (ECM)
   3.2 CITY OF COLORADO SPRINGS/EL PASO COUNTY ENGINEERING CRITERA MANUAL VOLUMES 1 AND 2.
   3.3 COLORADO DEPARTMENT OF TRANSPORTATION (CDOT) STANDARDS SPECIFICATION FOR ROAD AND BRIDGE CONSTRUCTION.
   3.4 CDOT M&S STANDARDS.
4. IT IS THE DESIGN ENGINEERS RESPONSIBILITY TO ACCURACY SHOW EXISTING CONDITION BOTH ONSITE AND OFFSITE ON THE CONSTRUCTION PLANS. ANY MODIFICATION NECESSARY DUE TO CONFLICT OMISSIONS OR CHANGED CONDITIONS WILL BE ENTIRELY THE DEVELOPERS RESPONSIBILITY TO RECTIFY.
5. IT IS THE CONTRACTORS RESPONSIBILITY TO UNDERSTAND THE REQUIREMENTS OF ALL JURISDICTIONAL AGENCIES AND TO OBTAIN ALL REQUIRED PERMITS, INCLUDING BUT NOT LIMITED TO EL PASO COUNTY EROSION AND STORM WATER QUALITY CONTROL PERMIT (ESQCP), US ARMY CORPS OF ENGINEER ISSUED 401 AND/OR 404 PERMITS AND COUNTY AND STATE FUGITIVE DUST PERMITS.
6. ANY TEMPORARY SIGNAGE AND STRIPING SHALL COMPLY WITH EL PASO COUNTY DOW AND MUTCD CRITERIA.
7. CONTRACTOR SHALL OBTAIN ANY PERMITS REQUIRE BY EL PASO COUNTY DOT INCLUDING WORK WITHIN THE RIGHT–OF–WAY AND SPECIAL TRANSPORT PERMITS.
8. THE LIMITS OF CONSTRUCTION SHALL REMAIN WITHIN THE PROPERTY LINE UNLESS OTHERWISE NOTED. THE OWNER/DEVELOPER SHALL OBTAIN WRITTEN PERMISSION AND EASEMENTS, WHERE REQUIRED, FROM ADJOINING PROPERTY OWNER(S) PRIOR TO ANY OFFSITE DISTURBANCE GRADING, OR CONSTRUCTION.

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

THE SANDS

GENERAL NOTES AND DETAILS

PROJECT NO. 43–089 | FILE: \dwg\Const Dwg\Storm – District\CH03.dwg

DESIGNED BY: DLM
DRAWN BY: JWP
CHECKED BY: VAS

SCALE
HORIZ: N/A
VERT: N/A

DATE: 09/30/2016

SHEET 3 OF 9

CH03

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

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

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

REVISIONS:

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

CAUTION
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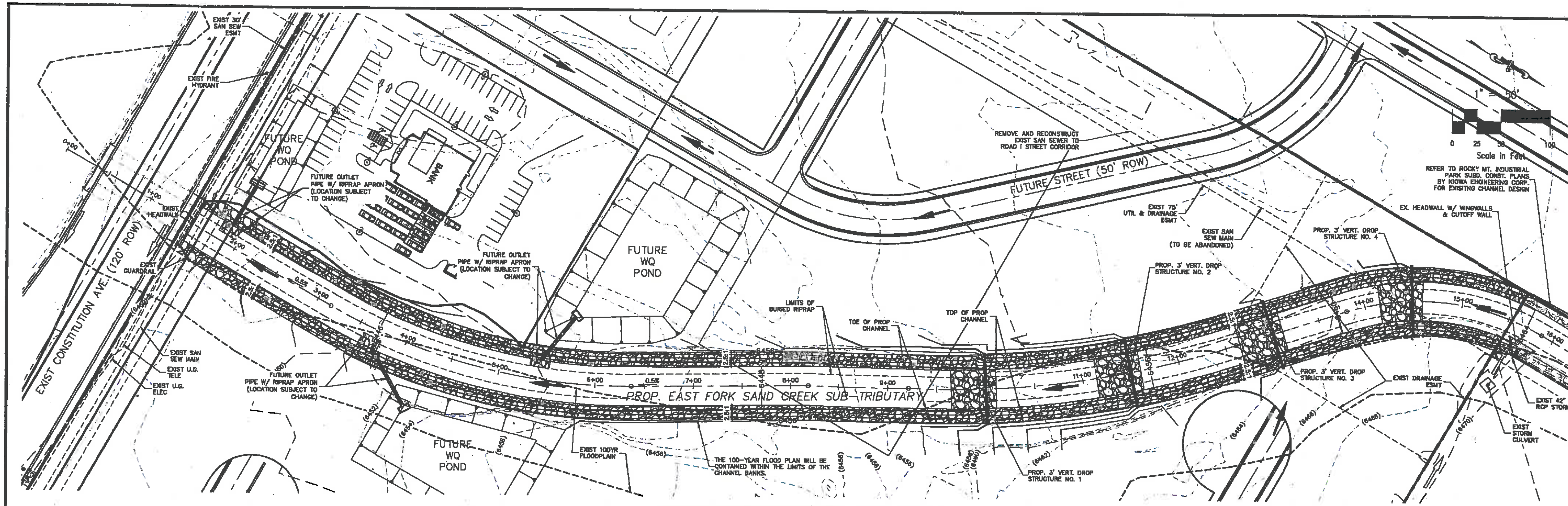
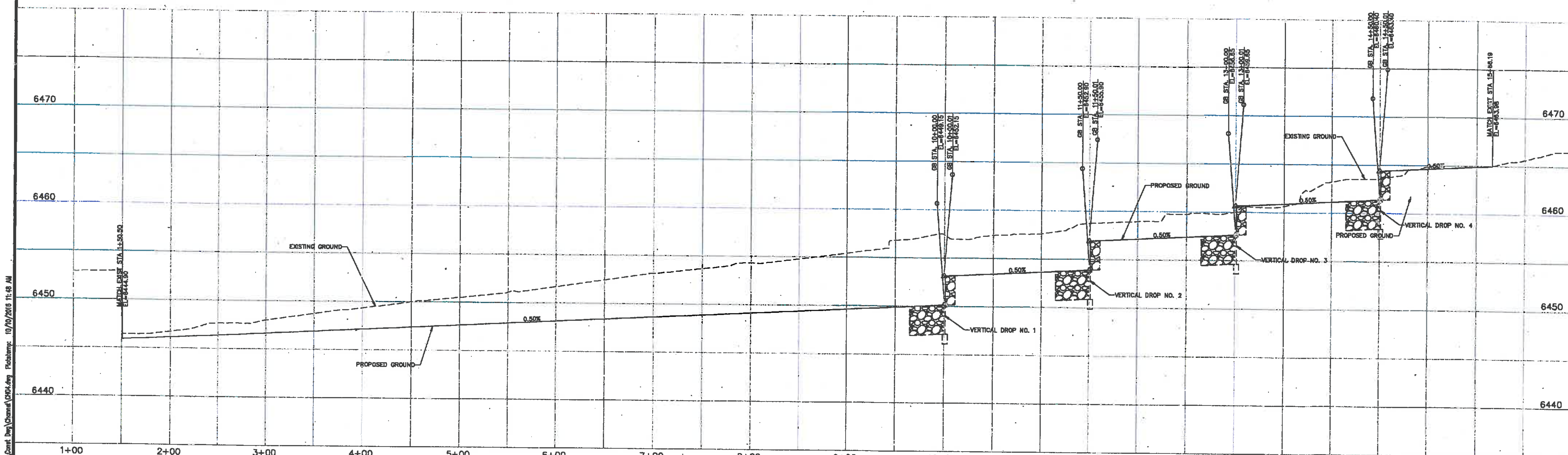


EAST FORK TRIBUTARY CHANNEL IMPROVEMENTS
STA 1+00.00 TO STA 15+66.99



EAST FORK TRIBUTARY CHANNEL IMPROVEMENTS - STA 1+00.00 TO STA 15+66.19

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

PRELIMINARY-NOT FOR CONSTRUCTION

DRAINAGE DESIGN:
FILED IN ACCORDANCE WITH SECTION 7-7-406 (DRAINAGE ORDINANCE) OF THE CODE OF THE CITY OF COLORADO SPRINGS 2001, AS AMENDED.
FOR THE CITY ENGINEER:
DRAINAGE REVIEW: ____ DATE: ____

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

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

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

THE SANDS
CHANNEL PLAN & PROFILE
PROJECT NO. 43-069
DESIGNED BY: DLM
DRAWN BY: JMP
CHECKED BY: VAS
SCALE HORIZ: 1"=50' VERT: 1"=5'
DATE: 09/30/2016
SHEET 4 OF 9
CH04

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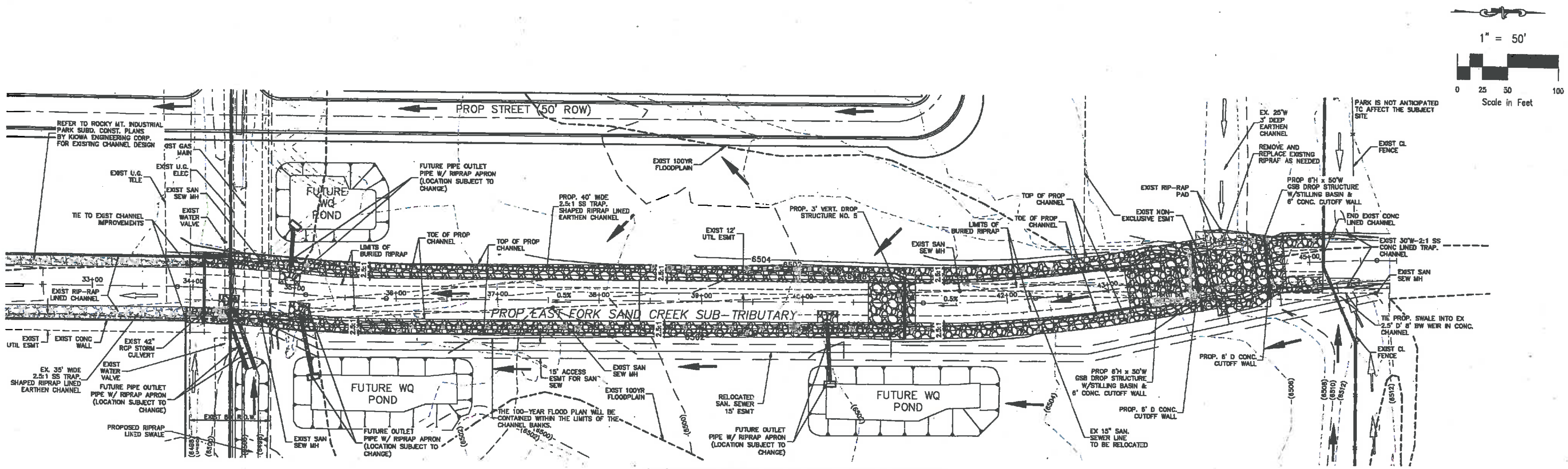
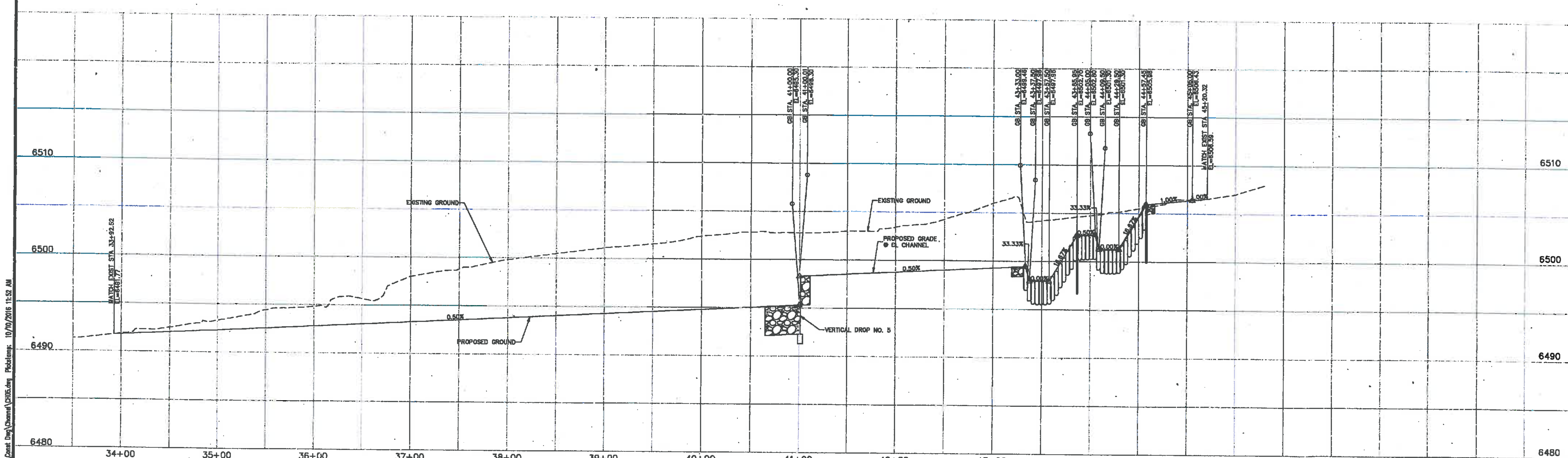


EAST FORK TRIBUTARY CHANNEL IMPROVEMENTS
STA 33+50.00 TO STA 46+00.00



EAST FORK TRIBUTARY CHANNEL IMPROVEMENTS STA 33+50.00 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.

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48 HRS BEFORE YOU DIG
CALL 1-800-922-1987

PRELIMINARY-NOT FOR CONSTRUCTION

DRAINAGE DESIGN:

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FOR THE CITY ENGINEER:

DRAINAGE REVIEW: ______ DATE: ______

THE SANDS
CHANNEL PLAN & PROFILE

PROJECT NO. 43-089
DATE: 09/30/2016
SCALE: HORIZ: 1"=50' VERT: 1"=5'
DESIGNED BY: DLM
DRAWN BY: JNP
CHECKED BY: VAS
SHEET 5 OF 9
CH05

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

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

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

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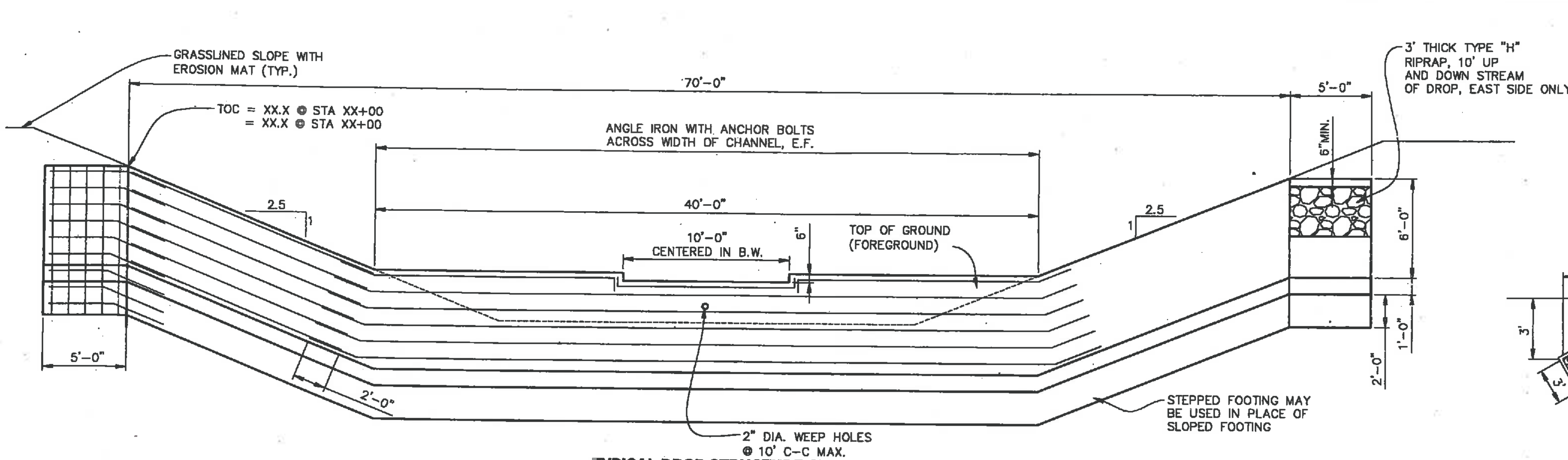
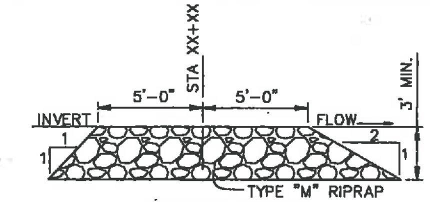
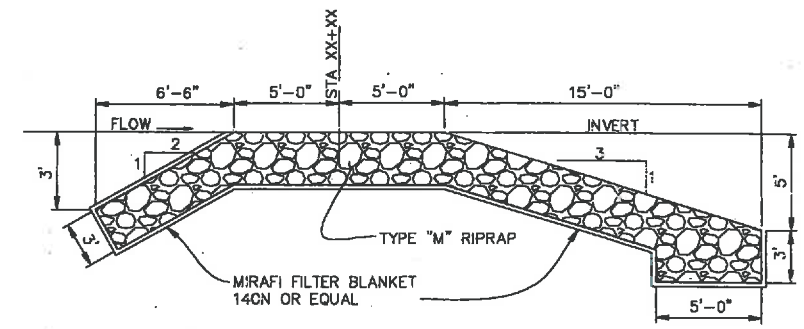
CAUTION



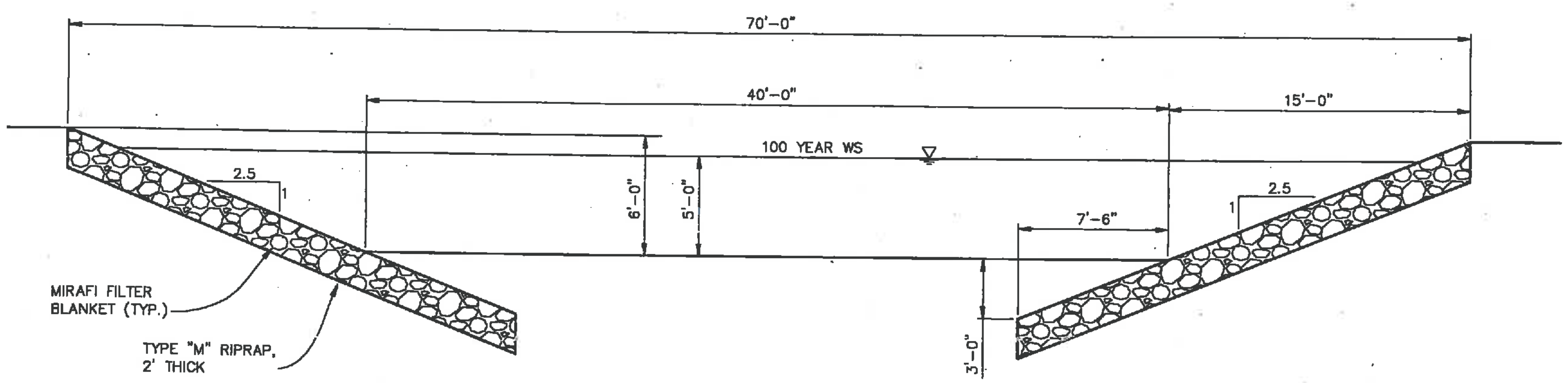
TYPICAL DROP STRUCTURE SECTION
SECTION B-B
SCALE: 1' = 1/4"



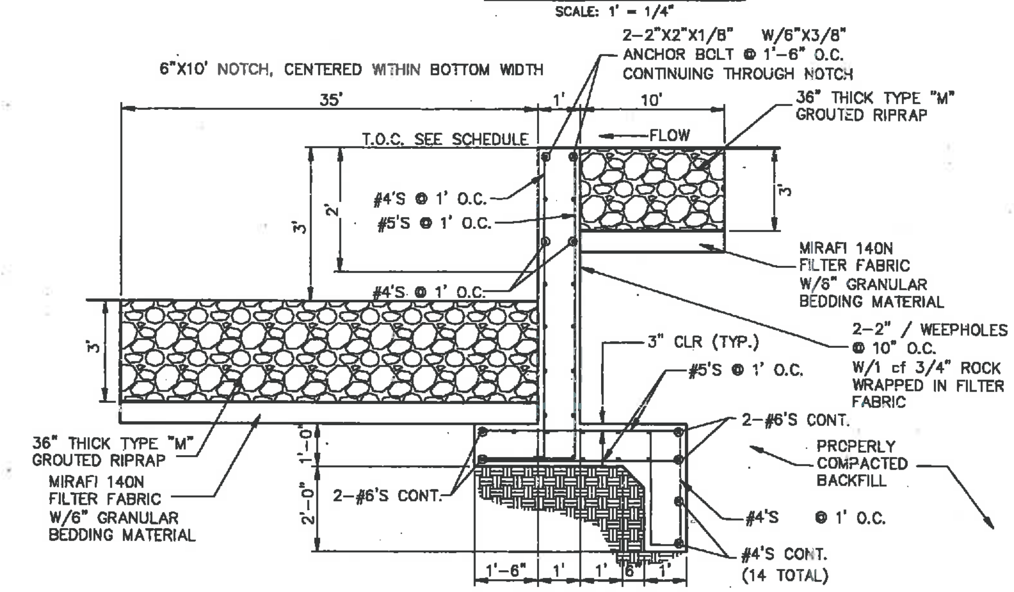
CHANNEL CHECK
SCALE: 1' = 1/4"



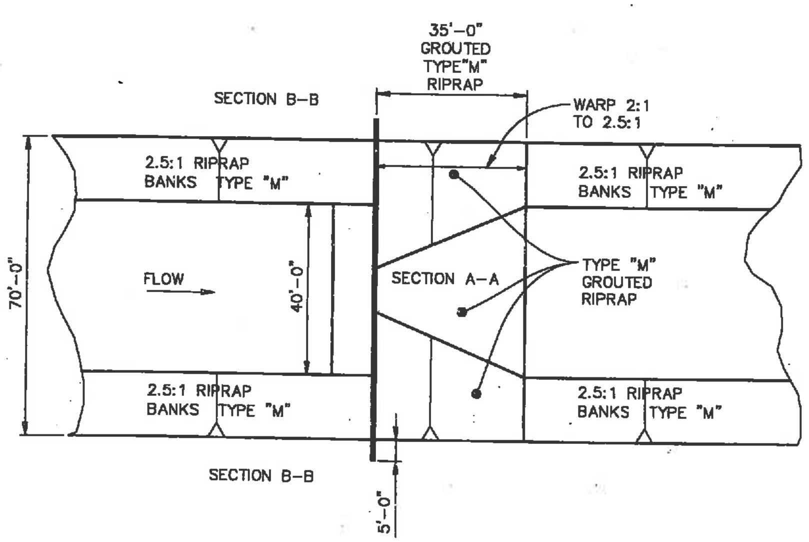
RIPRAP CHECK STA XX+XX
SCALE: 1' = 1/4"



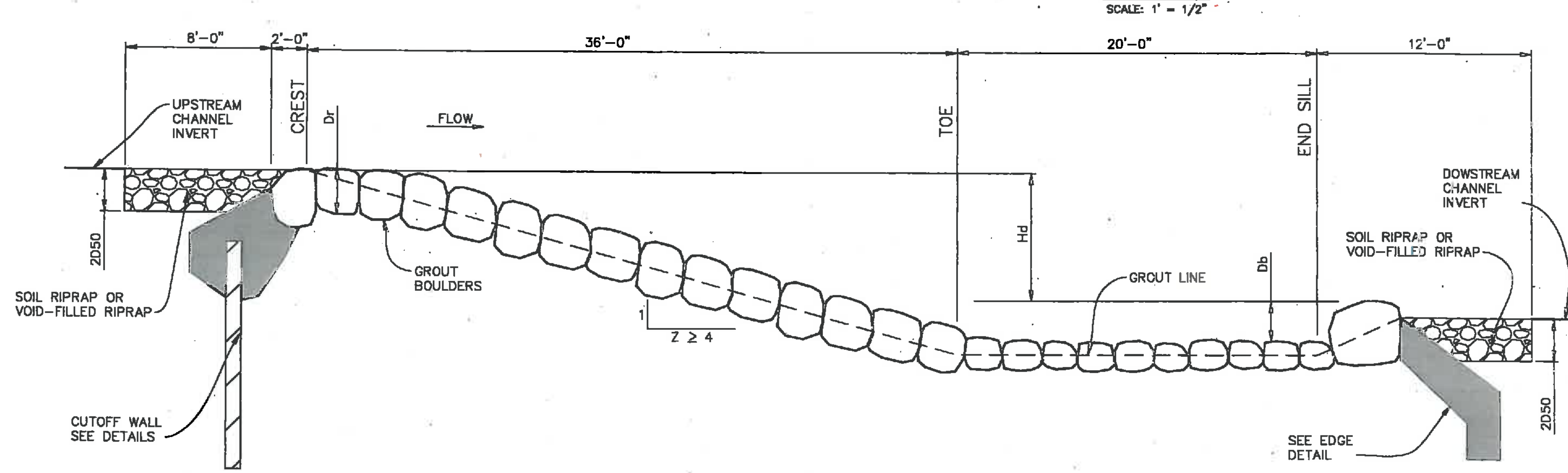
TYPICAL SECTION
EAST FORK SAND CREEK SUB-TRIBUTARY
SCALE: 1' = 1/4"



TYPICAL DROP STRUCTURE SECTION
SECTION A-A
SCALE: 1' = 1/2"



DROP STRUCTURE PLAN
SCALE: 1"=20'



GROUTED BOULDER DROP WITH
DEPRESSED STILLING BASIN
SCALE: N.T.S.

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

THE SANDS
CHANNEL DETAILS

PROJECT NO. 43-089 | FILE: V:eng\Const Dwg\Storm - District\CH06.dwg | DATE: 09/30/2016
DESIGNED BY: DLM | DRAWN BY: JWP | CHECKED BY: VAS | SCALE HORIZ: N/A | VERT: N/A | SHEET 6 OF 9

CH06

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

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

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

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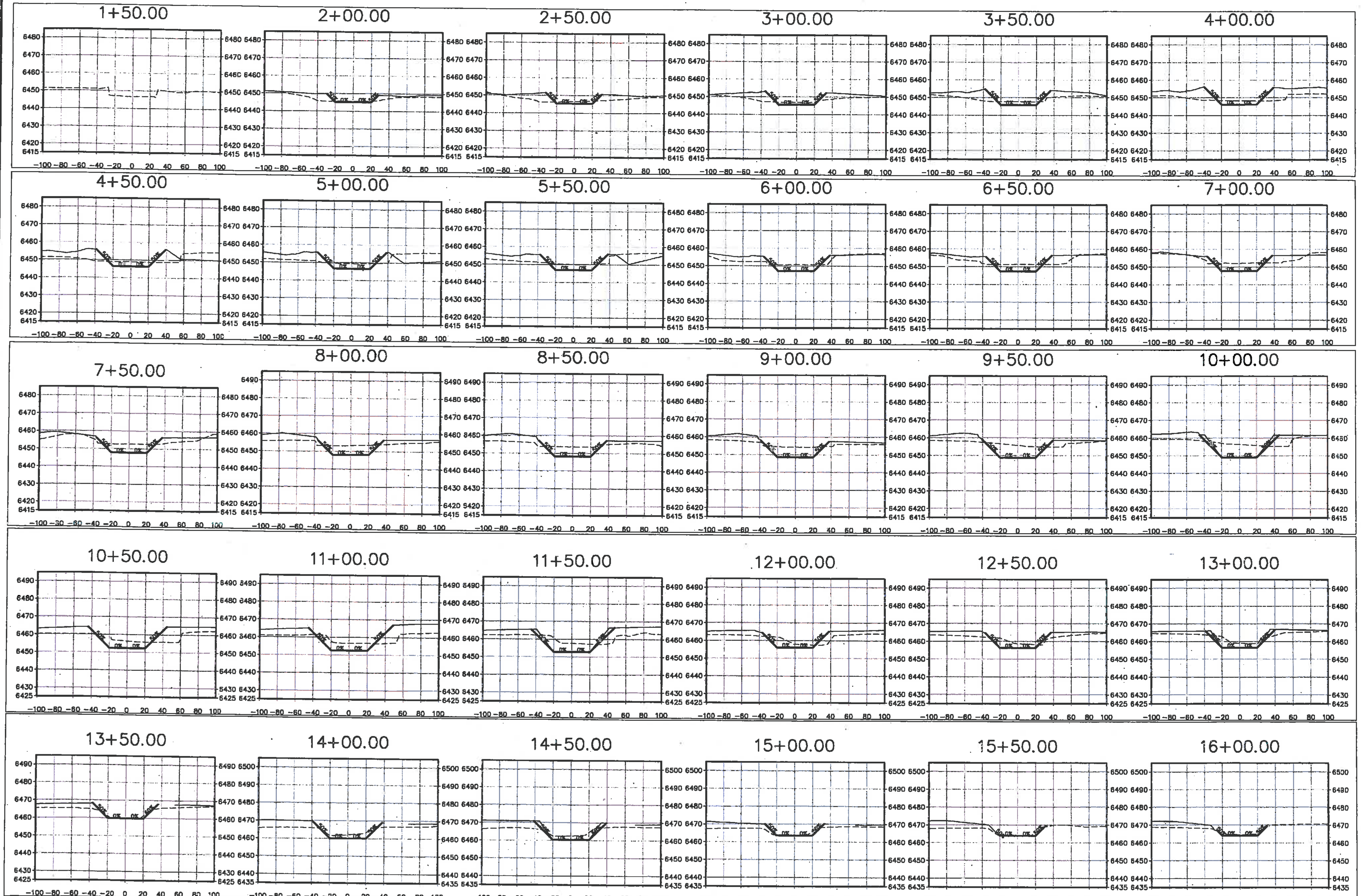
File: O:\43089\VS Rd-Const Aw\eng\Const Dwg\Channel\CH06.dwg Plotstamp: 1/31/2017 2:31 PM



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.

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FOR THE CITY ENGINEER:

DRAINAGE REVIEW:________________ DATE:________________

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

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CAUTION

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

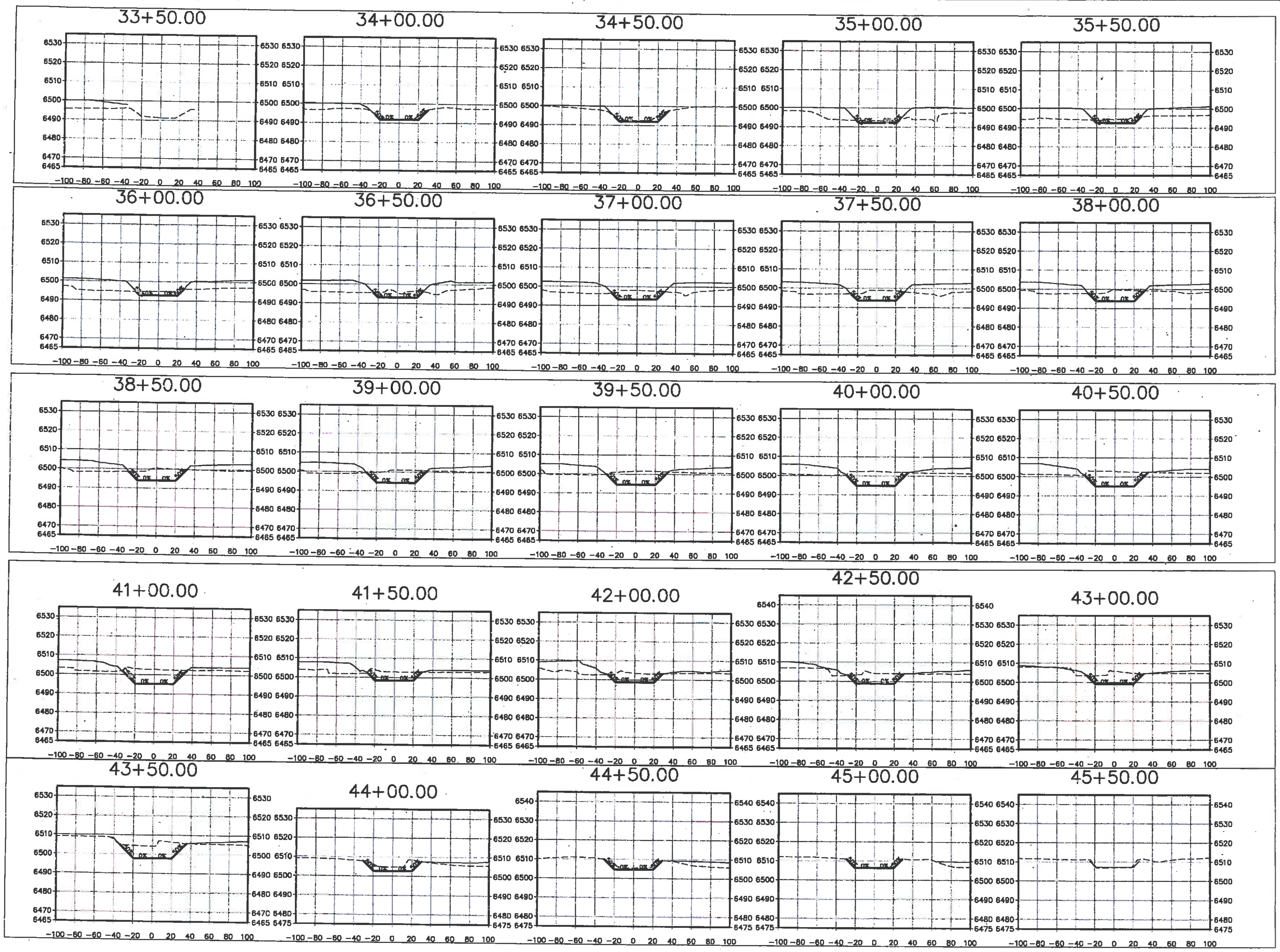
FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.

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

THE SANDS
CHANNEL SECTIONS

PROJECT NO. 43-089
FILE: \dwg\Const Dwg\Street & Storm Plans\CH08.dwg
DESIGNED BY: DLM
DRAWN BY: JWP
CHECKED BY: VAS
SCALE HORIZ: 1"=50' VERT: 1"=5'
DATE: 09/30/2016
SHEET 7 OF 9
CH07

File: G:\43089A\MS Rd-Const Ave\dwg\Const Dwg\Channel\CH08.dwg Plotstamp: 10/10/2016 11:59 AM



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FOR THE CITY ENGINEER:

DRAINAGE REVIEW: ____________________ DATE: ____________

THE SANDS

CHANNEL CROSS SECTIONS

PROJECT NO. 43-089 | FILE: \dwg\Const Dwg\Street & Storm Plans\CH08.dwg

DESIGNED BY: DLM
DRAWN BY: JWP
CHECKED BY: VAS

SCALE
HORIZ: 1"=50'
VERT: 1"=5'

DATE: 09/30/2016

SHEET 8 OF 9

CH08

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

CIVIL CONSULTANTS, INC.

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

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

REVISIONS:

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

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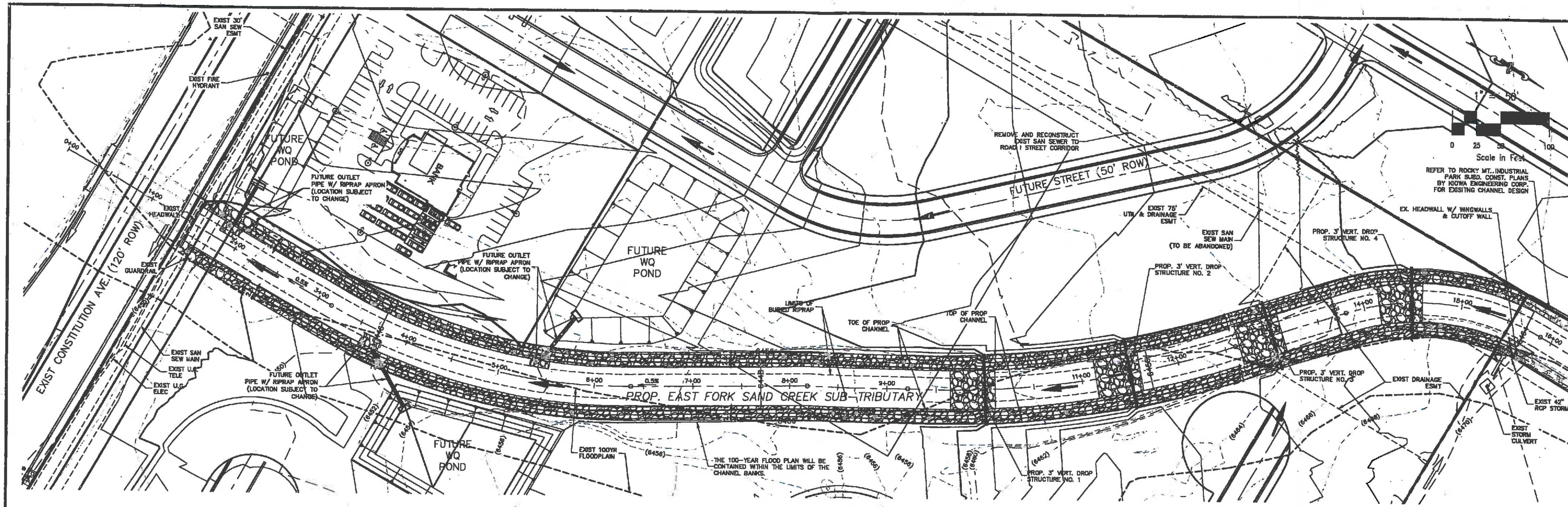
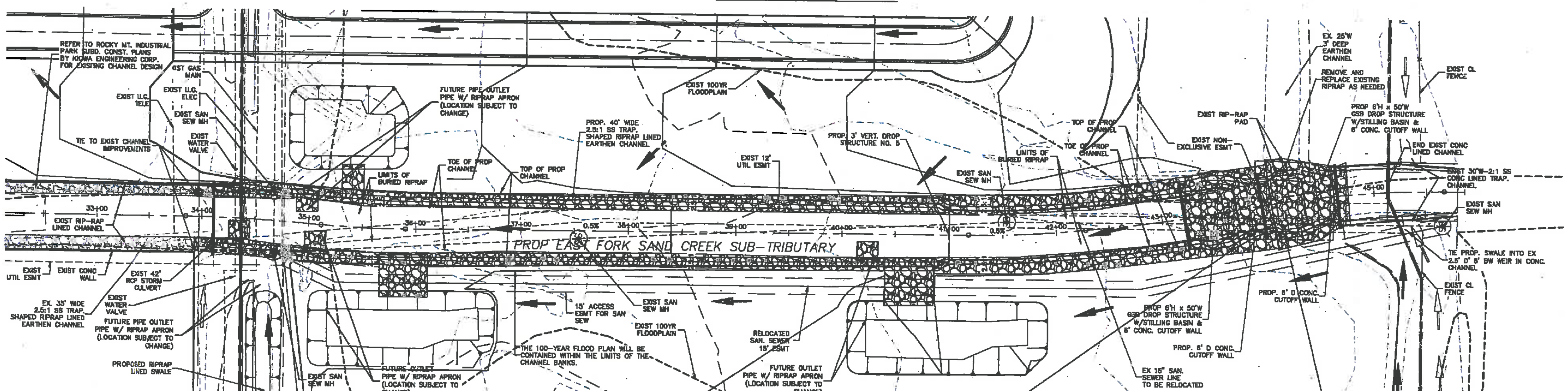
File: O:\43089A\MS Rd-Const Ave\dwg\Const Dwg\Channel\CH09.dwg Plotstamp: 10/10/2016 12:03 PM



EAST FORK TRIBUTARY CHANNEL IMPROVEMENTS
STA 33+50.00 TO STA 46+00.00



EAST FORK TRIBUTARY CHANNEL IMPROVEMENTS
STA 1+00.00 TO STA 15+66.99

LEGEND

xLP/xHP	LOW POINT/ HIGH POINT
—(6920)— —	EXISTING INDEX CONTOUR (10')
— (6918)- - - -	EXISTING NOMINAL CONTOUR (2')
---6920---	PROPOSED PHASE 1 OFFSITE INDEX CONTOUR (10').
---6918---	PROPOSED PHASE 1 OFFSITE NOMINAL CONTOUR (2')
— SF —	SILT FENCE
(IP)	INLET PROTECTION
(SBB)	STRAW BALE DITCH CHECK
(SF)	SILT FENCE
(VTC)	VEHICLE TRACKING CONTROL

LEGEND

	TEMPORARY RIPRAP PAD
(TRM)	TURF REINFORCEMENT MAT (NORTH AMERICAN GREEN SC-250 OR APPROVED EQUAL. SEE MANUFACTURE SPECIFICATIONS FOR INSTALLATION DETAILS)
(SB)	TEMPORARY SEDIMENT BASIN
2.00%	FLOW DIRECTION & SLOPE
	FLOW DIRECTION ARROW
	EXISTING FLOW DIRECTION ARROW
— — - —	PRELIMINARY PLAN BOUNDARY/LIMITS OF DISTURBANCE

STATEMENT:

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FOR THE CITY ENGINEER:

DRAINAGE REVIEW: ____________ DATE: ________

THE SANDS
CHANNEL IMPROVEMENTS

PROJECT NO. 43-089 | FILE: \dwg\Const Dwg\Street & Storm Plans\CH10.dwg

DESIGNED BY: DLM
DRAWN BY: JWP
CHECKED BY: VAS

SCALE: HORIZ: 1"=50' VERT: 1"=5'
DATE: 09/30/2016
SHEET 9 OF 9
CH09

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

CIVIL CONSULTANTS, INC.

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

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

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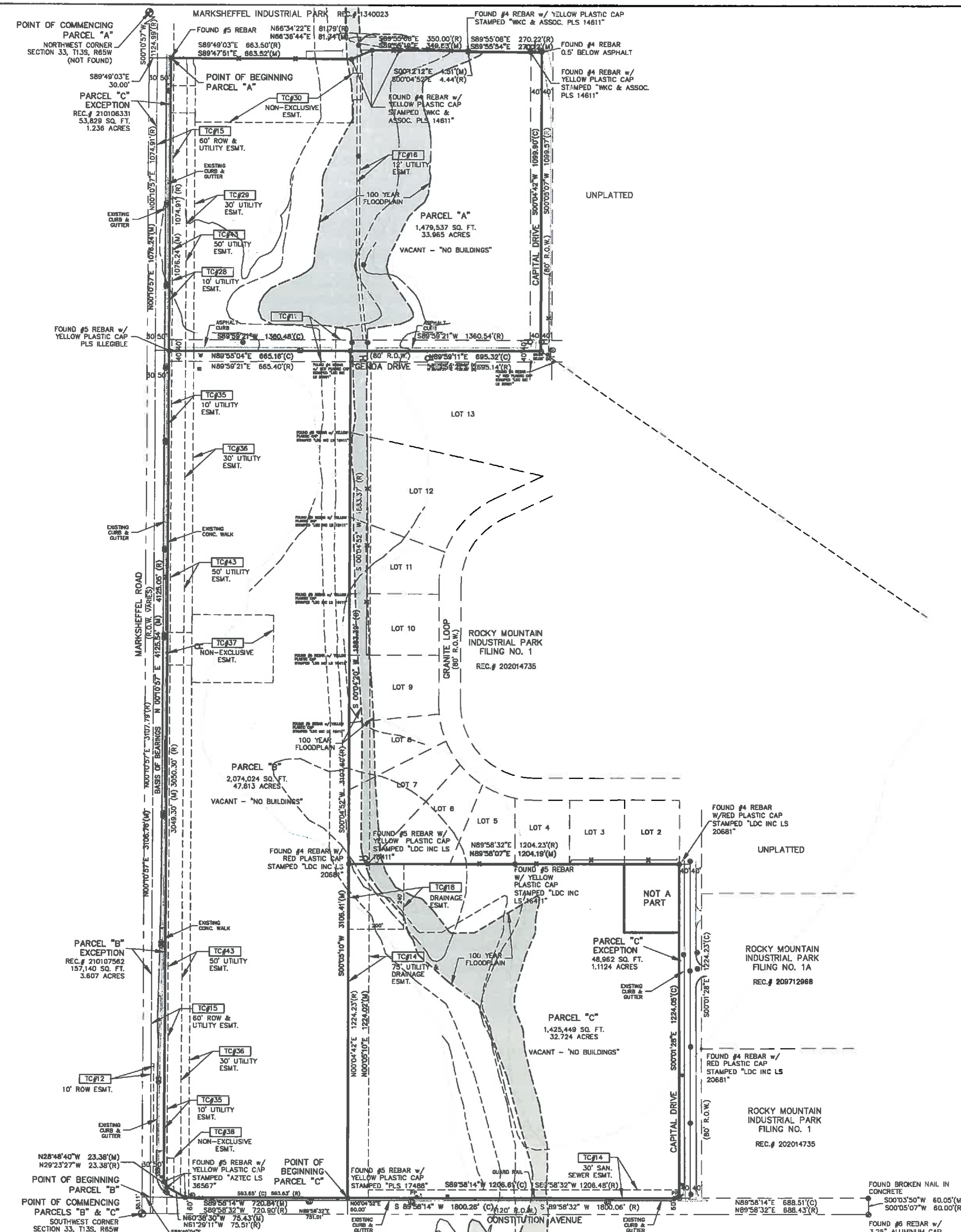
File: O:\43089A\MS Rd-Const Ave\dwg\Const Dwg\Channel\CH10.dwg Plotstamp: 10/10/2016 12:05 PM

BACKGROUND INFORMATION

ALTA/ACSM LAND TITLE SURVEY

A PORTION OF THE WEST HALF OF SECTION 33, TOWNSHIP 13S, RANGE 65 WEST OF THE SIXTH PRINCIPAL MERIDIAN, EL PASO COUNTY, COLORADO



LEGEND

- SET #5 REBAR AND ORANGE PLASTIC CAP STAMPED "PLS 38141"
- FOUND AS NOTED
- FOUND 1 1/2" CAP LS 30118
- TC#15 SCHEDULE B-2 EXCEPTION
- BOUNDARY
- FLOODPLAIN
- EASEMENT
- HYDRANT
- WATER VALVE
- SANITARY SEWER MANHOLE
- CHAIN LINK FENCE
- STREET SIGN
- ELECTRICAL VAULT
- ELECTRICAL MANHOLE
- FIBER OPTIC VAULT
- POWER POLE
- SANITARY SEWER MANHOLE
- STORM MANHOLE
- TELEPHONE PEDESTAL

1" = 200'

0 50 100 200 400

Scale in Feet

FOR REFERENCE ONLY

ALTA/ACSM LAND TITLE SURVEY
JOB NO.
DATE PREPARED: 08/17/15
DATE REVISED: 11/25/15

CIVIL CONSULTANTS, INC.

SHEET 2 OF 2

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, U.S. ARMY CORPS OF ENGINEERS
SOUTHERN COLORADO REGULATORY OFFICE
200 S. SANTA FE AVENUE, SUITE 301
PUEBLO, COLORADO 81003

REPLY TO
ATTENTION OF

October 27, 2017

Regulatory Division

SUBJECT: Nationwide Permit (NWP) Verification – Action No. SPA-2017-00336-SCO, The Sands Land Development – stream channel work in unnamed tributary to East Fork Sand Creek.

Jeff Mark
The Landhuis Company
212 N. Wahsatch Avenue
Suite 301
Colorado Springs, CO 80904

Mr. Mark:

This letter responds to your pre-construction notification for the proposed The Sands Land Development - channel work located at approximately latitude 38.8779 N, longitude -104.6802 W, in El Paso County, Colorado. The work as described in your submittal will consist of grade control, channel realignment and channelization in an unnamed tributary to East Fork Sand Creek. We have assigned Action No. SPA-2017-00336-SCO to this project. Please reference this number in all future correspondence concerning the project.

Based on the information provided, we have determined that the project is authorized by Nationwide Permit No. 209 for Residential Developments. A summary of this permit and the Colorado Regional Conditions are available on our website at http://www.spa.usace.army.mil/Missions/Regulatory-Program-and-Permits/NWP/. Please refer to our website at http://www.spa.usace.army.mil/Missions/Regulatory-Program-and-Permits/Water-Quality-Certification/ for specific information regarding compliance with state water quality certification (WQC) requirements. The permittee must ensure that the work complies with the terms and conditions of the permit, including Colorado Regional Conditions.

Our review of this project also addressed its effects on threatened and endangered species and historic properties in accordance with general conditions 18 and 20. Based on the information provided, we have determined that this project will not affect any federally listed threatened or endangered species or any historic properties listed, or eligible for listing, in the National Register of Historic Places. However, please note that the permittee is responsible for meeting the requirements of general condition 18 on endangered species and general condition 20 on historic properties

This verification is only valid for the project as described in your submittal. Appropriate erosion and sediment controls should be implemented to ensure that construction materials and/or activities do not enter any wetlands or other waterbodies beyond the scope of the authorization. If there are any changes in the project purpose, location, or design, you should contact our office for a reevaluation of Department of the Army permit requirements.

This letter does not constitute approval of the project design features, nor does it imply that the construction is adequate for its intended purpose. This permit does not authorize any injury to property or invasion of rights or any infringement of federal, state or local laws or regulations. The permittee and/or any contractors acting on behalf of the permittee must possess the authority and any other approvals required by law, including property rights, in order to undertake the proposed work.

This permit verification is valid until March 22, 2022 (33 CFR 330.6), unless the nationwide permit is modified, suspended, revoked or reissued prior to that date. Continued confirmation that an activity complies with the terms and conditions, and any changes to the nationwide permit, is the responsibility of the permittee. Activities that have commenced, or are under contract to commence, in reliance on a nationwide permit will remain authorized provided the activity is completed within 12 months of the date of the nationwide permits expiration, modification, or revocation.

Within 30 days of project completion, the permittee must fill out the enclosed Certification of Compliance form and return it to our office. The landowner must allow Corps representatives to inspect the authorized activity at any time deemed necessary to ensure that it is being, or has been, accomplished in accordance with the terms and conditions of the nationwide permit.

If you have any questions, please contact me at (719) 543-6915 or by e-mail at Van.A.Truan@usace.army.mil. At your convenience, please complete a Customer Service Survey at http://corpsmapu.usace.army.mil/cm_apex/f?p=136:4:0.

Sincerely,

TRUAN.VAN.ALL
AN.1231422150

Van Truan
Chief, Southern Colorado
Regulatory Branch

CIVIL CONSULTANTS, INC.

20 Boulder Crescent, Suite 110
Colorado Springs, CO 80903
(719) 955-5485

July 5, 2017

Steve Rossoll
City of Colorado Springs/Water Resources Divisions
30 S. Nevada Ave, Suite 401
Colorado Springs, CO 80901

RE: The Sands Concept Channel Design Concurrence

Dear Mr. Rossoll;

As you are aware "The Sands" development project will improve portions of the Sand Creek East Fork Sub-Tributary. Of the 4400'+/- of channel that traverses the site, approximately 1830' of the reach has been previously improved with the development of the adjacent Rocky Mt. Industrial Park (RMIP) Site, which resides in El Paso County and was approved by El Paso County Development Services in November of 2001.

The remaining 2,545' feet of channel, which is split into two segments by the existing RMIP improvements, shall now be located within the City Limits as a function of the developments planned annexation. As these improvements are public and are to be maintained by the City, the proposed improvements are subject to review and approval by your staff.

The Landuis Company and M&S Civil Consultants had previously met with City personal and had recommended that the proposed channel improvements for two (unimproved) segments of channel should closely mimic those improvements which have been constructed with the Rocky Mountain Park site, thereby bringing uniformity to the subject reach.

As discussed in meetings with City staff (during the Jan/Feb 2017 time period) incorporation of this previous design would function to safely convey runoff thru the development, however would not meet all current City of Colorado Springs Drainage Criteria and thus potentially could require additional maintenance after larger storm events. After the meetings, and submittal of a technical design memorandum and concept plans, it was discussed that M&S Civil would prepare an additional memorandum which determines the specific deviations from the current City of Colorado Springs Drainage Criteria, and referral documents (Urban Drainage Flood Control District Drainage Critiera Manuals) that would occur as a result of utilizing the past construction practices.

The following paragraphs will briefly outline the existing channel conditions, the DBPS recommendations, the elements of the existing and proposed construction as well as the applicable criteria of the El Paso County, City of Colorado Springs and when necessary Urban Drainage and Flood District Drainage Manual. The list is not considered all inclusive for channel design, but is considerably sufficient to evaluate concept design and potential deviations.

The ultimate goal of this submittal is to obtain concurrence from the City of Colorado Springs Engineering Developments Services regarding the enclosed concept design (see attachment), thereby allowing for the continuation of subsequent preliminary and final engineering documents and a concurrent submittal to Federal Emergency Management Agency as part of the required CLOMR/LOMR process. Please refer to the previously submitted memorandum for additional information.

Sincerely

Darin L. Moffett, P.E.

Existing Unimproved Channel (see attached photos)

- 2700' at ~1.2% slope
- Bottom width ranges from 35' to 110', average ~ 75'
- Incised channel, w/aggredation present
- Est. Vel ~ 10.4 fps in 100-year

DBPS Flow Rates and Recommendations (see attached documents)

- Design flow rates of 1720 cfs (100-yr) and 580 cfs (10-yr)
  - Of note, FEMA FIS flow rate = 1920 cfs or 1900 cfs
- Design Slope of 1.1%
- Trapezoidal Channel w/35' bottom width
- 100-yr riprap linings
- Depth of flow = 4'
- Four (4) vertical drops (3' + 1' Depression) below Genoa Drive
- Two (2) vertical drops (3'+ 1' Depression) and one (1) check upstream of Genoa Drive
- Two 6'h x 14'w box culvert crossing at Genoa Drive

Existing Channel Improvements (elements to generally mimic)
(Rocky Mt Industrial Park)

- 1,830' improved, Hard Lined – Soft Bottom Channel
- Trapezoidal shape – 35'w sand bottom w/ riprap lined 2.5:1 side slopes atop Mirafi
- 1.2% channel slope
- Two (2) 3' concrete vertical drop structures w/3' thick riprap aprons
- Three (3) riprap check structures
- Access easements provided (along east side)

Proposed Channel Improvements (see attached concept plans)

- 2,545' improved, (1,415' North & 1,130 South) Hard Lined – Soft Bottom Channel
- Hard Lined – Soft Bottom Channel - Trapezoidal shape
- Depth of flow = 5'+/-
  - 40'w sand bottom w/ Soil riprap lined 2.5:1 side slopes atop Mirafi
  - Type 'M' Soil Riprap
  - 3'-5' Toe below sand bed
  - 0.5% channel slope
    - protected to a minimum resultant slope of 0.22% w/structures
- Two (2) GSB drop structures
  - To be designed in accordance with Simplified Procedure of UDFCD
  - 50'wide
  - 6:1 Sloped Face
- Two (2) 3' concrete vertical drop structures
  - Grouted Riprap Basin
  - Concrete cutoff wall
  - 36" Type 'M' Riprap Aprons w/toe protection
- Two (2) riprap check structures
  - 1' Concrete wall
  - Type 'M' Riprap apron w/ toe protection
- Access along channel with two (2) paths to bottom of channel
- Crossing at Genoa (Two 6'h x 14'w box culvert) Not to be constructed

General Design Considerations

- Not a natural channel or a channel restoration project, but rather a constructed flood conveyance structure
- Create a uniform channel design from top to bottom of project
- Lower slope to create additional hydraulic separation between channel and site.

<u>Applicable Design Criteria List</u>

<u>City of CS/El Paso Country Drainage Criteria Manual (Nov 1991)</u>
Design Parameters:

<u>Natural Unlined Channels (Table 10-3)</u>

- Maximum Velocity - (Coarse Sand/Fine Gravel) 4.0-5.0 ft/s

Side Slopes (10.5.1)

- **Slopes** flatter than the angle or repose

Depth (10.5.2)

- Maximum Channel Depth 5.0 ft (channels less than 1500cfs)

Bottom Width (10.5.3)

- Bottom Width (for channels = to or less than 1500cfs) min. 2* depth or 8' for channels less than 400cfs

Low Flow Channel (10.5.4)

- Required where erosion of the bottom of the channel appears to be a potential problem

Freeboard (1.4.2) & (10.5.5)

- Freeboard FBH= 1.0 + 0.025 (v) (d^0.33)
  Min 1' above estimated 100 year WSE

Superelevation (10.5.6)

- Superelevation SH=(C(v^2)W)/(g R)
  Where (C=0.5 (sub) or 1.0 (super))
- Transition (Normal to Super) 2*width of channel
- Alignment Radius 3*top width or 100'

Supercritical Flow (10.7)

- Froude attempt to avoid F>1

Vertical Drops (10.8.5)

- Height Height less than 4 ft

Sloped Drops (10.8.8)

- Loose Riprap Sloped Drops Structures Height < 4 ft,
  - Filter material provided
- Recommended face slope 6:1 to 10:1
- Grouted Riprap Slope Drop Structures Height 4 ft to 12 ft

Ditch Checks (10.8.9)

- Should only be provided in ditch sections
    - Recommended in DBPS, general construction identified in DBPS

Sizing Riprap (10.10.2)

- Linings (Riprap) — VS^0.17/(Ss-1)^.66 (valid for Froude No. < 0.9)

Scour

- Design guidelines and criteria for channels and hydraulic structures on Sandy soil, Simon & Li and Associates June 1981

Riprap Lined Slopes (Figure 10-20) — 2.5:1 or flatter than repose angle

- Channel lining
    - Side slopes (Riprap) — steep as 2.5:1(check repose angle)
    - Toe Protection (Riprap) — 3 ft below bed; 1 ft above 100-yr
    - Thickness — 2*d50 above channel bed; 3*d50 below channel bed

<u>City of Colorado Springs Drainage Criteria Manual - Chapter 12 - Open Channels (2014)</u>

(Seven steps for recommended design <u>natural channels</u> does not apply)

Design Parameters:

Natural Unlined Channels (Table 12-3)

- Maximum 100-yr Velocity (Sandy Bottom/Poor Vegetation) — 5.0 ft/sec
- Froude No. 100–yr — 0.6
- Maximum Tractive Force (shear) — 0.6 lbs/sf

Channel Slope (3.1.2)

- Grade Control Structures to be laid out using the low flow channel slope (Figure 12-4) ~ 2000 cfs = 0.2% design slope
- (Measured from the lowest crest elevation of the downstream structure to the toe of the face of the upstream structure)

Stabilize banks Using Riprap Bank Protection (3.1.4)

- Design in accordance with UDFCD Volume 1
- All riprap bank protection shall consist of soil riprap that is buried with topsoil and vegetated.

Freeboard (3.1.5)

- At bends shall take into account super elevation calculated in accordance with UDFCD Volume 1
- Freeboard shall be contained within a floodplain tract and/or easement

Riprap Lined Channels (3.2.6.1)

- Design in accordance with UDFCD Volume 1 (not specific if this assumes full lining)

Design Flow Freeboard (3.3)

- Minimum (1) one foot freeboard on all channels,
- Additional freeboard determined as described in UDFCD Volume 1

Grade Control Structures (4.0)

- The maximum drop height for constructed channels shall be 6 feet
- Additional Guidance on Design in UDFCD Volume 2

Constructed Channel Drop Structures (4.2.2)

- The maximum height shall be 6 feet

Drop Structure Types (4.3)

- Grouted Sloping Boulder – designed in accordance with UDFCD
- Vertical Drops = Maximum Height = 2 feet
- Discourage Cast in place vertical waslls or sheet pile

Drop Structure Placement (4.4)

- Drop Structures must extend below the design slope to provide protection from scour and long-term degredation

Easements (6.0)

- Contain freeboard
- For slopes steeper than 4:1
  - from toe of slope + 15' for access road
    - (This may be appropriate for unprotected banks?)

Access (7.0)

- Along entire length of channel
- 8' wide, 12' clear width for radius of >80' 14'w radius of 50' to 80'
- Longitudinal Slope = 10%

<u>Urban Drainage and Flood Control District Manual – Chapter 8 – Open Channels (March 2017)</u>
Design Parameters

Freeboard (3.2)

- Recommends 18" or more of freeboard for new developments

<u>Natural Unlined Channels (Table 8-3)</u>

• Maximum 5-yr velocity (within bankfull channel width)	5 ft/sec
• Maximum 100-yr velocity (within bankfull channel width)	7 ft/sec
• Froude No. 5-yr (within bankfull channel width)	0.7
• Froude No. 100–yr (within bankfull channel width)	0.8
• Maximum shear stress (within bankfull channel width)	1.2 lbs/sf
• Maximum longitudinal slope of low flow channel	0.2 percent
o (assumes unlined un-vegetated low flow channel)	
• Minimum radius of curvature	2.5*Tw

Roughness (7.2.3)

Sand bed invert n value n= 0.03 (table 8.5 UDFCD)
Riprap lining n value = 0.039 d50^(1/6) assuming (1') n=0.39 ~ 0.04

Values used

<u>Velocity/Froude/Shear/analysis</u>

Sand Bed = 0.03 (Riprap lining (bttm of channel 0.40 used /side of channel 0.50 used)

<u>WSE/Depth Analysis</u>

Sand Bed =0.04 (Riprap lining (bttm of channel 0.45 used /side of channel 0.55 used)

Rock and Boulders (8.0)

- "Soil riprap is intended for use in application where vegetative cover can be established and where the shear stress imposed by frequent occurring flows"

- "In areas where it is difficult to establish vegetation, Void filled riprap is better able to resist the direct prolonged impingement of water on the riprap installation

Riprap Channel Lining (Mild Slope Conditions) (8.1.1)

- D_{50} >/= (VS^0.17)/4.5(G*S-1) where slopes are less than 2% and flow is subcritical
- At terminus channel lining thickness should increase to 50% for at least 3 feet to prevent undercutting
- Figure 8-34 – illustrates that channel lining should be toed down a min of 3 feet
  - (5 feet where soil are not cohesive)

Riprap Channel Lining (Steep Slope Conditions) (8.1.2)

-

Boulders (8.2.1)

- Stacked over 6 feet high require structural design

Soil riprap (8.2.2)

- Place 4" – 6" of topsoil on top of soil riprap

<u>Urban Drainage and Flood Control District Manual – Chapter 9 – Hydraulic Structures (Volume II, March 2017)</u>

Design Parameters:

General Considerations (2.0)

- Limit drop height to 5 feet or less
- Vertical Drops should not exceed 3 feet at any location

Criteria to meet simplified design (2.21)

- Drop Structure is 35 cfs/ft or less
- Net drop height is 5 feet or less
- Drop structure is constructed of GSB or SC
- Drop structure is located within a tangent section
- Drop structure located at least 2x width of the drop from a point of curvature
- Drop structure is located in a reach that has been evaluated per the design requirements of the Open Channels Chapter

Simplified Design Criteria (2.2) – Grouted Boulder Drop Structure

- Maximum Net Drop Height (Hd) 5 feet
- Maximum Unit Discharge over any portion of Drop width 35cfs/ft
- Maximum Longitudinal Slope (steepest Face) 4(H):1(V)

• Minimum Stilling Basin Depression	1 foot (Sec 2.26)
• Minimum Length of Approach Riprap (La)	8 feet
• Minimum Stilling Basin Length (Lb)	Figure 9.1
• Minimum Stilling Basin Width (B)	same as crest width
• Minimum Cutoff Wall Depth	6 feet (or Sec 2.26)
• Minimum Length of Riprap Downstream of Stilling Basin	10 feet
• Minimum D_{50} for Approach and Downstream Riprap	12 inches
• Minimum Boulder Size for Drop Structure	Figure 9.1

Stilling Basin (2.2.5)
In non cohesive soil channel and channel where future degradation is expected recommendation for elimination of stilling basin and sloping face be extended 5 feet below the downstream future channel invert elevation (after assumed degradation)

Manning's Roughness Coefficient for Drop Structures (2.3.3)

- n= (0.097(Y/D)^0.16)/(LN(2.55Y/D)

Values used for Grouted Boulders
<u>Velocity/Froude/Shear/analysis</u>
n= 0.05 bttm of channel, n = 0.06 sides of channel
<u>WSE/Depth Analysis</u>
n= 0.06 bttm of channel, n = 0.07 sides of channel

Weep drains (2.42)
- not required less than 5' net height

Boulder Sizing (2.6.3)
- Rp=(VS^0.17)/((Ss-1)^0.66)
- Results: B36 in bttm, B18 on sides
- UDFCD recommends one size for entire drop

Grout (2.63)
- In accordance with Figure 9-15, design assumes ½ depth

Edge Wall (2.63)
- 3' below the top surface of the structure that extends around the entire parameter of the structure. (Figure 9-22)

Vertical Drop Structure (2.8.1)
- limited to 2 ft (downstream invert to upstream invert)
- 1 ft deep stilling basin
- Should be limited to channels with less than 500 cfs and less than 35 cfs/ft

Please see the attached matrix for a summary of where the proposed channel can meet or will not meet El Paso County, City of Colorado Springs, and Urban Drainage and Flood Control Criteria.

In some conditions, guidance is unclear or not applicable and has been marked as such.

The Sands Channel Improvements

Design Criteria	Meets County Standards			Comments	Meets City Standards			Comments	Meets UDFCD Standards			Comments
	Yes	No	Unclear or N/A		Yes	No	Unclear or N/A		Yes	No	Unclear or N/A	
General Design												
Alignment Radius	X			Greater than 3*TW			X	Not specifically defined for Constructed Channels, Refer to UDFCD	X			Not specifically defined for Constructed Channels, 2.5*TW (Natural channels)
Bottom Width	X			At least 2 * design flow depth			X	Not specifically defined, more defined around achieving permissible velocities. Refer also to UDFCD, (Proposed bw closely matches upstream and downstream channels)			X	Not specifically defined for Constructed Channels, Based upon limiting depth and velocity
Slope		X		Not specifically defined, more defined around permissible velocities	X			Defined around permissible velocities & Table 12-4 or Sediment transport analysis, min slope = 0.05% (Proposed 0.5%, w/structures stable to less than projected slope of 0.22%), Existing channels are 0.64% and 1.2%, UDFCD recommended 1.1%)			X	Not specifically defined for Constructed Channels, Urban drainage recommends slopes between 0% and 0.2% for Unlined Natural Channels
Possesses Low Flow Channel			X	Low Flow Channel required if erosion in the bottom appears to be a problem			X	Maybe needed where sediment load passage is required and in Natural Channels. Required for Natural Channel Design, (Proposed Channel lacks L.F. channel due in part to consolidation and heavy movement of material)			X	Recommends bankfull channel for Natural Stream or Restored channels (not applicable with this project)

The Sands Channel Improvements

Design Criteria	Meets County Standards			Comments	Meets City Standards			Comments	Meets UDFCD Standards			Comments
	Yes	No	Unclear or N/A		Yes	No	Unclear or N/A		Yes	No	Unclear or N/A	
Natural Channel (Bottom)												
Depth	X			< 5' max depth for 100 year for Q=1500 cfs or less (channel is 1720 cfs)			X	Not specifically defined, more defined around permissible velocities, Refer to UDFCD Standards	X			5' max depth for 100 year outside of Bankfull channel
5-Year Velocity			X	Not Specifically Discussed			X	Not Specifically Discussed		X		5 feet/sec (proposed is 5-7 feet/sec, high as 9'/s)
100-Year Velocity		X		4 - 5 feet per sec allowed		X		5 - 7 feet per sec		X		5-7 feet per sec (Typically proposed xs avg is 8-9'/s, high as 15'/s)
5-Year Froude Number	X			Not Specifically Discussed, try to avoid Froude # >1			X	Not Specifically Discussed		X		0.7, doesn't specify outside bankfull (proposed ranges from 0.7 to 1.0)
100-Year Froude Number	X			Not Specifically Discussed, try to avoid Froude #>1		X		0.6 (Unlined/Erosive Soils)		X		0.8, doesn't specify outside bankfull area (proposed ranges from 0.8 to 1.4)
100 year Shear			X	Not Specifically Discussed, design based upon permissible velocity		X		0.6 lbs/sf (Unlined/Erosive Soils) (Proposed 1.3 in flat sections. 3.4 in 250' curve, high as 7.5 below drops		X		1.2, doesn't specify outside bankfull area
Freeboard	X			FB > FBH + SHE, see table (min 1' above 100 year WSE)			X	All channels a minimum of 1 foot, Also refers to UDFCD FB & SE calculation which is no longer in UDFCD manual, Freeboard should be contained within tract or easement		X		18" Minimum, (currently only a few places in Proposed design not anticipated meet criteria, will revise)
Transition (Normal Section to Superelevation Section)	X			2* width of Channel (Proposed Slope Protection is constantly higher than FB w/SE Requirement)			X	Not Specifically Discussed, Riprap Lining however to be designed according to UDFCD			X	Not Specifically Discussed

The Sands Channel Improvements

Design Criteria	Meets County Standards			Comments	Meets City Standards			Comments	Meets UDFCD Standards			Comments
	Yes	No	Unclear or N/A		Yes	No	Unclear or N/A		Yes	No	Unclear or N/A	
Channel Lining												
Material	X			Riprap with bedding material and filter fabric (Doesn't discuss soil riprap lining)	X			All riprap bank protection shall consist of soil riprap buried with topsoil (Require City Input on Material)	X			Soil Riprap where vegetation can be established, void filled is better to resist the direct prolonged impingement of water on the riprap installation
Size of Riprap (Mild Slope Analysis)			X	VS^0.17/(Ss-1)^.66 (valid for Froude # < 0.9) (Proposed design Froude # exceeds 0.9 in several locations - See table)		X		Design in accordance w/UDFCD (see table)	X			D50 >/= ((VS^0.17)/4.5(G*S-1))^2 for Mild Slopes <2%, states valid for subcritical flows, (Proposed design is supercritical in some locations, outside of drop faces, note that proposed design matches existing channel section utilizing 'Type M' riprap), Proposed Vert Drop Basins are Grouted
Angle of Repose/Side Slope	X			38 < (39.5-41.8) therefore Stable (degrees) < 2.5:1	X			Design in accordance w/UDFCD	X			2.5:1 max (proposed channel lining matches)
Height	X			1.0' above 100 Yr WSE	X			To where Tractive Forces are acceptable for Natural unlined channels (CSDCM Table 12-3) (Proposed channel extends protection a Min of FB height above 100yr WSE)			X	Not certain is defined in critieria
Toe Protection	X			3.0 below channel bottom or Scour Depth		X		Design in accordance w/UDFCD		X		3.0' below channel bed (non erosive soils) 5.0' below channel bed (erosive soils) (proposed 3' toe down below 0.22% slope = depth varies 3-4.5' below proposed 0.5%)
Thickness		X		2*D50 above channel bed 3*d50 below channel bed	X			Design in accordance w/UDFCD	X			2*D50 above and below channel bed
Granular Bedding	X			Requires 6" Type II Bedding, (Upgrade from existing design)	X			Design in accordance w/UDFCD	X			Requires Bedding with Soil riprap, Does not with Void Filled
Filter Fabric	X			Recommends if soils require (Upgrade from existing design)	X			Design in accordance w/UDFCD	X			Not Required (May be added in final design)

The Sands Channel Improvements

Design Criteria	Meets County Standards			Comments	Meets City Standards			Comments	Meets UDFCD Standards			Comments
	Yes	No	Unclear or N/A		Yes	No	Unclear or N/A		Yes	No	Unclear or N/A	
Structures												
Location (in alignment)			X	Not Specifically discussed		X		Not Specifically Discussed, Refer to UDFCD		X		Drops Structure not recommended in curves or within 2xTW from PC (Proposed drops occasionally located in large curves)
Location (channel grade)		X		Spacing based upon slope to provide permissible design flow velocities	X			If no sediment transport analysis, achieve slope defined by Figure 12-4 and Refer to UDFCD		X		Placement related to equilibrium slope, cross sectional capacity and drop structure height, Equilibrium Slope estimated between 0 and 0.2% (proposed channel provides hard points to nearly 0%, but not graded at 0-0.2%)
General Structure Width			X	Not Specifically discussed, References UDFCD	X			Full Width Structures required where velocities exceed non-erosive levels	X			Full Width Structures required where velocities exceed non-erosive levels
General Structure Height			X	Not Specifically discussed, References UDFCD	X			6' max	X			5' Net drop or less, 3' or less for Vertical drops

The Sands Channel Improvements

Design Criteria	Meets County Standards			Comments	Meets City Standards			Comments	Meets UDFCD Standards			Comments
	Yes	No	Unclear or N/A		Yes	No	Unclear or N/A		Yes	No	Unclear or N/A	
GSB Drop Structures												
Width, Design Flow/ft			X		X			Design in accordance w/UDFCD	X			Simplified design limits discharge to 35 cfs/ft (proposed design matches this, request City to accept simplified design, despite exceeding a few criteria, such as drops in curve)
Drop Face Slope	X			6:1 to 10:1	X			Design in accordance w/UDFCD	X			4:1 max, (proposed design 6:1)
Drop Height	X			Loose Riprap 4' or less			X	6' max., Table 12-7 applies to stabilized natural channels/constructed natural channels, additional guidance provided by UDFCD	X			5' max (net), (proposed < 5')
Length/Depth/Material of U/S Apron			X	Design procedure not well defined, refer to UDFCD/McLaughlin Water Engineers	X			In accordance w/UDFCD	X			8' min. length, 12" min d50. or larger soil or void filled riprap, size using UDFCD Channel Lining Equation, (Proposed rock will be sized per UDFCD, limit to 8' long)
Cutoff Wall			X	Design procedure not well defined, refer to UDFCD/McLaughlin Water Engineers		X		In accordance w/UDFCD		X		6' or Section 2.26 or Section 2.4, (Proposed design to limit to 6' deep 1'wide concrete wall despite potential for non cohesive soils)
Length/Depth/Material of Basin			X	Design procedure not well defined, refer to UDFCD/McLaughlin Water Engineers	X			In accordance w/UDFCD	X			Figure 9.1 for Boulder size and Length, recommends eliminating lower stilling basin, extend face 5' below future channel bed (Proposed length, size, per table 9-1 proposed design retains lower stilling basin, but extends toe)
Length/Depth/Material of D/S Apron			X	Design procedure not well defined, refer to UDFCD/McLaughlin Water Engineers	X			In accordance w/UDFCD	X			10' min. length, 12" min d50. or larger soil or void filled riprap, size using UDFCD Channel Lining Equation, (Propcsed will be sized per UDFCD, limit to 10' long)

The Sands Channel Improvements

Design Criteria	Meets County Standards			Comments	Meets City Standards			Comments	Meets UDFCD Standards			Comments
	Yes	No	Unclear or N/A		Yes	No	Unclear or N/A		Yes	No	Unclear or N/A	
Vertical Drop Structures												
Width, Design Flow/ft		X		Channel typically same width above and below drop (Figure 10-11)			X	No design data, would assume refer to UDFCD,		X		Other drops recommended for flows > 500 cfs, Limits unit discharge from vertical structures to 35 cfs/ft (proposed channel 38 cfs outer banks - 48 cfs, 10' center depression) (Proposed design mimics existing design)
Drop Height	X			4' Max		X		2' Max	X			3' Max. (proposed design uses 3' max, 2.5' at center of channel for 10')
Length/Depth/Material of U/S Apron			X	Design procedure not well defined for non-concrete hard basin vertical drops, refer to UDFCD/McLaughlin Water Engineers			X	No design data, would assume refer to UDFCD,		X		8' min length, soil or void filled riprap apron, thickness 2*D50, Riprap Sized per UDFCD Channel Lining Equation (proposed 10' length Type M, 3' thick, soil riprap atop 6" granular bedding and Filter Fabric)
Cutoff Wall			X	Design procedure not well defined for non-concrete hard basin vertical drops, refer to UDFCD/McLaughlin Water Engineers			X	No design data, would assume refer to UDFCD, mentions that grouted boulder face is preferred over concrete or sheet pile due to aesthetics	X			Detail shows concrete cutoff Wall, UDFCD states to be structurally designed (proposed design to mimic existing design, will check structural design to ensure compliance)
Length/Depth/Material of Basin			X	Design procedure not well defined for non-concrete hard basin vertical drops, refer to UDFCD/McLaughlin Water Engineers			X	No design data, would assume refer to UDFCD		X		Sized to contain jump, basin made of 18" min Grouted boulders, Includes GB Sill and Baffle boulders, Allows for both Depressed and Free Draining Basins (Proposed design shows 35' long basin, may be slightly less than 40'-45' to meet UDFCD criteria, proposed design use grouted 12" riprap vs. 18" min. boulders, no formal sill, or soil riprap beyond sill
Length/Depth/Material of D/S Apron			X	Design procedure not well defined for non-concrete hard basin vertical drops, refer to UDFCD/McLaughlin Water Engineers			X	No design data, would assume refer to UDFCD		X		10' min length, soil or void filled riprap apron, thickness 2*D50, Riprap Sized per UDFCD Channel Lining Equation (proposed incorporated into still pad)

The Sands Channel Improvements	Meets County Standards			Comments	Meets City Standards			Comments	Meets UDFCD Standards			Comments
Design Criteria	Yes	No	Unclear or N/A		Yes	No	Unclear or N/A		Yes	No	Unclear or N/A	
Check Structures												
Location			X	Does not detail large scale rock check structures. Smaller should be provided only in roadside ditches only	X			No design data, would assume refer to UDFCD,	X			As needed to maintain overall channel stability, should not exceed a 3' vertical drop, once degraded to future slope (Assumes some maintenance may be needed)
Design			X	Refers to roadside ditches, Smaller checks include concrete wall			X	No design data, would assume refer to UDFCD,			X	Most discussion around low flow channel checks, Sheet pile perferred to concrete, provide riprap aprons, (proposed design lose riprap, concrete wall can be incorporated with final design at city request (proposed design mimics existing checks, but with additional toe down to meet channel lining)
Access												
Location			X	Not discussed in open channels chapter	X			Along entire length of channel, (proposed design provides full length access, and enters channel at upper and lower section)			X	Proposed design will used CSDCM Criteria
Width			X	Not discussed in open channels chapter	X			8' min (12' clear)			X	Proposed design will used CSDCM Criteria
Slope			X	Not discussed in open channels chapter	X			10 % longitudinal			X	Proposed design will used CSDCM Criteria
Material			X	Not discussed in open channels chapter	X			6" of CDOT Class 2 Road base (Proposed Design will hardscape Trail below 100 year + FB where applicable)			X	Proposed design will used CSDCM Criteria
Easements												
			X	Not specifically discussed, Requires access to be provided to public drainage facilities for maintenance	X			Contain freeboard, allow for access			X	Proposed design will used CSDCM Criteria
Outfalls from Site to Channel												
Outfall Protection	Design to be furthered with site development											

EAST FORK SAND CREEK SUB-TRIBUTARY
REQUIRED CHANNEL DEPTH TABLE
(USING HEC-RAS MODEL OUTPUT)

H1=1.0+0.025*V*D^0.33 CSDCM EQN. FOR CHN FREEBOARD

KNOWN
Q100=1720CFS, SS=2.5:1, BW=40,

H4=C*V^2*TW/(G*R) CSDCM EQN. FOR CHN SUPERELEVATION FREEBOARD
C= 0.5 (SUB) C= 1 (SUPER)

* Top Width and Depth Values taken from WSE, Depth Model HEC-RAS model
** Avg Channel Velocity values taken from Velocity, Shear, Froude Model
*** Address with Final Design

R1 600 R2 2200 R3 940 R4 250 R5 1380 R6 1000 R7 1010 R8 1000 R9 1000

STATION		SLOPE %	AVERAGE VELOCITY (across channel) ** (FT/S)	SUPERCRITICAL FLOW C=1.0, IF N C=2.0, IF Y (Y/N)	TOP WIDTH * (FT)	RADIUS AT CL (FT)	MAX CHANNEL DEPTH * W/O SUPER H1 (FT)	REQUIRED FREEBOARD H2 (FT)	MINIMUM CHANNEL DEPTH W/ FREEBOARD AND INSIDE CURVE H3 (FT)	ADDITIONAL FREEBOARD DUE TO CURVATURE H4 (FT)	MINIMUM REQUIRED HEIGHT ALONG OUTSIDE OF CURVE H5 (FT)	HEIGHT PROVIDED ALONG WEST SIDE OF CHANNEL H6 (FT)	HEIGHT PROVIDED ALONG EAST SIDE OF CHANNEL H7 (FT)	18" OF FREEBOARD
4800		0.64	11.00	N	45.01		5.00	1.47	6.47	N/A	N/A	7.6	7.6	YES
4700		0.64	10.90	N	45.01		5.03	1.46	6.49	N/A	N/A	7.6	7.6	YES
4600		0.64	11.01	N	45.32		5.11	1.47	6.58	N/A	N/A	7.6	7.6	YES
4566.35	PT	0.64												
4505		0.5	13.96	Y	53.37	1000	2.67	1.48	4.15	0.32	4.48	6.0	6.0	YES
4405		0.5	7.42	N	63.51	1000	4.70	1.31	6.01	0.05	6.06	7.2	5.3	YES RES/NO INDU ***
4361.97	PCC	0.5												
4309		0.5	7.94	N	64.28	1000	4.86	1.33	6.19	0.06	6.26	8.7	6.7	YES
4261.93	PC	0.5												
4227.87	PT	0.5												
4225		0.5	7.86	N	63.83	1010	4.77	1.33	6.10	0.06	6.16	9.1	6.2	YES
4118.08	PC	0.5												
4121		0.5	9.10	N	60.73		4.15	1.36	5.51	N/A	N/A	7.7	5.7	YES
4100		0.5	16.13	Y	41.08		3.22	1.59	4.81	N/A	N/A	10.4	8.7	YES
4055		0.5	8.02	N	64.79		4.96	1.34	6.30	N/A	N/A	10.9	8.9	YES
3950		0.5	7.98	N	64.83		4.97	1.34	6.31	N/A	N/A	10.8	9.2	YES
3800		0.5	7.99	N	64.74		4.95	1.34	6.29	N/A	N/A	9.8	9.0	YES
3650		0.5	7.82	N	64.78		4.96	1.33	6.29	N/A	N/A	8.6	11.0	YES
3590.34	PT	0.5												
3500		0.5	7.48	N	64.75	1000	4.95	1.32	6.27	0.06	6.32	8.5	7.7	YES
3498.64	PCC	0.5												
3392.52		1.2	7.37	N	63.79	1380	4.76	1.31	6.07	0.04	6.11	8.2	6.2	
3372.09	PC	1.2												
3342.52		1.2	9.65	N	55.65		4.13	1.39	5.52	N/A	N/A	6.0	5.0	YES RES/NO INDU
3252		1.2	11.33	Y	55.67		4.13	1.45	5.58	N/A	N/A	6.0	5.0	YES RES/NO INDU
										N/A	N/A	6.0	5.0	YES RES/NO INDU
1752		1.2	9.86	Y	56.35		4.27	1.40	5.67	N/A	N/A	6.0	5.0	YES RES/NO INDU
1602		1.2	11.51	Y	55.03		4.01	1.46	5.47	N/A	N/A	6.0	5.0	YES RES/NO INDU
1587.52	PT	0.5												
1553.66		0.5	12.43	Y	63.41	250	4.68	1.52	6.20	1.22	7.41	8.1	6.2	YES
1471		0.5	8.96	N	60.85	250	4.17	1.36	5.53	0.30	5.83	7.2	6.5	YES
1450.1		0.5	9.69	N	57.65	250	4.05	1.38	5.43	0.34	5.77	7.0	7.0	YES
1405		0.5	8.00	N	63.48	250	4.70	1.33	6.03	0.25	6.29	9.6	8.8	YES
1380.51	PC	0.5												
1300		0.5	16.13	y	41.08		3.22	1.59	4.81	N/A	N/A	9.4	9.4	YES
1246.94	PT	0.5												
1255		0.5	8.00	N	63.48	940	4.70	1.33	6.03	0.07	6.10	9.6	9.6	YES
1150		0.5	16.13	Y	41.08	940	3.22	1.59	4.81	0.35	5.17	11.6	13.1	YES
1105		0.5	8.00	N	63.48	940	4.70	1.33	6.03	0.07	6.10	12.1	13.3	YES
1021		0.5	8.96	N	60.85	940	4.71	1.37	6.08	0.08	6.16	10.8	10.8	YES
1000.1		0.5	16.13	N	57.65	940	4.03	1.64	5.67	0.25	5.92	8.4	8.4	YES
965		0.5	14.09	Y	65.34	940	5.07	1.60	6.67	0.43	7.10	11.0	10.5	YES
955		0.5	8.01	N	64.8	940	3.51	1.30	4.81	0.07	4.88	11.1	10.1	YES
923.87	PCC	0.5												
825		0.5	8.00	N	64.81	2200	3.51	1.30	4.81	0.03	4.84	8.5	9.1	YES
808.3	PC	0.5												
700		0.5	8.01	N	64.76		3.51	1.30	4.81	N/A	N/A	8.4	9.0	YES
636.96	PT	0.5												
600		0.5	8.00	N	64.72	600	3.51	1.30	4.81	0.11	4.92	8.3	8.9	YES
450		0.5	7.97	N	64.57	600	3.52	1.30	4.82	0.11	4.93	8.3	8.8	YES
350		0.5	7.92	N	64.35	600	3.54	1.30	4.84	0.10	4.94	8.2	8.1	YES
315.05	PC	0.5												
200		0.5	7.72	N	63.06		3.60	1.29	4.89	N/A	N/A	5.0	5.0	NO ***

Note: This table is not for final design and does not included all sections, but was used for general concept channel sizing

The Sands Channel Improvements
Riprap Channel Lining Sizing Table

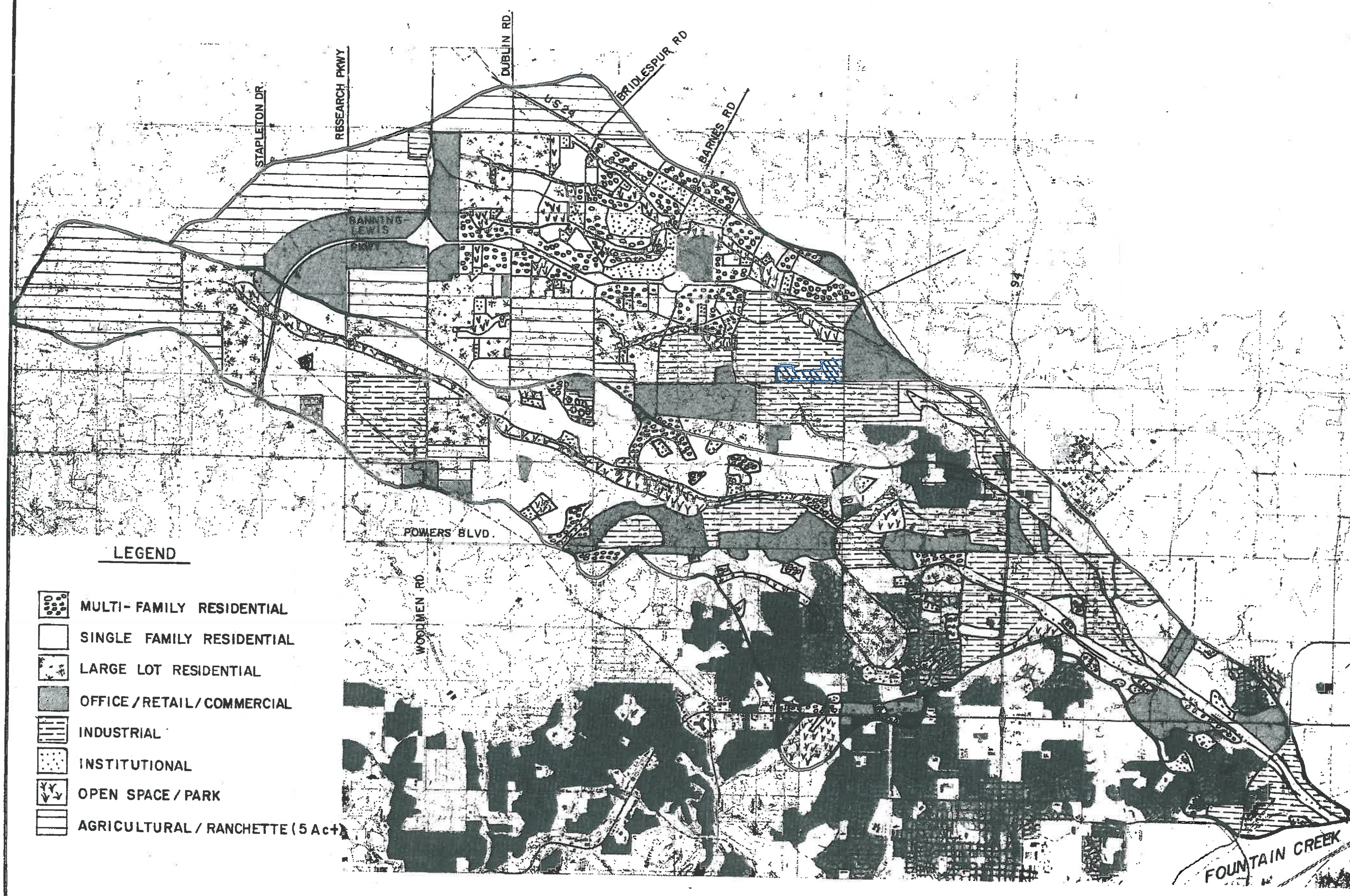
STATION		SLOPE %	Hydr Depth (taken from V, F, Sh model)	Velocity (across channel) ** (FT/S)	Froude # (channel)	D50 EPC DCM Riprap No	EPC DCM Required Riprap Size (Table 10-6) (valid for F<0.9)	D50 UDFCD Eqn 8-11 Riprap No FT	UDFCD DCM Required Riprap Size (Table 10-6) Valid for F<1.0)	UDFCD Recommends upsizing Safety Factor	Proposed Size Proposed * indicates grouted FT	Comments
4800		0.64	3.65	11.00	0.89	3.49	9" (Type L)	0.63	9" (Type L)	1.0 '(Type M)	N/A	Existing Concrete Lined channel to remain
4700		0.64	3.67	10.90	0.88	3.46	9" (Type L)	0.62	9" (Type L)	1.0 '(Type M)	N/A	Existing Concrete Lined channel to remain
4600		0.64	3.64	11.01	0.89	3.49	9" (Type L)	0.63	9" (Type L)	1.0 '(Type M)	N/A	Existing Concrete Lined channel to remain
4566.35	PT	0.5										
4505		0.5	2.32	13.96	1.65	4.25	1.0' (Type M)	0.93	1.0 '(Type M)	1.5' (Type H)	1.0 '(Type M)	Anticipate adding riprap to floor in this location with final design, likely slowing velocities
4476.45		0.5	2.70	12.70	1.26	3.86	9" (Type L)	0.77	1.0 '(Type M)	1.5' (Type H)	1.0 '(Type M)	Anticipate adding riprap to floor upstream of this location with final design, likely slowing velocities, will upsize if necessary
4405		0.5	3.70	7.42	0.69	2.26	6" (Type VL)	0.26	6" (Type VL)	9" (Type L)	N/A	In grouted boulder drop
4361.97	PCC	0.5										
4309		0.5	3.53	7.94	0.76	2.42	6" (Type VL)	0.30	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
4261.93	PC	0.5										
4227.87	PT	0.5										
4225		0.5	3.56	7.86	0.76	2.39	6" (Type VL)	0.29	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
4118.08	PC	0.5										
4121		0.5	3.20	9.10	0.93	2.77	6" (Type VL)	0.40	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
4100		0.5	2.59	16.13	1.79	4.91	1.5' (Type H)	1.24	1.5' (Type H)	2.0' (Type VH)	1.0 '(Type M)*	base of Vert drop structure
4055		0.5	3.51	8.02	0.79	2.44	6" (Type VL)	0.31	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
3950		0.5	3.52	7.98	0.78	2.43	6" (Type VL)	0.30	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
3800		0.5	3.51	7.99	0.78	2.43	6" (Type VL)	0.30	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
3650		0.5	3.57	7.82	0.76	2.38	6" (Type VL)	0.29	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
3590.34	PT	0.5										
3500		0.5	3.68	7.48	0.72	2.28	6" (Type VL)	0.27	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
3498.64	PCC	0.5										
3392.52		0.5	3.72	7.37	0.68	2.24	6" (Type VL)	0.26	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
3372.09	PC	0.5										
3342.52		1.2	3.25	9.65	0.98	3.41	9" (Type L)	0.60	1.0 '(Type M)	1.5' (Type H)	1.0 '(Type M)	Existing Type M Riprap lined channel
3252		1.2	2.90	11.33	1.22	4.00	1.0' (Type M)	0.83	1.0 '(Type M)	1.5' (Type H)	1.0 '(Type M)	Existing Type M Riprap lined channel
											1.0 '(Type M)	Existing Type M Riprap lined channel
1752		1.2	3.20	9.86	1.01	3.48	9" (Type L)	0.62	1.0 '(Type M)	1.5' (Type H)	1.0 '(Type M)	Existing Type M Riprap lined channel
1602		1.2	2.87	11.51	1.24	4.06	1.0' (Type M)	0.85	1.0 '(Type M)	1.5' (Type H)	1.0 '(Type M)	Existing Type M Riprap lined channel
1587.52	PT	0.5										
1553.66		0.5	2.53	12.43	1.41	3.78	9" (Type L)	0.74	1.0 '(Type M)	1.5' (Type H)	1.0 '(Type M)	Lining can be upsized with Final design if required
1471		0.5	3.24	8.96	0.91	2.73	6" (Type VL)	0.38	6" (Type VL)	9" (Type L)	1.0 '(Type M)	

The Sands Channel Improvements
Riprap Channel Lining Sizing Table

STATION		SLOPE %	Hydr Depth (taken from V, F, Sh model)	Velocity (across channel) ** (FT/S)	Froude # (channel)		D50 EPC DCM Riprap No	EPC DCM Required Riprap Size (Table 10-6) (valid for F<0.9)	D50 UDFCD Eqn 8-11 Riprap No FT	UDFCD DCM Required Riprap Size (Table 10-6) Valid for F<1.0)	UDFCD Recommends upsizing Safety Factor	Proposed Size Proposed * indicates grouted FT	Comments
1450.1		0.5	3.08	9.69	0.97		2.95	6" (Type VL)	0.45	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
1405		0.5	3.51	8.00	0.78		2.43	6" (Type VL)	0.31	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
1380.51	PC	0.5											
1300		0.5	2.59	16.13	1.79		4.91	1.5' (Type H)	1.24	1.5' (Type H)	2.0' (Type VH)	1.0 '(Type M)*	base of Vert drop structure
1246.94	PT	0.5											
1255		0.5	3.51	8.00	0.78		2.43	6" (Type VL)	0.31	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
1161		0.5	3.28	8.79	0.86		2.67	6" (Type VL)	0.37	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
1150		0.5	2.59	16.13	1.79		4.91	1.5' (Type H)	1.24	1.5' (Type H)	2.0' (Type VH)	1.0 '(Type M)*	base of Vert drop structure
1105		0.5	3.51	8.00	0.78		2.43	6" (Type VL)	0.31	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
1021		0.5	3.24	8.96	0.91		2.73	6" (Type VL)	0.38	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
1000.1		0.5	3.08	9.69	0.97		2.95	6" (Type VL)	0.45	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
965		0.5	3.71	6.21	0.68		1.89	1.0' (Type M)	0.18	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
955		0.5	3.69	7.46	0.69		2.27	6" (Type VL)	0.27	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
923.87	PCC	0.5											
825		0.5	3.51	8.00	0.78		2.43	6" (Type VL)	0.31	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
808.3	PC	0.5											
700		0.5	3.51	8.01	0.78		2.44	6" (Type VL)	0.31	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
636.96	PT	0.5											
600		0.5	3.51	8.00	0.78		2.43	6" (Type VL)	0.31	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
450		0.5	3.52	7.97	0.78		2.42	6" (Type VL)	0.30	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
350		0.5	3.54	7.92	0.77		2.41	6" (Type VL)	0.30	6" (Type VL)	9" (Type L)	1.0 '(Type M)	
315.05	PC	0.5											
200		0.5	3.6	7.72	0.75		2.35	6" (Type VL)	0.28	6" (Type VL)	9" (Type L)	1.0 '(Type M)	

Note: This table is not intended for final design or to analyze all sections, but for use in general concept sizing.

BACKGROUND INFORMATION



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

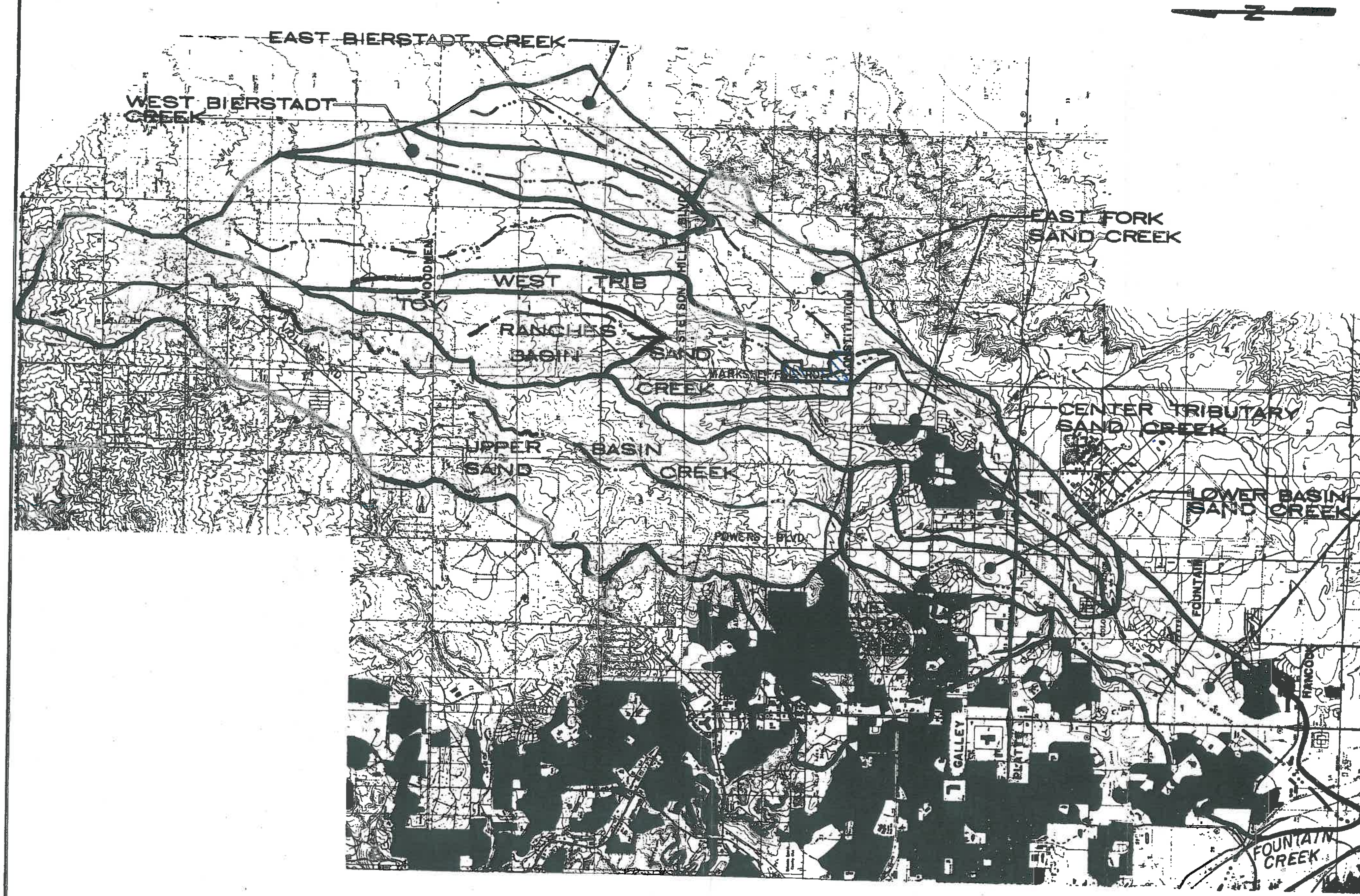
SAND CREEK DRAINAGE BASIN PLANNING STUDY

PROPOSED LAND USE

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

7

FIG. II-3



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419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY

REGIONAL SUB-BASINS

Project No	90-04-09
Date:	11/90
Design:	
Drawn:	EAK
Check.	
Revisions:	

11

FIG. III-1

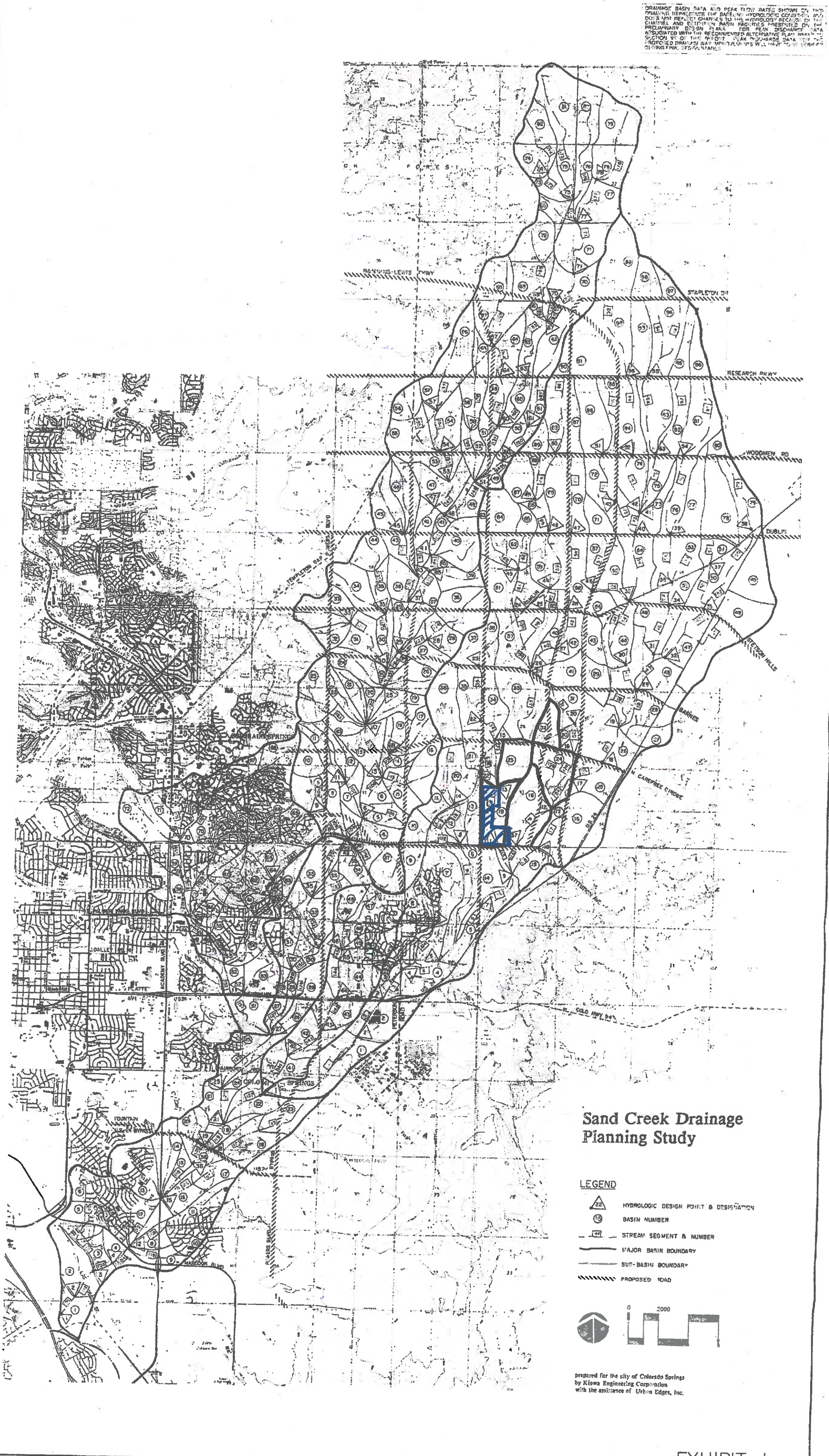
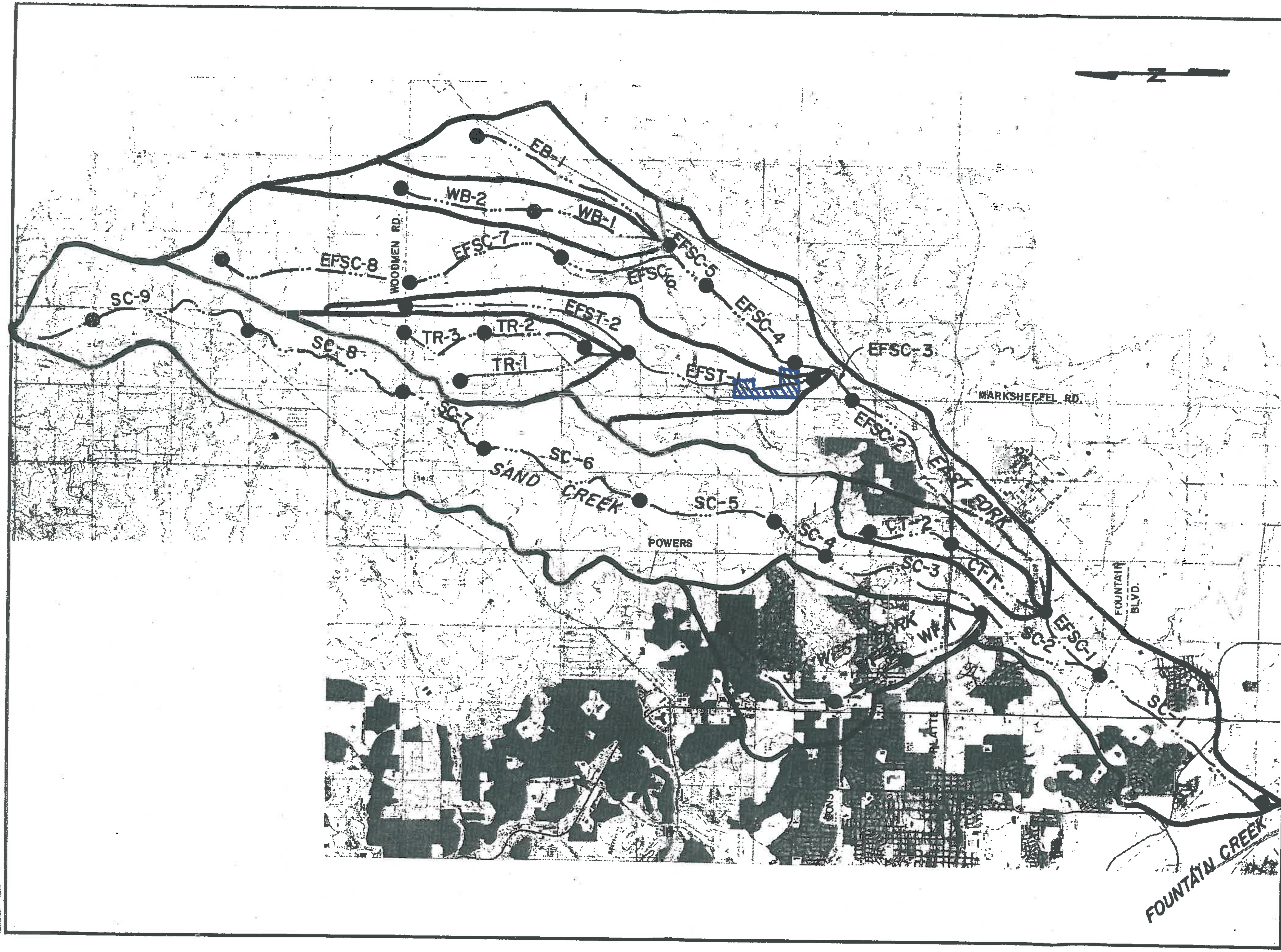

Sand Creek Drainage
Planning Study
LEGEND
HYDROLOGIC DESIGN POINT & DESIGNATION
BASIN NUMBER
STREAM SEGMENT & NUMBER
MAJOR BASIN BOUNDARY
SUB-BASIN BOUNDARY
PROPOSED ROAD
0
2000
prepared for the city of Colorado Springs
by Kiowa Engineering Corporation
with the assistance of Urban Edges, Inc.
BANNING-LEWIS PKWY
STAPLETON DR
RESEARCH PKWY
WOODMEN RD
DUBLIN
STETSON HILLS
BARNES
CAREFREE CIRCLE
CONSTITUTION AVE
COLO HWY 94
PLATTE
ACADEMY BLVD
FOUNTAIN
PETERSON RD
MARKSHEFFEL

EXHIBIT 1



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Colorado Springs, Colorado
80905-1308

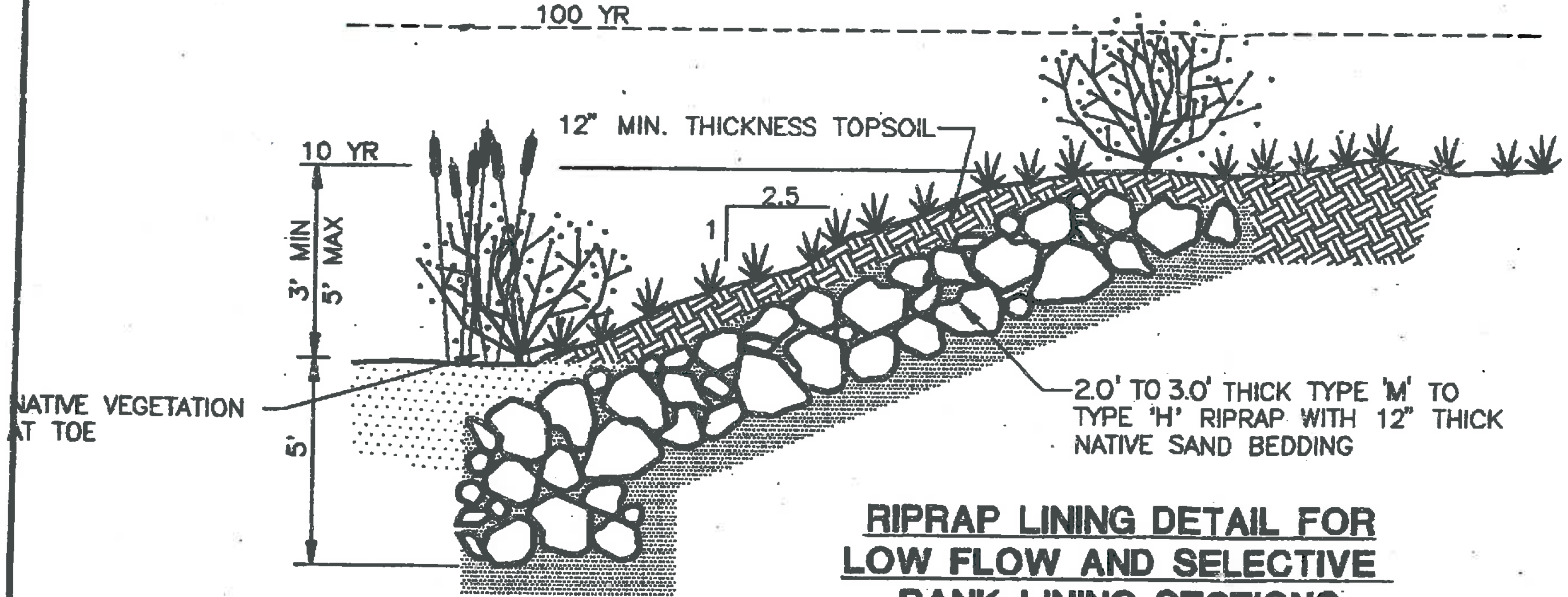
SAND CREEK DRAINAGE
BASIN PLANNING STUDY

REACH DELINEATIONS

Project No.	90-04-09
Date:	1-91
Design:	RNW
Drawn:	EAK
Check:	
Revisions:	

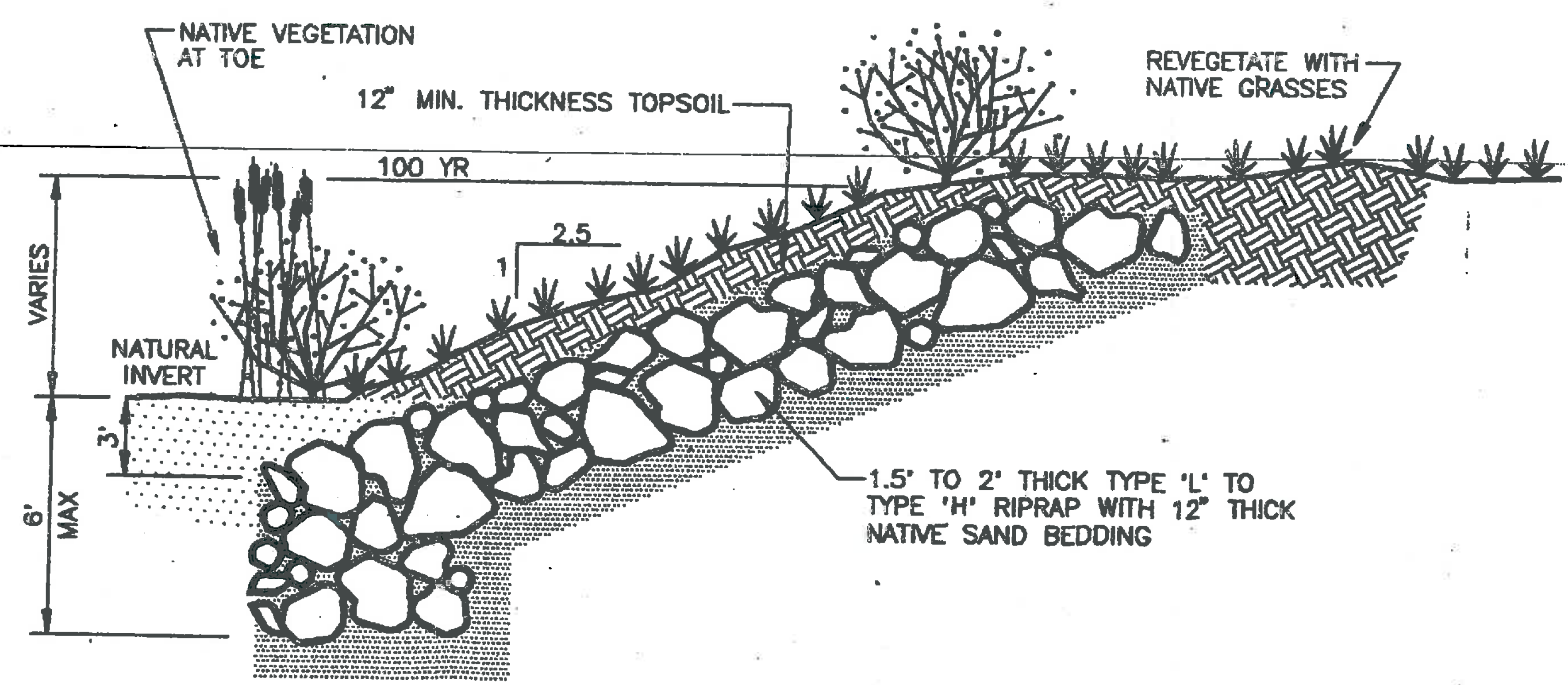
30

FIG. IV-1



RIPRAP LINING DETAIL FOR LOW FLOW AND SELECTIVE BANK LINING SECTIONS

NTS



RIPRAP LINING DETAIL FOR 100 YR CHANNEL SECTIONS

NTS

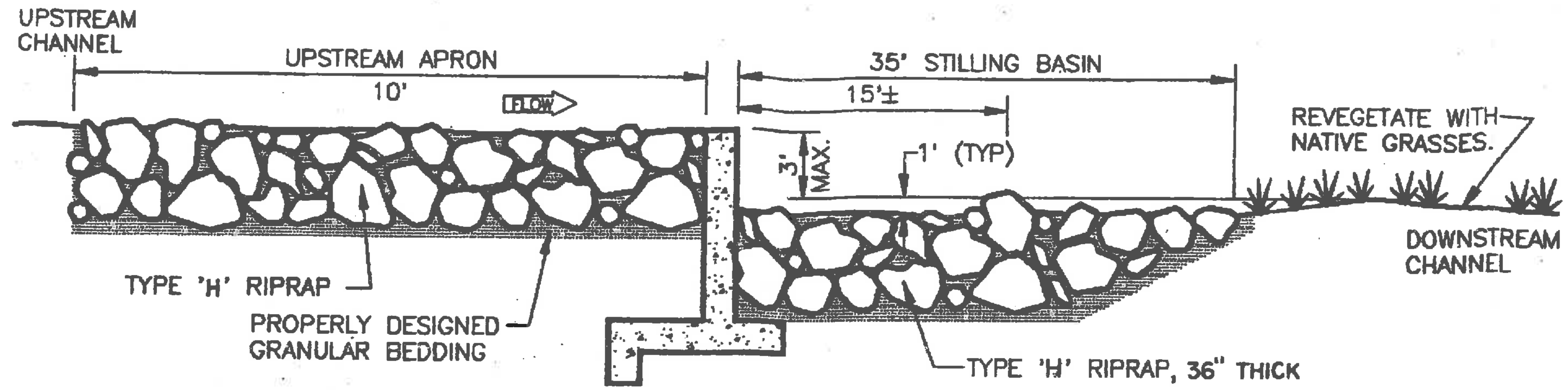
EXHIBIT "I"

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

SAND CREEK DRAINAGE BASIN PLANNING STUDY

Project No:
Date:
Design:
Drawn:
Check:
Revisions:

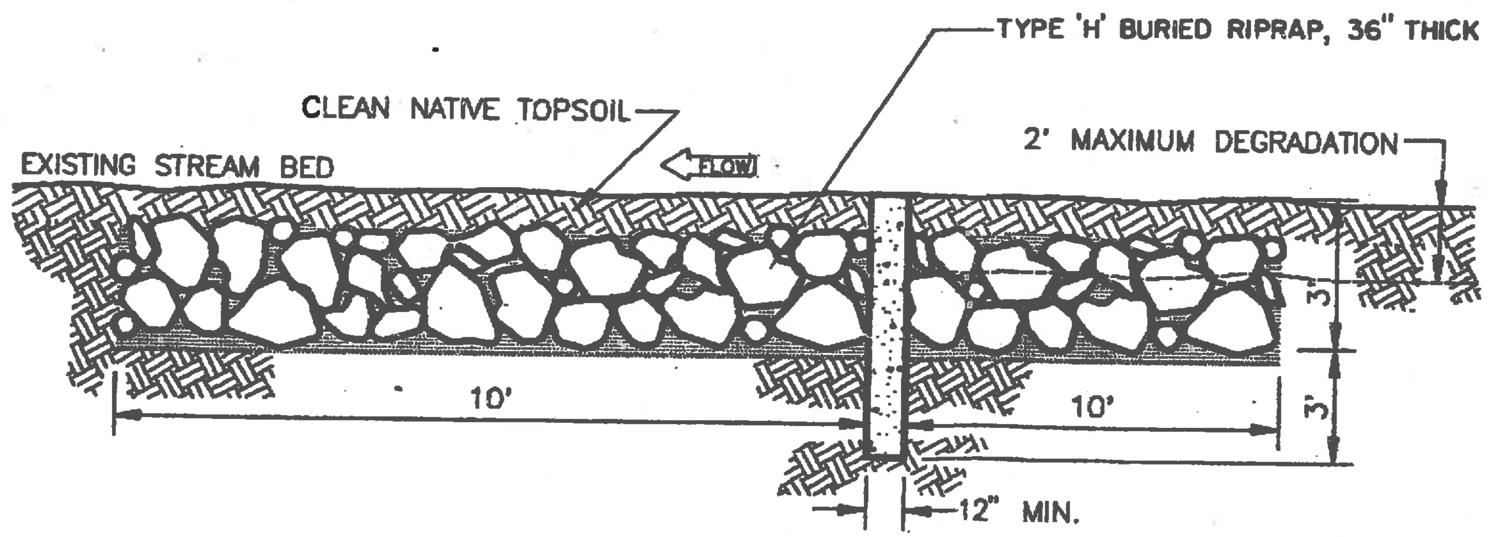
CS-6



TYPICAL DROP STRUCTURE GENERALIZED PROFILE

NTS

NOTE: DIMENSIONS OF APRON, STILLING BASIN, RIPRAP, AND CHECK STRUCTURE IS TO BE DETERMINED DURING FINAL DESIGN.



TYPICAL EROSION CONTROL CHECK PROFILE

NTS

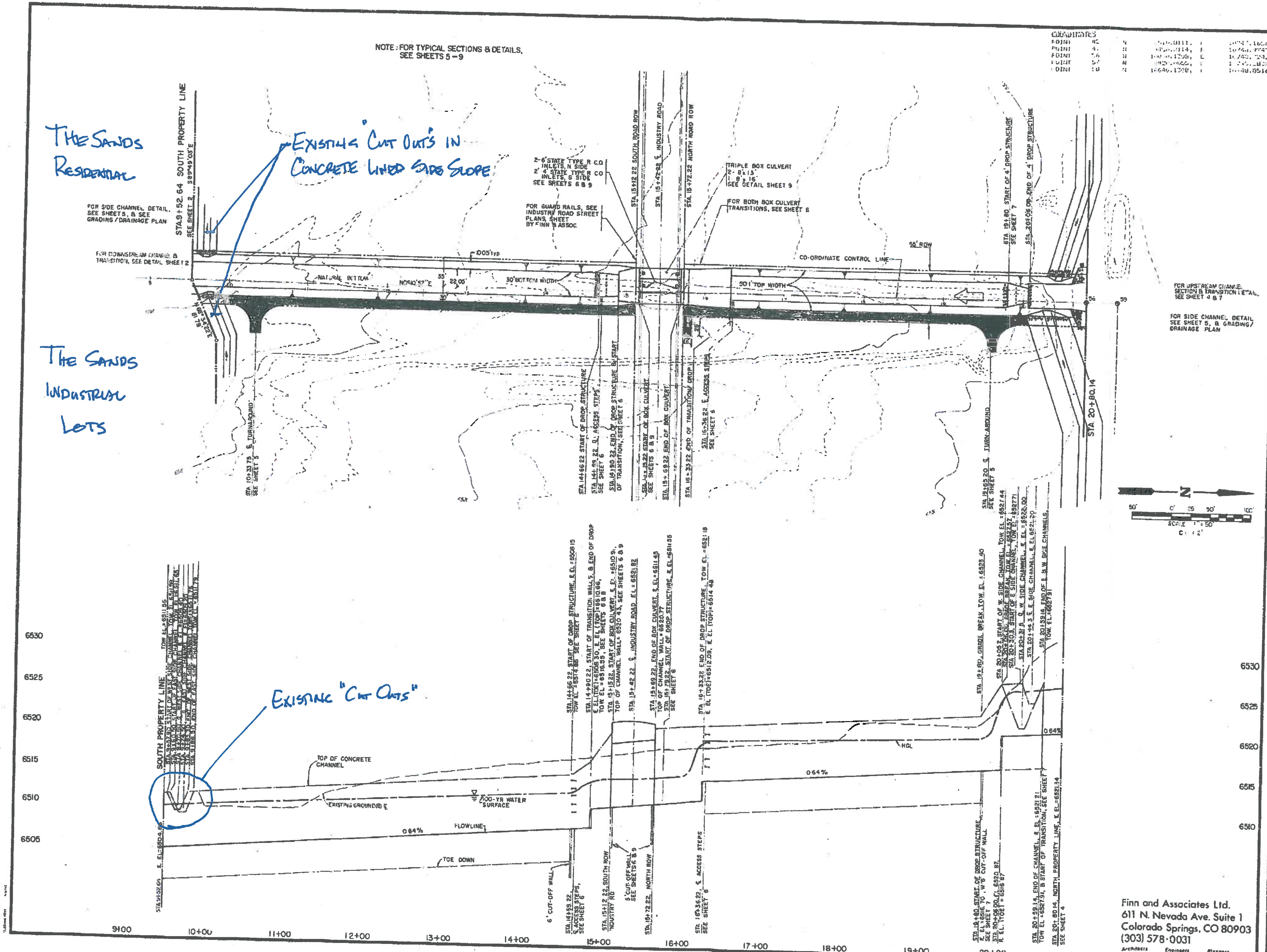
EXHIBIT "J"

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

SAND CREEK DRAINAGE BASIN PLANNING STUDY

Project No
Date:
Design:
Drawn:
Check:
Revisions:

CS-7



MARKSHEFFEL INDUSTRIAL PARK

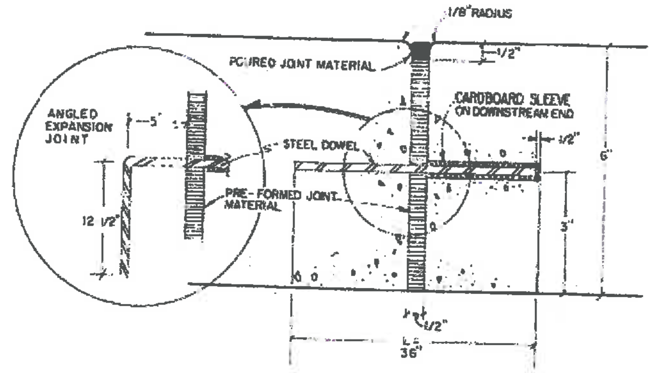
PLAN & PROFILE: STA. 9+52.64 TO STA. 20+80.14

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

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

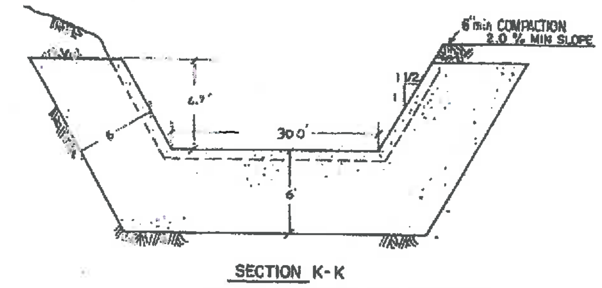
Project No:
Date: 3/86
Design: JRL
Drawn: EAK
Check: RNW
Revisions:

3



EXPANSION JOINT DETAIL

n.t.s.

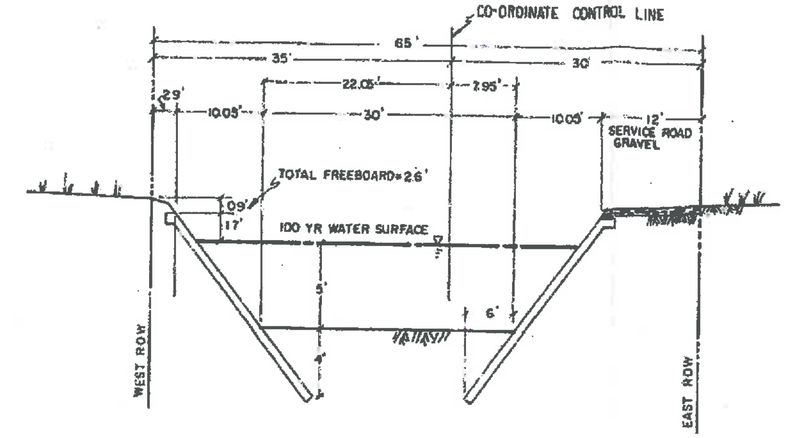


SECTION K-K

FOR STA 14+66.22 AND 19+80.00

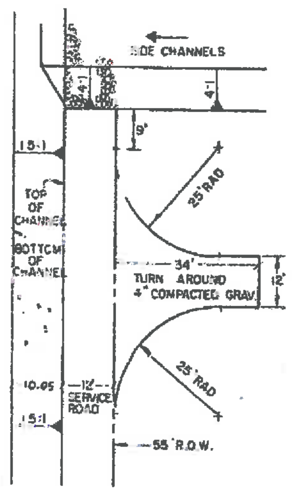
CUT-OFF WALL

nts



TYPICAL CHANNEL SECTION

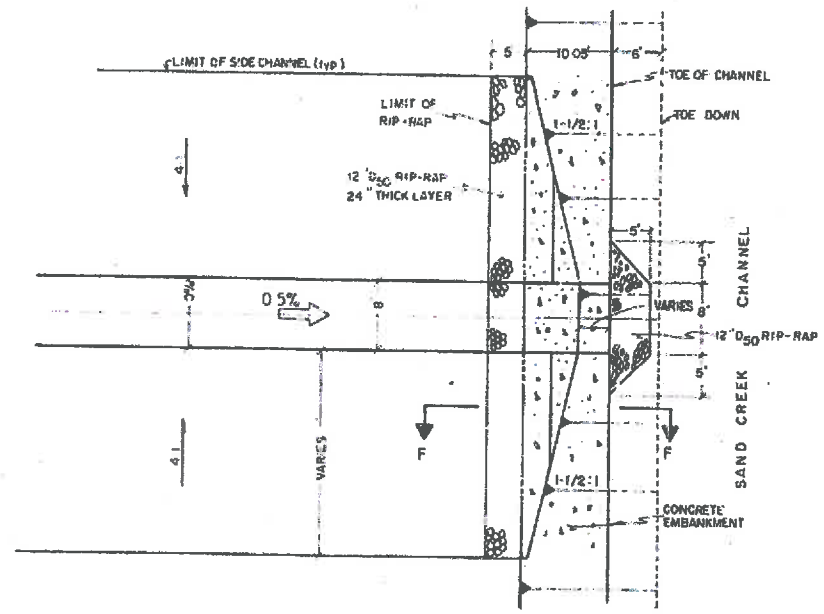
Q = 2770 cfs
S = 0.64%
V = 14.7 fps



ACCESS ROAD TURNAROUND

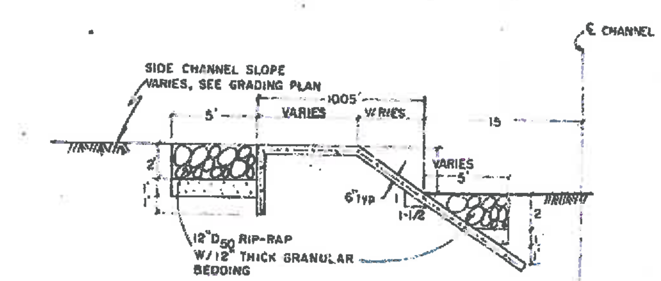
SCALE 1" = 20'

EAST SIDE ONLY



TYPICAL SIDE CHANNEL CONNECTION DETAIL

SCALE 1" = 10'



TYPICAL SIDE CHANNEL, SECTION F-F

SCALE 1" = 5', H & V

GRADATION FOR GRANULAR BEDDING

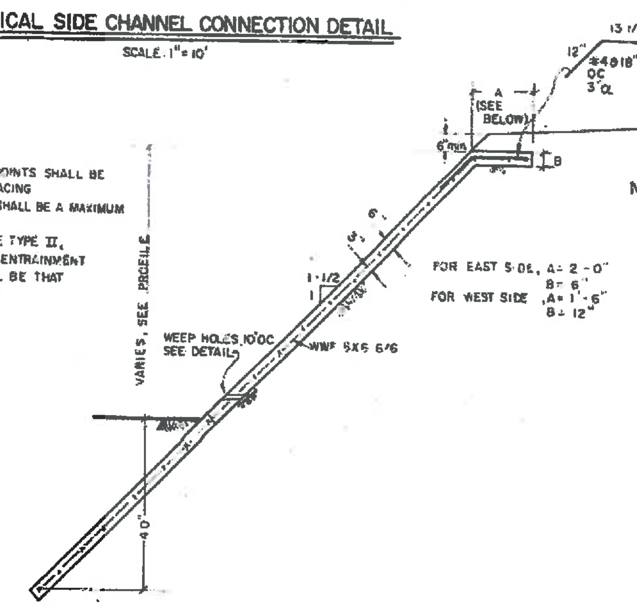
Square Mesh Sieves Type II	U. S. Standard Sieve Size
90 - 100	3"
-	1-1/2"
20 - 90	3/4"
-	3/8"
0 - 20	#4
-	#16
-	#50
-	#100
0 - 3	#200

CLASSIFICATION AND GRADATION OF ORDINARY RIPRAP

Riprap Designation	% Smaller Than Given Size By Weight	Intermediate Rock Dimension (Inches)	d_{50}* (Inches)
Type M	70-100	21	
	50-70	18	
	35-50	12	12
	2-10	4	
Type H	100	30	
	50-70	24	
	35-50	18	18
	2-10	6	

*d_{50} = Mean particle size

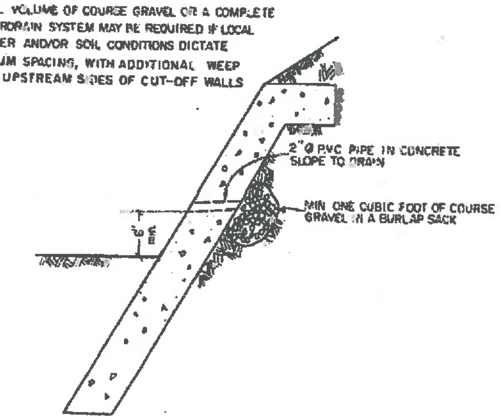
NOTES:
1) 1/2" CONTRACTION JOINTS SHALL BE MAXIMUM OF 20' SPACING
2). EXPANSION JOINTS SHALL BE A MAXIMUM OF 100 SPACING.
3) CONCRETE SHALL BE TYPE II, 3000 psi, WITH AIR ENTRAINMENT
4) THE SURFACE SHALL BE THAT OF A BROOM FINISH



TYPICAL CONCRETE BANK PROTECTION

FROM STA. 9+52.64 TO STA. 14+66.22
& FROM STA. 16+33.22 TO STA. 19+80.00
& FROM STA. 20+06.00 TO STA. 20+59.14
SCALE : 1" = 2', H & V

NOTES:
1) NO 4? GALVANIZED STEEL SCREEN OR FILTER FABRIC MAY BE USED IN LIEU OF BURLAP SACK (SEE SPECIFICATIONS)
2) WATER PVC PIPE FLUSH WITH CONCRETE
3) ADDITIONAL VOLUME OF COURSE GRAVEL OR A COMPLETE ROCK UNDERDRAIN SYSTEM MAY BE REQUIRED IF LOCAL GROUNDWATER AND/OR SOIL CONDITIONS DICTATE
4) 10' MAXIMUM SPACING, WITH ADDITIONAL WEEP HOLES ON UPSTREAM SIDES OF CUT-OFF WALLS



WEEP HOLE DETAIL

NO SCALE

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Colorado Springs, CO 80903
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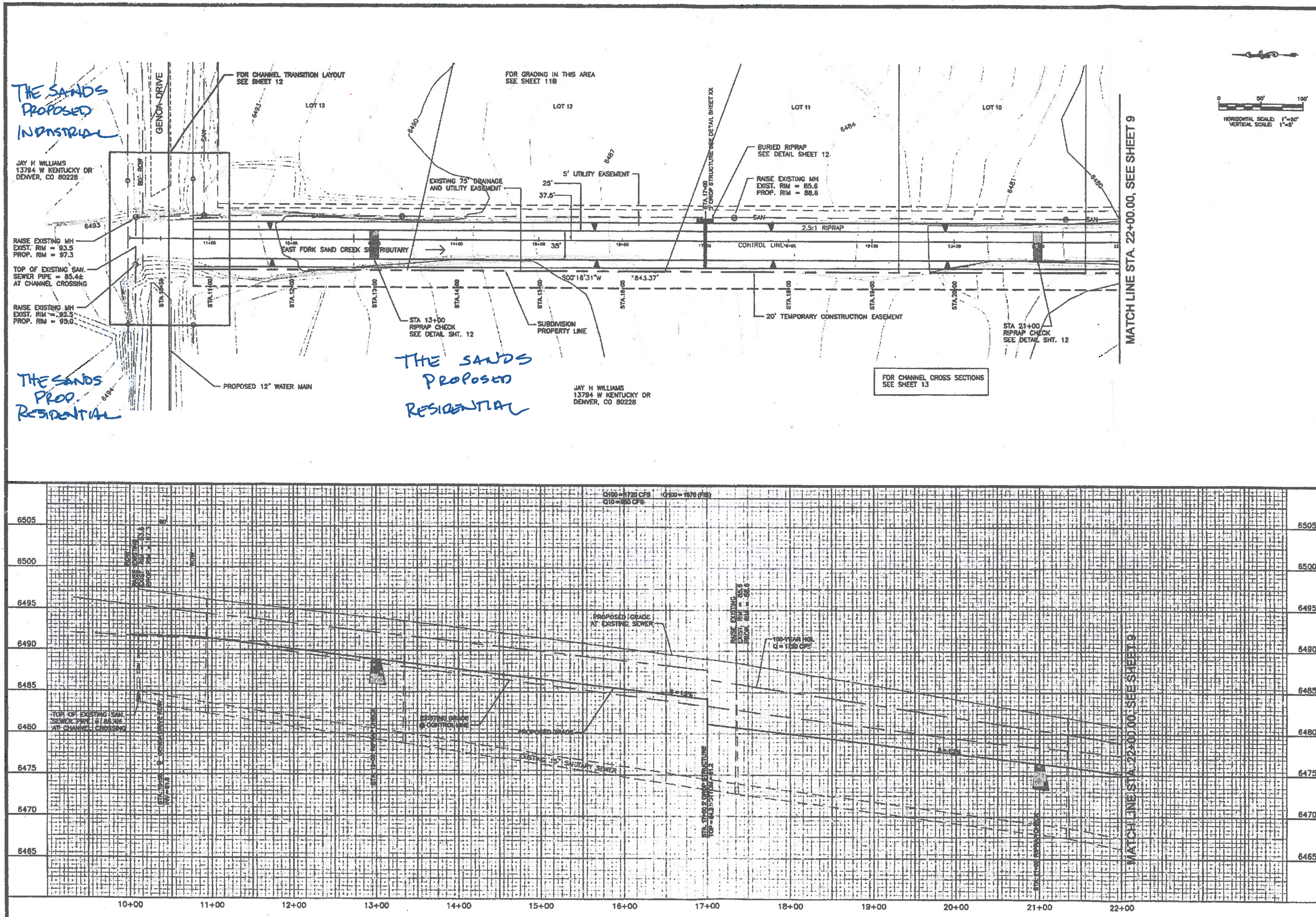
Architects Engineers Planners

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

MARKSHEFFEL INDUSTRIAL PARK
CHANNEL DETAILS

Project No	R-CO-FA 06
Date:	3/86
Design:	JR
Drawn:	EAK
Check:	RNW
Revisions:	

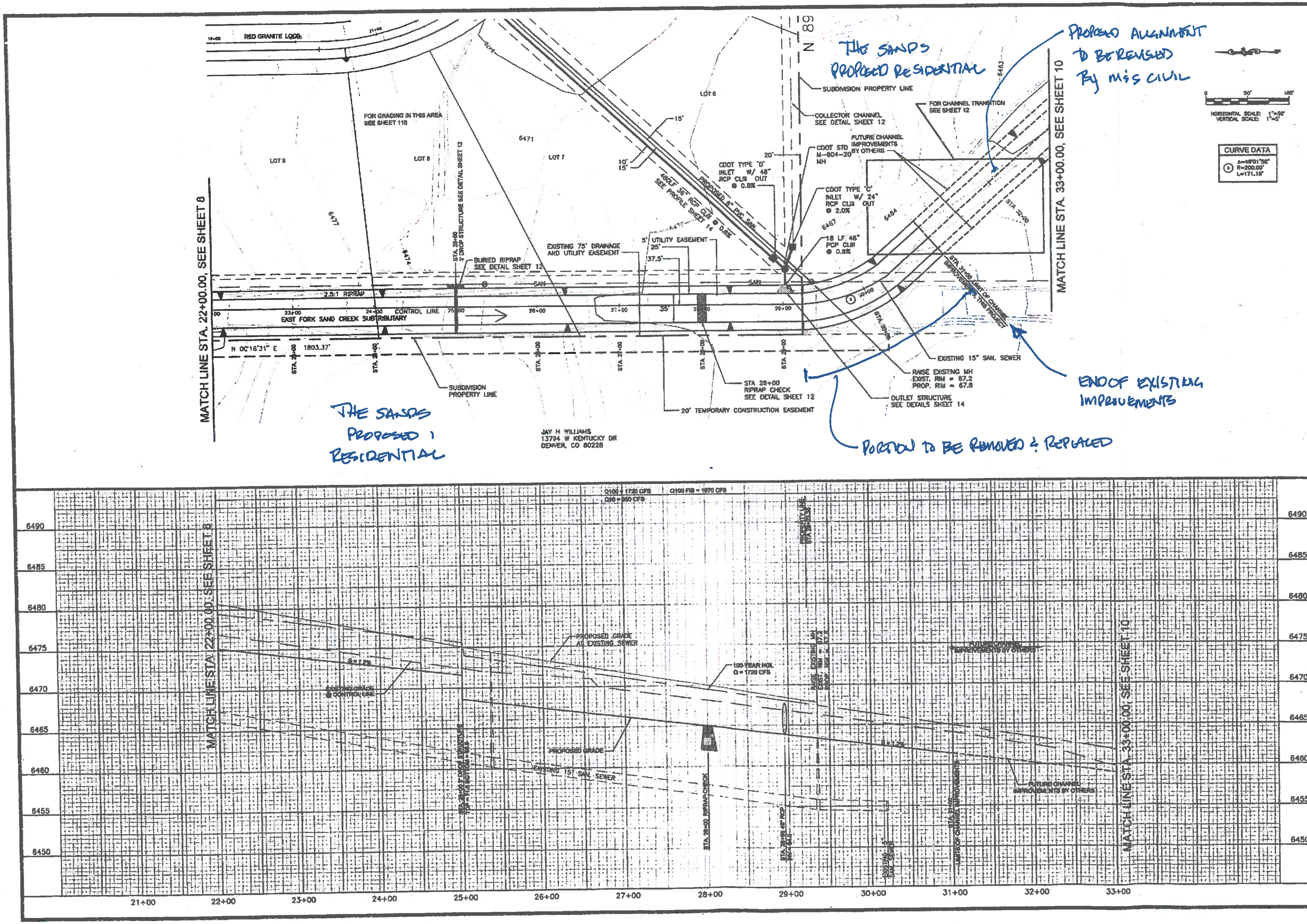


Kiowa Engineering Corporation
2814 International Circle
Colorado Springs, Colorado
80910-3127
(719) 630-7342

ROCKY MOUNTAIN INDUSTRIAL PARK
EAST FORK SAND CREEK SUBTRIBUTARY
PLAN AND PROFILE
EL PASO COUNTY, COLORADO

Project No.: 01017
Date: November 1, 2001
Design: RNW
Drawn: WMS
Check: RNW
Revisions: 01/21/02
Cher. Met. Dist. comments

SHEET
8
OF 15 SHEETS



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80910-3127
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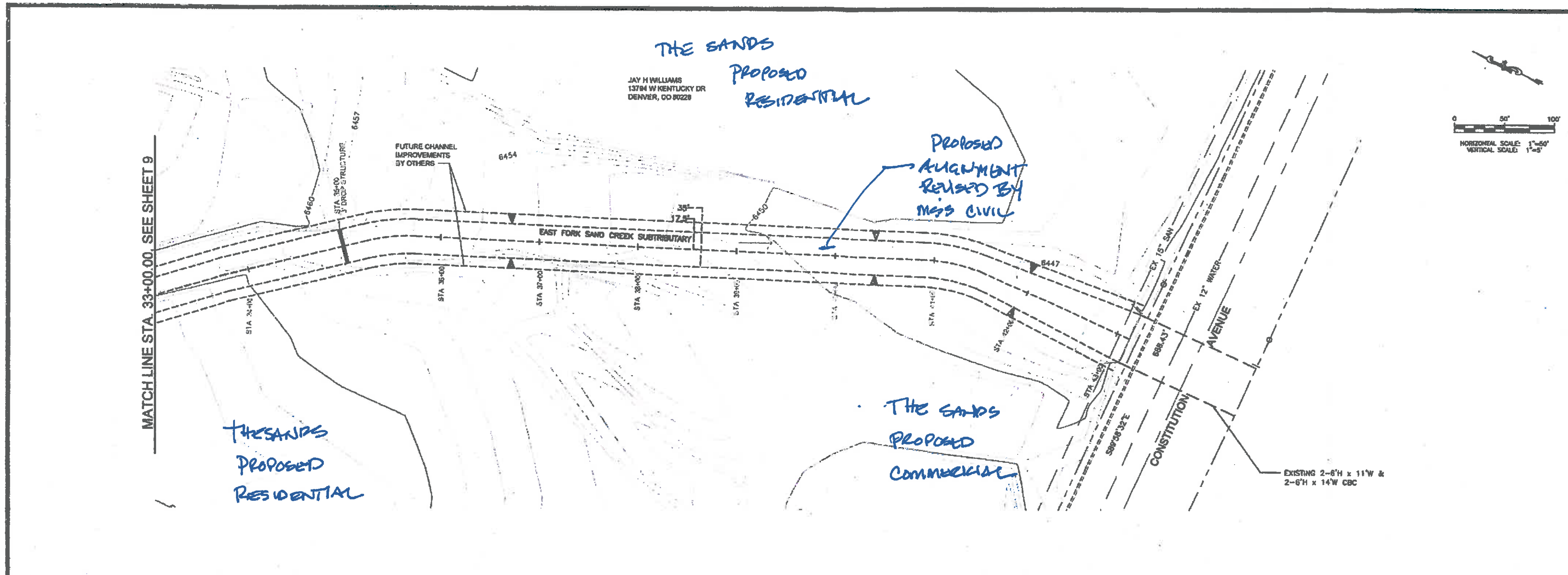
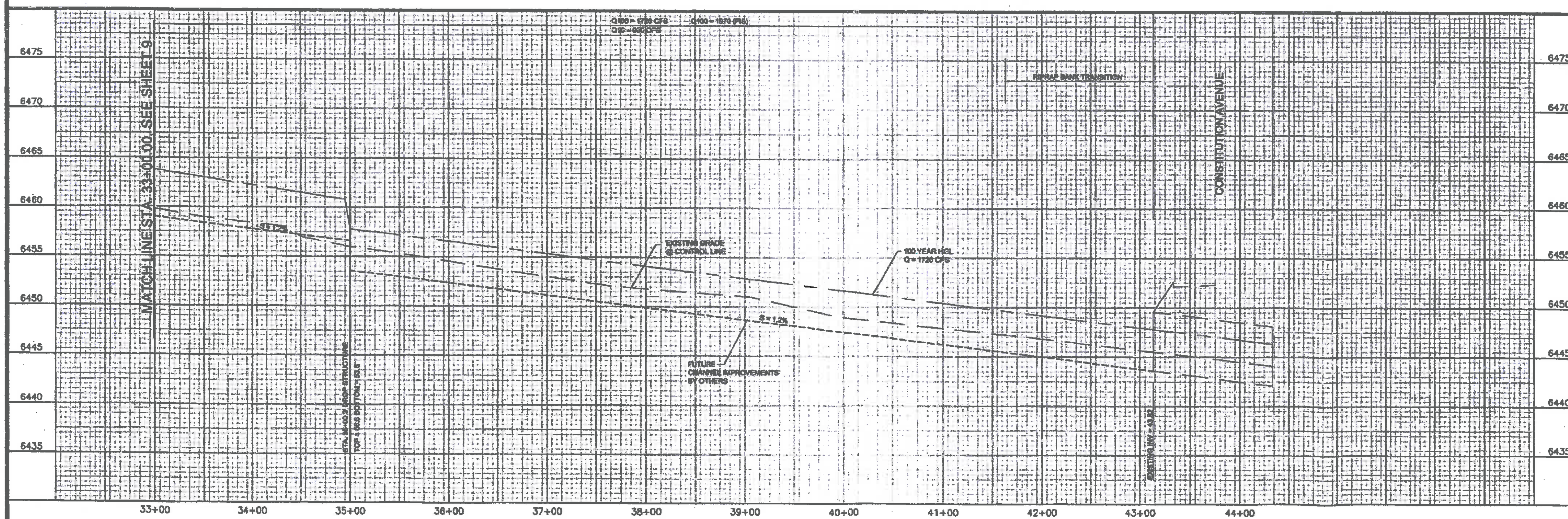
ROCKY MOUNTAIN INDUSTRIAL PARK
EAST FORK SAND CREEK SUBTRIBUTARY
PLAN AND PROFILE
EL PASO COUNTY, COLORADO

Project No.: 01017
Date: November 1, 2001
Design: RNW
Drawn: WNS
Check: RNW
Revisions: 01/21/02
Cher. Met. Dist. comments

SHEET
9
OF 15 SHEETS





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Colorado Springs, Colorado
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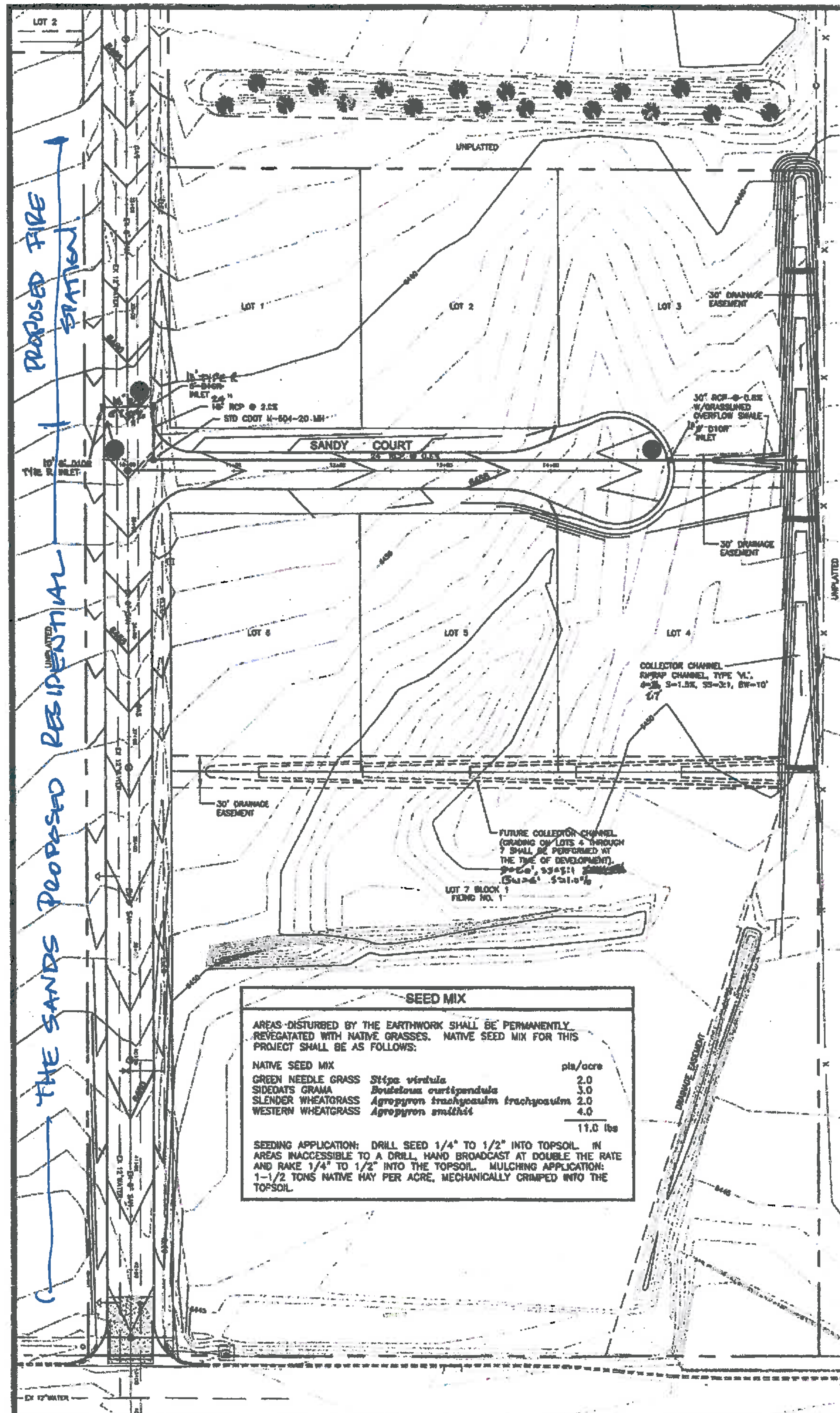
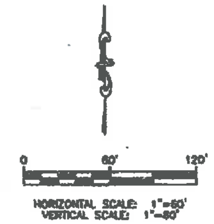
ROCKY MOUNTAIN INDUSTRIAL PARK
EAST FORK SAND CREEK SUBTRIBUTARY
PLAN AND PROFILE
EL PASO COUNTY, COLORADO

Project No.: 01017
Date: November 1, 2001
Design: RNW
Drawn: WMS
Check: RNW
Revisions:

SHEET
10
OF 15 SHEETS





LEGEND

—×—×—	SILT FENCE
▬▬	STRAW BALE CHECK
▭	VEHICLE TRACKING CONTROL
●	INLET PROTECTION

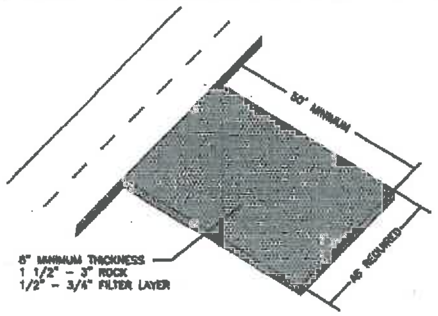
VEHICLE TRACKING CONTROL

DEFINITION

A STONE STABILIZATION PAD LOCATED AT POINTS OF VEHICULAR INGRESS ON A CONSTRUCTION SITE.

PURPOSES

TO REDUCE THE AMOUNT OF MUD TRANSPORTED ONTO PUBLIC ROADS BY MOTOR VEHICLES OR RUNOFF.



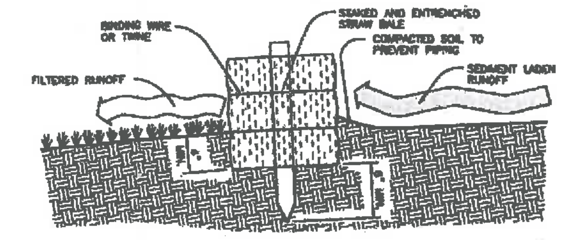
STRAW BALE BARRIER

DEFINITION

A TEMPORARY SEDIMENT BARRIER CONSISTING OF A ROW OF ENTRENCHED AND ANCHORED STRAW BALES

PURPOSES

1. TO INTERCEPT AND DETAIN SMALL AMOUNTS OF SEDIMENT FROM DISTURBED AREAS OF LIMITED EXTENT IN ORDER TO PREVENT SEDIMENT FROM LEAVING THE SITE.
2. TO DECREASE THE VELOCITY OF SHEET FLOWS AND LOW-TO-MODERATE LEVEL CHANNEL FLOWS.



CROSS-SECTION OF A PROPERLY INSTALLED STRAW BALE

STORM DRAIN CURB INLET PROTECTION

DEFINITION

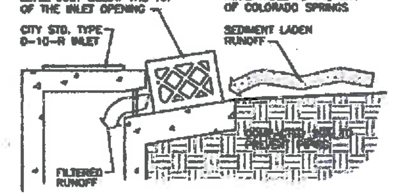
A SEDIMENT FILTER OR AN EXCAVATED IMPOUNDING AREA AROUND A CURB INLET.

PURPOSES

TO PREVENT SEDIMENT FROM ENTERING STORM DRAINAGE SYSTEMS PRIOR TO PERMANENT STABILIZATION OF THE DISTURBED AREA.

PLASTIC MILK CRATES TO BE WIRED TOGETHER AND FILLED WITH 3" RIVER ROCK TO A LEVEL JUST BELOW THE TOP OF THE INLET OPENING

NOTE:
CONTRACTOR MAY USE OTHER INLET PROTECTION METHODS ACCEPTABLE TO THE CITY OF COLORADO SPRINGS



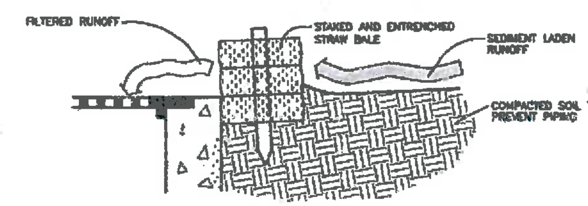
STORM DRAIN GRATED INLET PROTECTION

DEFINITION

A SEDIMENT FILTER OR AN EXCAVATED IMPOUNDING AREA AROUND A STORM DRAIN DROP INLET OR CURB INLET.

PURPOSES

TO PREVENT SEDIMENT FROM ENTERING STORM DRAINAGE SYSTEMS PRIOR TO PERMANENT STABILIZATION OF THE DISTURBED AREA.



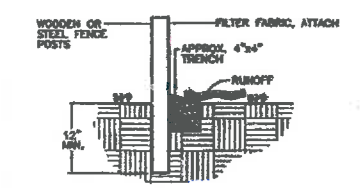
SILT FENCE DETAIL

DEFINITION

A TEMPORARY SEDIMENT BARRIER CONSISTING OF A FILTER FABRIC STRETCHED ACROSS AND ATTACHED TO SUPPORTING POSTS AND ENTRENCHED. THE SILT FENCE IS A TEMPORARY LINEAR FILTER BARRIER CONSTRUCTED OF SYNTHETIC FILTER FABRIC AND SUPPORTED BY WOODEN OR STEEL POSTS.

PURPOSES

1. TO INTERCEPT AND DETAIN SMALL AMOUNTS OF SEDIMENT FROM DISTURBED AREAS DURING CONSTRUCTION OPERATIONS IN ORDER TO REDUCE SEDIMENT IN RUNOFF FROM LEAVING THE SITE.
2. TO DECREASE THE VELOCITY OF SHEET FLOWS AND LOW-TO-MODERATE LEVEL CONCENTRATED FLOWS.



SEED MIX

AREAS DISTURBED BY THE EARTHWORK SHALL BE PERMANENTLY REVEGATATED WITH NATIVE GRASSES. NATIVE SEED MIX FOR THIS PROJECT SHALL BE AS FOLLOWS:

NATIVE SEED MIX		pls/acre
GREEN NEEDLE GRASS	*Stipa virdula*	2.0
SIDEOATS GRAMA	*Bouteloua curtipendula*	3.0
SLENDER WHEATGRASS	*Agropyron trachycaulm trachycaulm*	2.0
WESTERN WHEATGRASS	*Agropyron smithii*	4.0
		11.0 lbs

SEEDING APPLICATION: DRILL SEED 1/4" TO 1/2" INTO TOPSOIL. IN AREAS INACCESSIBLE TO A DRILL, HAND BROADCAST AT DOUBLE THE RATE AND RAKE 1/4" TO 1/2" INTO THE TOPSOIL. MULCHING APPLICATION: 1-1/2 TONS NATIVE HAY PER ACRE, MECHANICALLY CRIMPED INTO THE TOPSOIL.

GRADING NOTES

1. ALL EARTHWORK REQUIRED OF THIS CONSTRUCTION SHALL BE COMPLETED IN ACCORDANCE WITH ALL APPLICABLE SECTIONS OF THE PROJECT SPECIFICATIONS.
2. RUBBISH INCLUDING TIMBER, CONCRETE RUBBLE, TREES, BRUSH, AND ASPHALT SHALL NOT BE BACKFILLED ADJACENT TO ANY OF THE STRUCTURES OR BE IN THE PLACEMENT OF ANY UNCLASSIFIED FILL. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE REMOVAL AND HAULING OF SUCH MATERIALS TO A SUITABLE SPOIL AREA. COSTS ASSOCIATED WITH THE REMOVAL OF SUCH MATERIALS SHALL BE PAID FOR AS DOCUMENTED IN THE PROJECT SPECIFICATIONS.
3. EXCESS EXCAVATION SHALL BECOME THE PROPERTY OF THE CONTRACTOR AND SHALL BE DISPOSED OF AT THE CONTRACTOR'S EXPENSE. THE COST OF HAULAGE AND SPOILING OF EXCESS EXCAVATED MATERIALS SHALL BE PAID FOR AS DOCUMENTED IN THE PROJECT SPECIFICATIONS.
4. WATER SHALL BE USED AS A DUST PALLIATIVE AS REQUIRED AND SHALL BE INCLUDED IN THE COST FOR EARTHWORK ITEM(S). NO SEPARATE PAYMENT WILL BE MADE FOR DUST CONTROL ASSOCIATED WITH THE SITE CONSTRUCTION.
5. THE ROAD GRADES AND DETENTION BASINS SHALL BE CLEARED OF VEGETATION AND THE TOPSOIL STOCKPILED FOR LATER USE.
6. GEOTECHNICAL INVESTIGATIONS HAVE BEEN COMPLETED BY ENTECH, INC. CONTRACTOR SHALL FAMILIARIZE HIMSELF WITH THIS INFORMATION
7. COMPACTION FOR THIS PROJECT SHALL BE IN CONFORMANCE WITH ASTM D1557.
8. GRADING CONTOURS SHOWN ON THIS PLAN ARE TO FINAL GRADE.
9. COMPACTION UNDER PAVED AREAS AND BUILDING SITES SHALL BE 95 PERCENT OF THE MAXIMUM MODIFIED PROCTOR DENSITY (ASTM D1557) AT TWO (2) PERCENT ± OF OPTIMUM MOISTURE CONTENT. COMPACTION FOR ALL UTILITY TRENCHES AND AREAS OUTSIDE THE BUILDING PERIMETER AND NOT LOCATED BENEATH ROADWAYS SHALL BE 85 PERCENT OF THE MAXIMUM MODIFIED PROCTOR DENSITY (ASTM D1557) AT TWO (2) PERCENT ± OF OPTIMUM MOISTURE CONTENT.
10. NO RUBBLE OR DEBRIS SHALL BE PLACED IN THE BACKFILL UNDER ANY OF THE PROPOSED BUILDINGS, STREETS, CURB AND GUTTER, DRAINAGE STRUCTURES, OR WITHIN FIVE (5) FEET OF A BUILDING FOOTPRINT. PROPERLY GRADED RUBBLE MAY BE USED IN SOME LOCATIONS AS SPECIFIED AND VERIFIED BY THE ENGINEER.
11. CONTRACTOR IS RESPONSIBLE FOR REVIEWING THE SITE PRIOR TO BIDDING TO VERIFY SITE CONDITIONS.
12. ALL SURFACES NOT RECEIVING PAVEMENT OR OTHER TREATMENT SHALL BE SEEDED AND MULCHED.
13. CONTRACTOR IS RESPONSIBLE FOR PROVIDING EROSION CONTROL MEASURES AS APPROVED BY THE EL PASO COUNTY DEPARTMENT OF TRANSPORTATION.
14. ALL SLOPES EQUAL TO OR GREATER THAN 3:1 SHALL REQUIRE EROSION CONTROL BLANKET, SINGLE NETTED FABRIC, AMERICAN EXCELSIOR OR EQUAL, AS A TEMPORARY STABILIZATION MEASURE.
15. A PRECONSTRUCTION MEETING SHALL BE SCHEDULED WITH THE DEVELOPER, ENGINEER, CONTRACTOR AND THE EL PASO COUNTY DEPARTMENT OF TRANSPORTATION PRIOR TO ANY CONSTRUCTION.
16. THE DEVELOPER IS RESPONSIBLE FOR MAINTAINING EROSION CONTROL MEASURES UNTIL A MATURE STAGE OF VEGETATION IS ESTABLISHED.
17. ADDITIONAL EROSION CONTROL STRUCTURES AND/OR GRADING MAY BE REQUIRED AT THE TIME OF CONSTRUCTION.

STATEMENTS

ENGINEER'S STATEMENT

THIS GRADING AND EROSION CONTROL PLAN WAS PREPARED UNDER MY DIRECTION AND SUPERVISION AND IS CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF, IF INDICATED GRADING IS PERFORMED IN ACCORDANCE WITH THIS PLAN, THE WORK WILL NOT BECOME A HAZARD TO LIFE AND LIMB, ENDANGER PROPERTY OR ADVERSELY AFFECT THE SAFETY, USE OR STABILITY OF A PUBLIC WAY, DRAINAGE CHANNEL OR OTHER PROPERTY.

RICHARD N. WRAY P.E. #19310 — DATE 11/01/01
FOR AND ON BEHALF OF KIOWA ENGINEERING CORPORATION

APPROVAL – EL PASO COUNTY

FILED IN ACCORDANCE WITH SECTION 51-1 OF THE EL PASO COUNTY LAND DEVELOPMENT CODE, AS AMENDED.

JOHN A. McCARTY, P.E. — DATE 12-5-01
COUNTY ENGINEER/DIRECTOR

DEVELOPER'S STATEMENT

I, THE DEVELOPER, HAVE REVIEWED AND WILL COMPLY WITH THE REQUIREMENTS OF THIS GRADING AND EROSION CONTROL PLAN.

BY: Stephen J. Schnurr, Trustee
TITLE: STEVEN J. SCHNURR LIVING TRUST
ADDRESS: 1910 RAND ROAD
COLORADO SPRINGS, COLORADO 80906

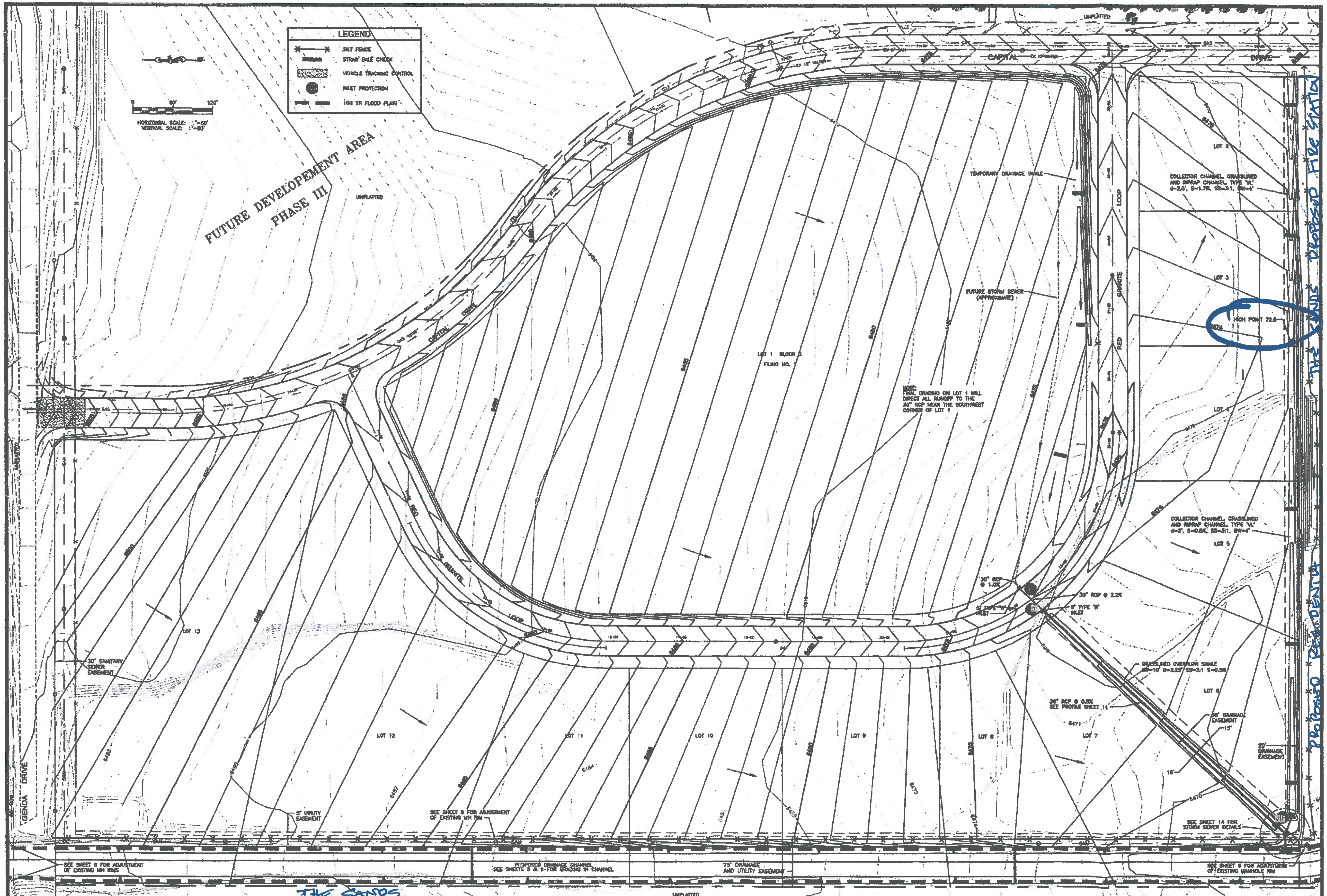
Kiowa Engineering Corporation
2814 International Circle
Colorado Springs, Colorado
80910-3127
(719) 630-7342

ROCKY MOUNTAIN INDUSTRIAL PARK
GRADING AND EROSION CONTROL PLAN

EL PASO COUNTY, COLORADO

Project No.: 01017
Date: November 1, 2001
Design: NRK
Drawn: WMS
Check: RNW
Revisions: 1-16-02 ... DRAINAGE COMMENTS

SHEET
11A
OF 16 SHEETS



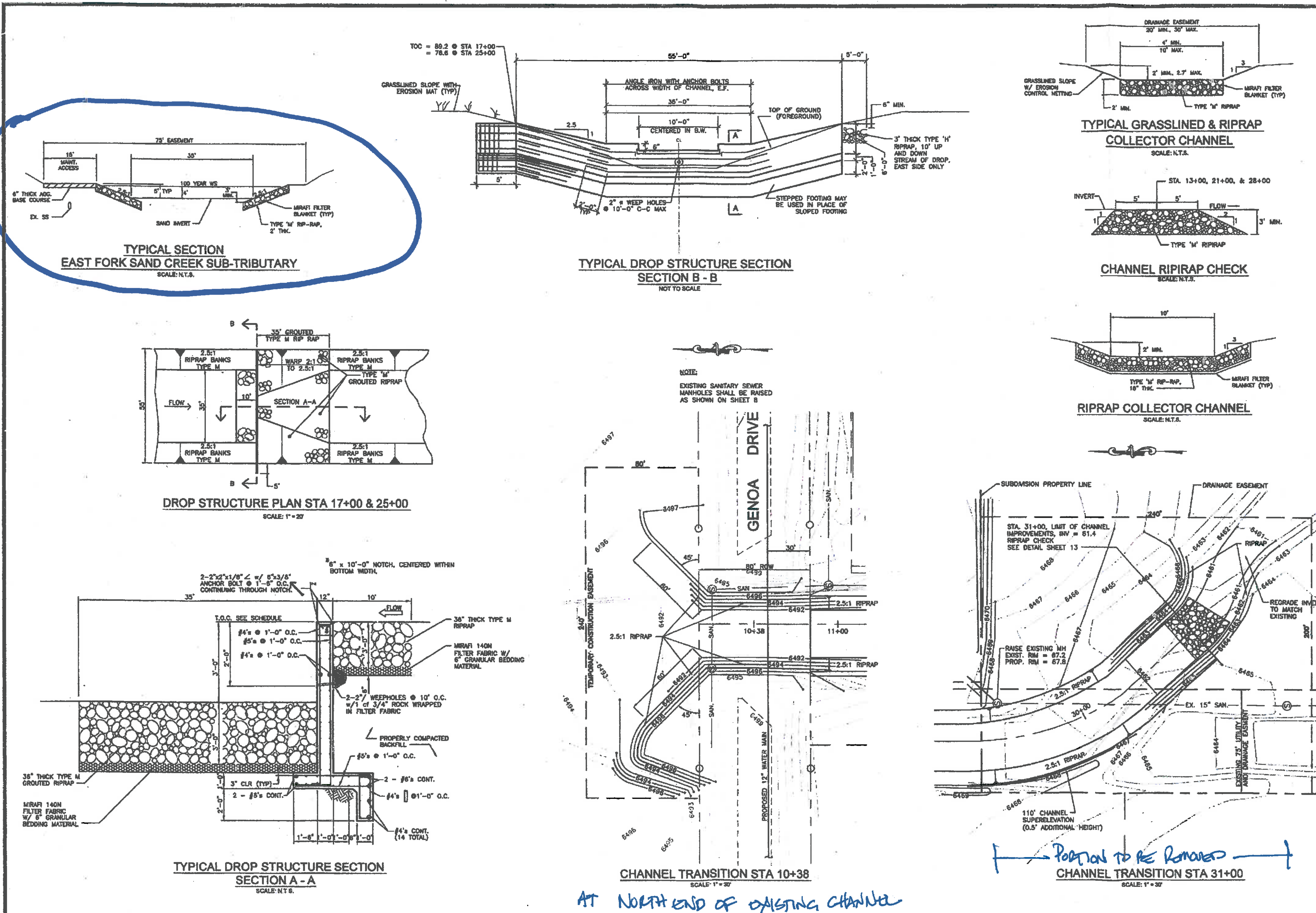
Kiowa Engineering Corporation
2814 International Circle
Colorado Springs, Colorado
80910-3127
(719) 630-7342

ROCKY MOUNTAIN INDUSTRIAL PARK
GRADING AND EROSION CONTROL PLAN
EL PASO COUNTY, COLORADO

Project No.: 01017
Date: Nov. 1, 2001
Design: NRK
Drawn: WMS
Check: RNW
Revisions: 01/21/02
Cher. Met. Dist.
1/10/02 EPCDOT
SHEET comments

11B

OF 15 SHEETS



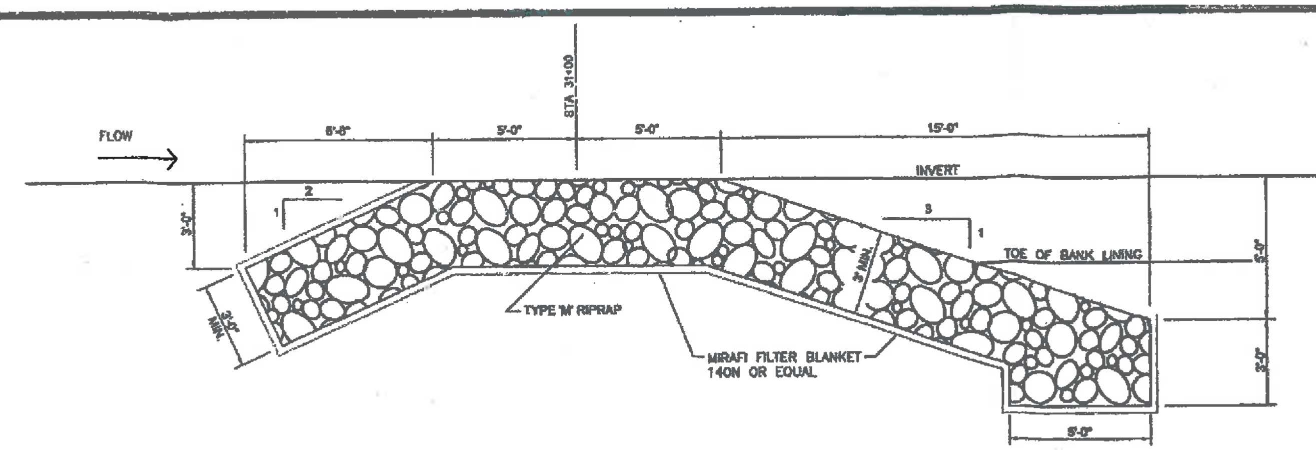
Kiowa Engineering Corporation
2814 International Circle
Colorado Springs, Colorado
80910-3127
(719) 630-7342

ROCKY MOUNTAIN INDUSTRIAL PARK
DETAIL SHEET
EL PASO COUNTY, COLORADO

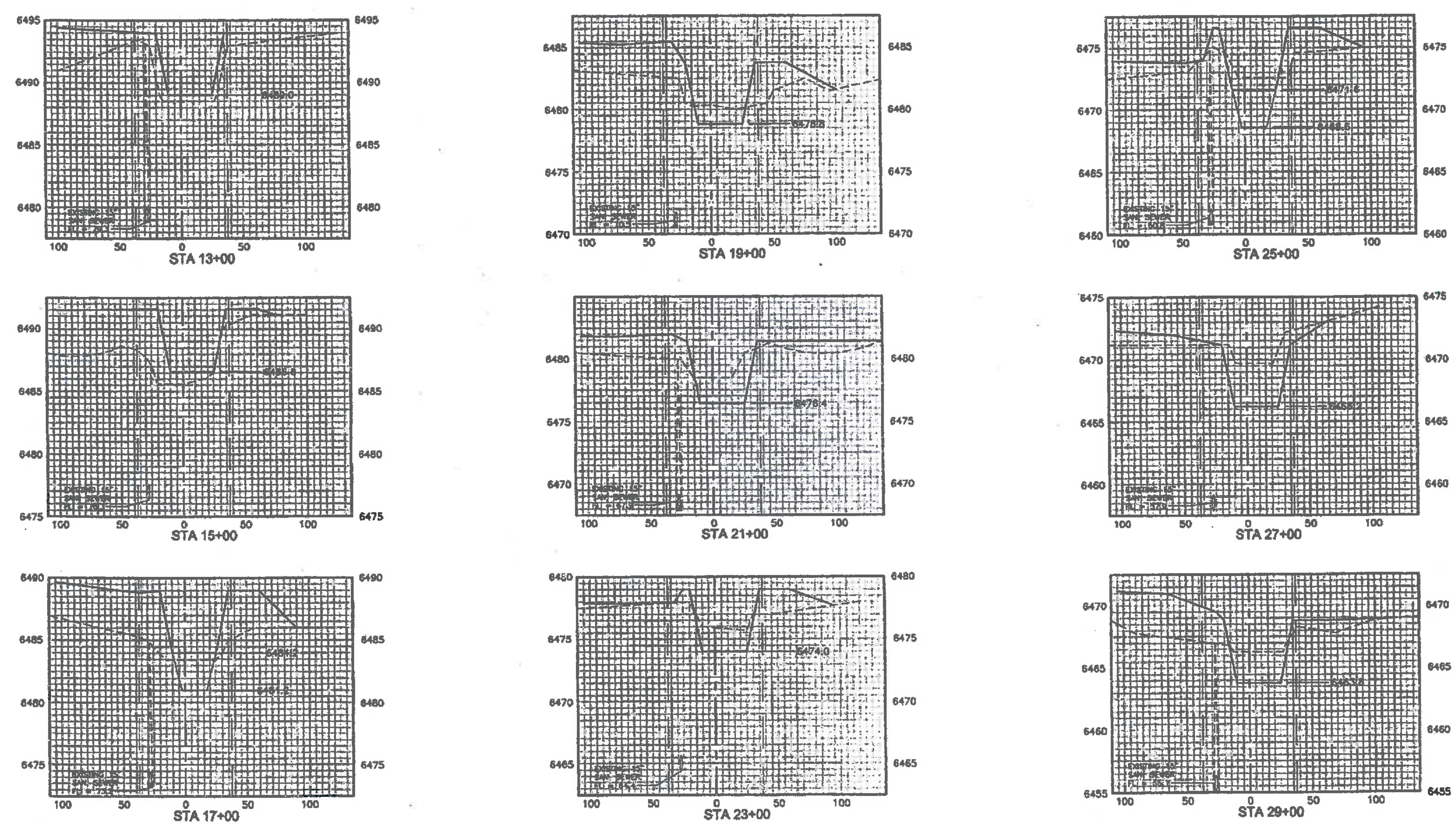
Project No.: 01017
Date: November 1, 2001
Design: RNW
Drawn: WMS
Check: RNW
Revisions: Jan. 10, 2002
Cher. Met. Dist. comments
12/26/01 CDOT comments

SHEET
12
OF 15 SHEETS

EXISTING CHANNEL IMPROVEMENTS

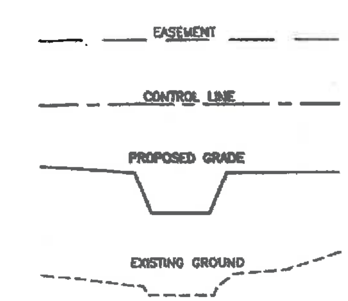


RIPRAP CHECK STA 31+00
SCALE: 1" = 3'



CHANNEL CROSS-SECTIONS
HORIZONTAL SCALE: 1" = 50'
VERTICAL SCALE: 1" = 5'

LEGEND



NOTES:
1. ALL CROSS-SECTIONS ORIENTED LOOKING UP-STATION
2. SEE SHEETS 8 AND 9 FOR ADJUSTMENTS TO SANITARY SEWER MH RIM ELEVATIONS

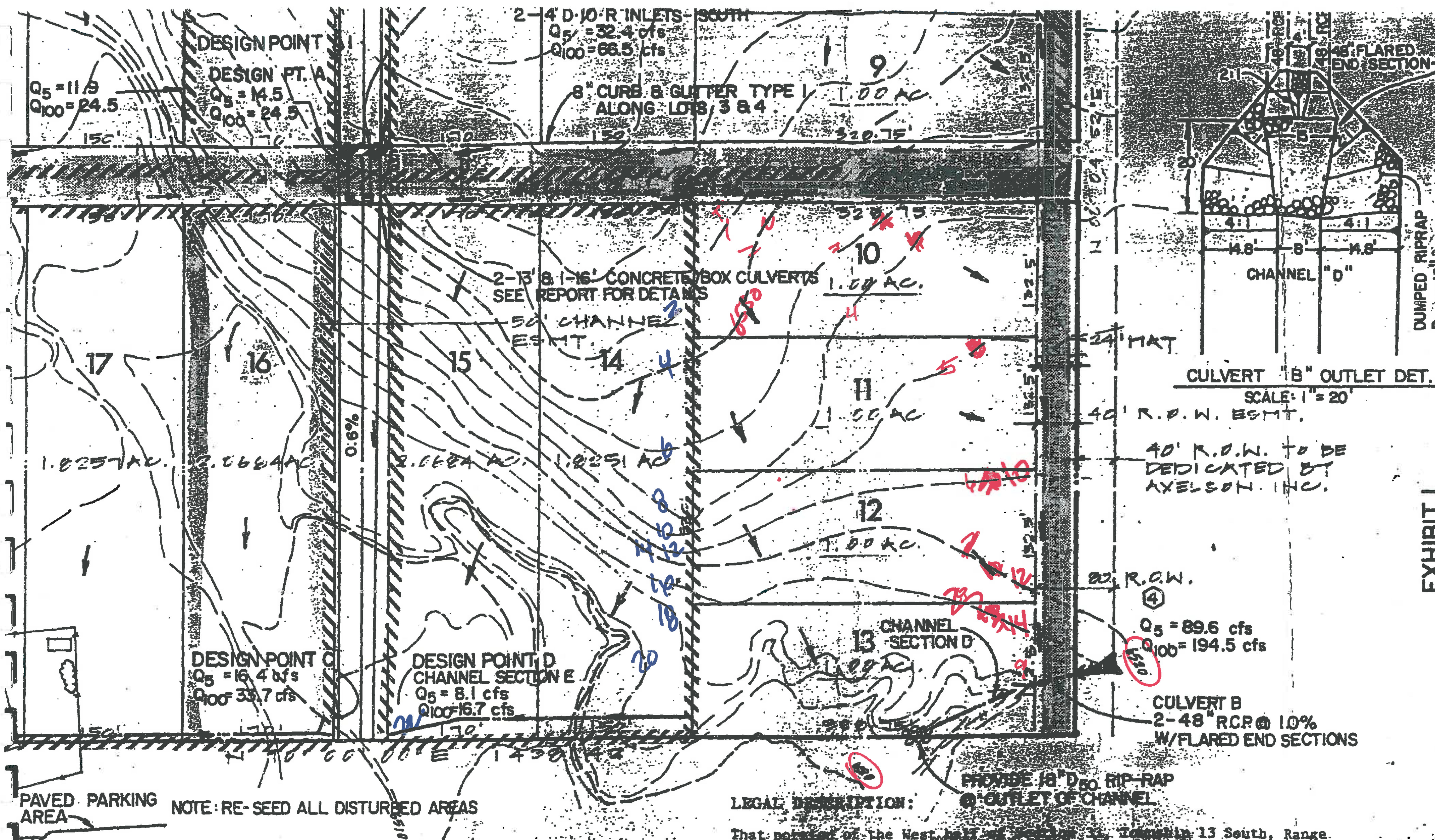
Kiowa Engineering Corporation
2814 International Circle
Colorado Springs, Colorado
80910-3127
(719) 630-7342

ROCKY MOUNTAIN INDUSTRIAL PARK
CHANNEL CROSS-SECTIONS
EL PASO COUNTY, COLORADO

Project No.: 01017
Date: November 1, 2001
Design: NRK
Drawn: WMS
Check: RNW
Revisions: Dec. 14, 2001
Cher. Met. Dist. comments

SHEET
13
OF 15 SHEETS

EXISTING CHANNEL IMPROVEMENTS



NOTE: RE-SEED ALL DISTURBED AREAS

SUB-BASIN BOUNDARY

SMARTT CONST. CO.
6055 LEHMAN DR.

LEGAL DESCRIPTION:

That portion of the West half of Section 31, Township 13 South, Range 65 West of the 6th P.M., [illegible]

Beginning at the Northwest [illegible] Section 31; thence South [illegible] on the West [illegible] thence North 90°00'00" [illegible] 1438.42 [illegible] West, 1080.00 feet to a point on the North line [illegible] thence South 90°00'00" West on said North line, [illegible] to the point of Beginning, El Paso County, Colorado.

PREPARED BY:
SIMONS, LI & ASSOCIATES
118 N. TEJON STREET
COLORADO SPRINGS, CO
80905

DRAINAGE PLAN

EXHIBIT I

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

MARKSHEFFEL INDUSTRIAL PARK

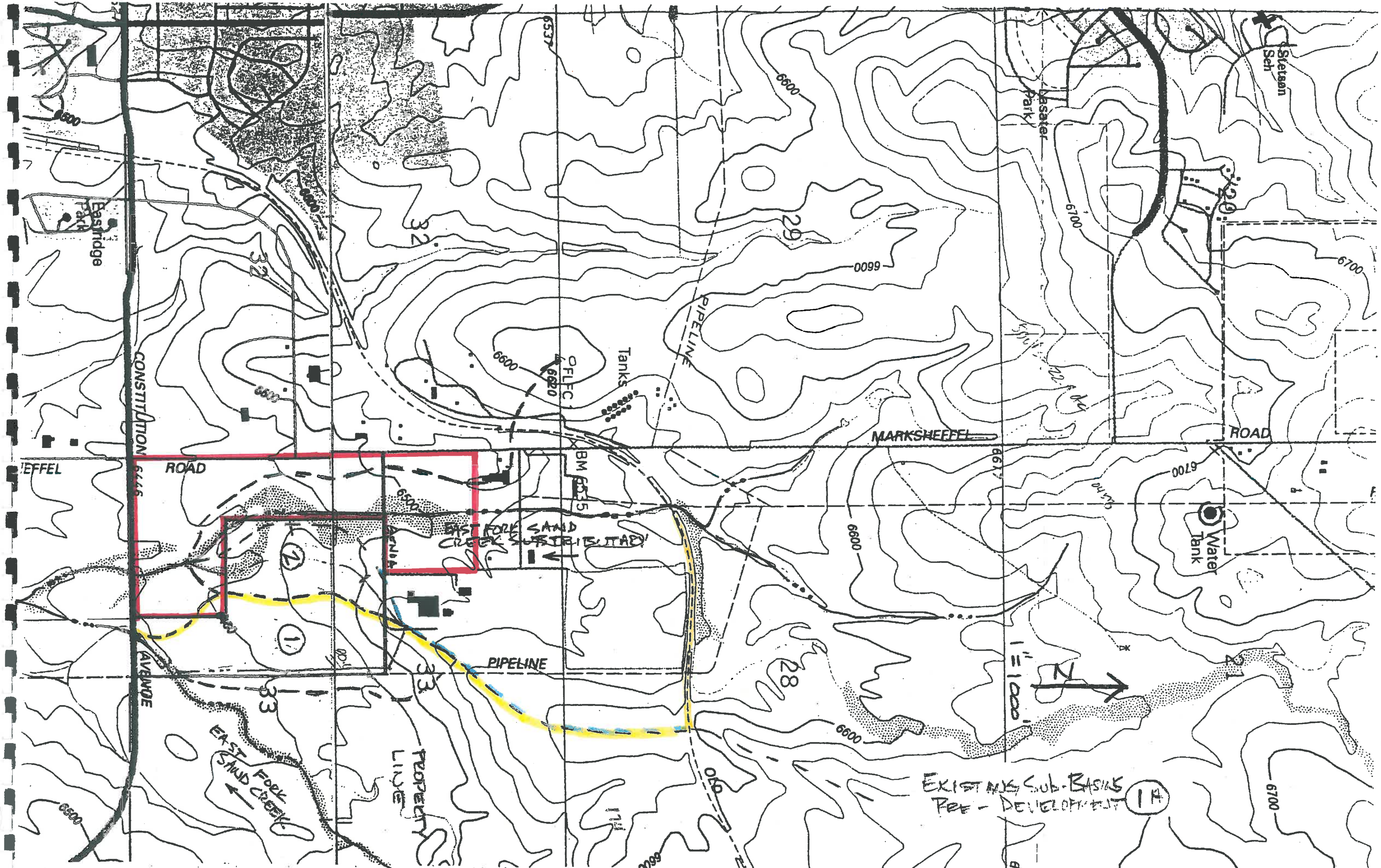
JAY DEVELOPMENT INC.
2460 WATHOKA RD. - JERRY GOETSCH
COLO. SPGS, CO 80915

OCTOBER

finn & ARCHITECTS
611 N. Nevada Ave. S

JOB NO: 0511
FILE NO: 250
DATE: 3/05
SCALE: 1" = 100'

1/1



CONSTITUTION AVENUE
ROAD
EFFEL
MARKSHEFFEL ROAD
PIPELINE
PIPELINE
Tanks
Water Tank
Lasater Park
Eastridge Park
Stetson Sch
BM 6635
EAST FORK SAND CREEK SUBTRIBUTARY
EAST FORK SAND CREEK
PROPERTY LINE
OLD
6600
6700
6500
32
33
29
28
20
21
N
1" = 1000'
EXISTING SUB-BASINS PRE-DEVELOPMENT
1A
1
2

DRAINAGE MAPS

OFF-SITE DRAINAGE MAP

NOTES:

DESIGN POINTS REFERENCED FROM EXISTING CONDITIONS MAP.

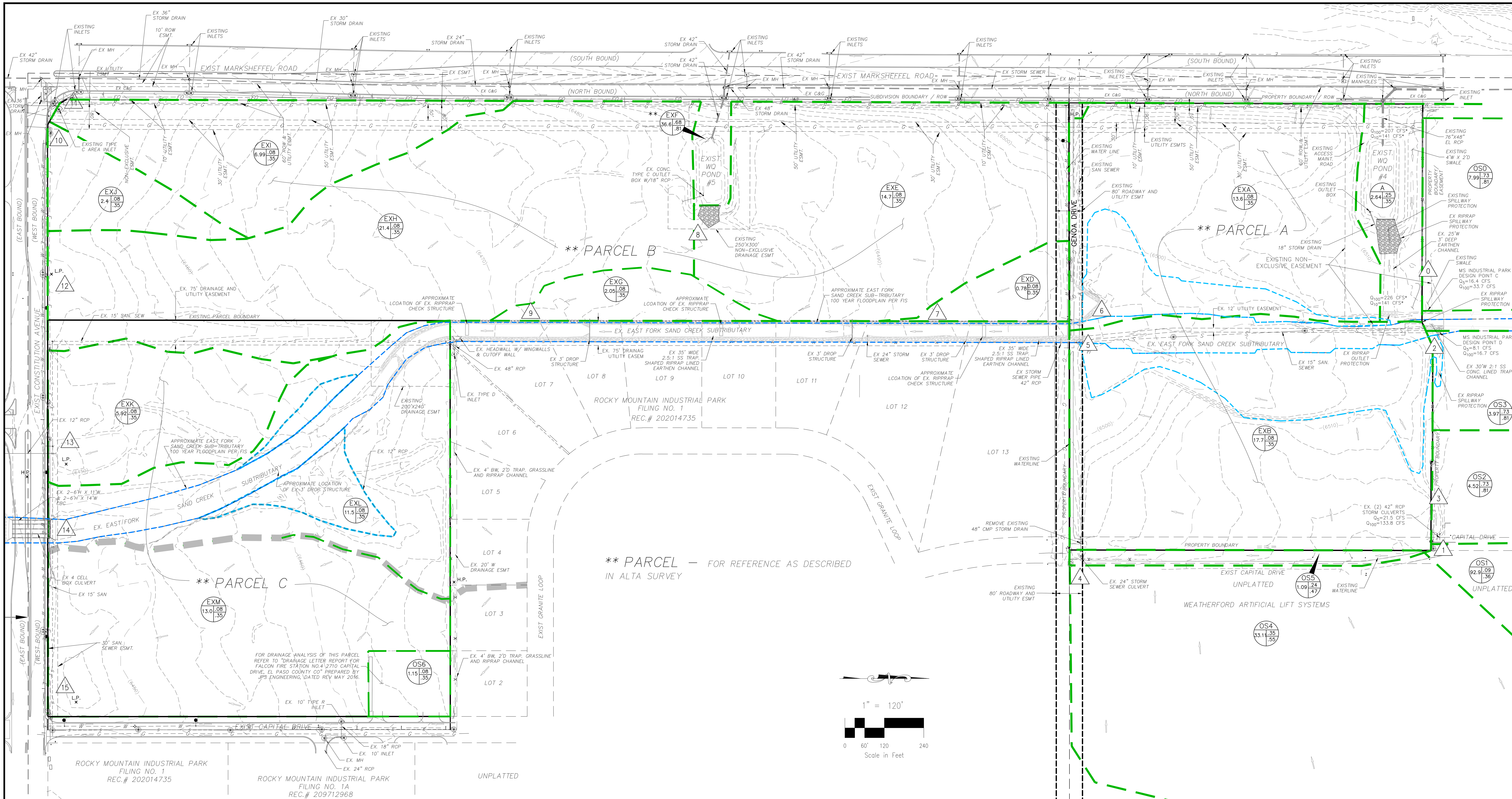
CONTOURS TAKEN FROM USGS SURFACE.

OFF-SITE DRAINAGE MAP
JOB NO. 43-089
DATE PREPARED: 05/23/2017

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

SHEET 1 OF X

File: O:\43089A\MS Rd-Const Ave\dwg\Dev Plan\MDDP\43089-DM-Offsite.dwg Plotstamp: 5/23/2017 11:02 AM



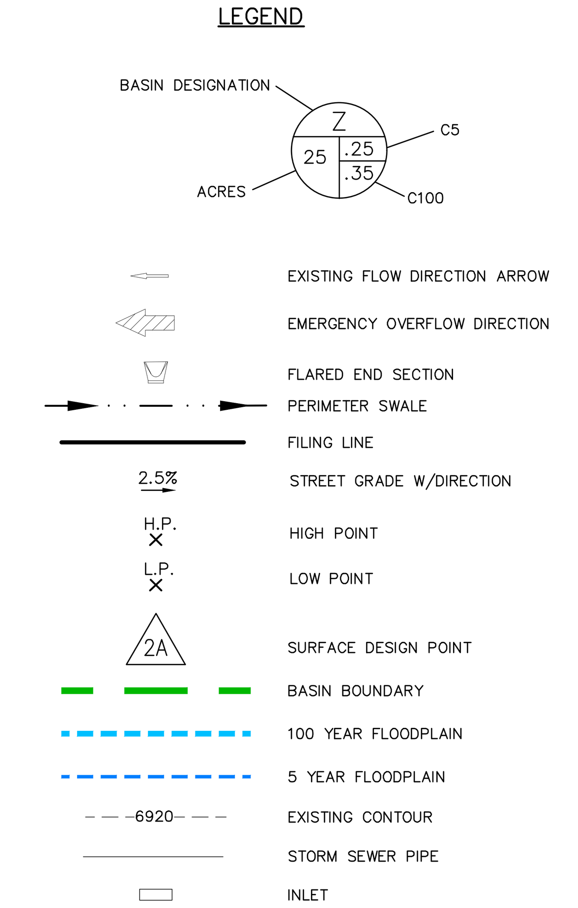
BASIN SUMMARY			
BASIN	AREA (ACRES)	Q5	Q100
OS0	7.99	19.9	37.1
OS1	92.92	21.5	133.8
OS2	4.52	13.7	25.4
OS3	3.97	12.3	22.9
OS4	33.11	32.6	85.4
OS5	1.09	0.8	2.5
EXA	13.61	3.2	23.4
EXB	17.68	4.1	30.0
EXD	0.78	0.2	1.6
EXE	14.72	3.9	27.1
**EXF	36.59	81.3	159.9
EXG	2.05	0.5	3.4
EXH	21.40	4.6	33.5
EXI	6.99	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	EXI, 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



THE SANDS
PREDEVELOPED CONDITIONS DRAINAGE MAP

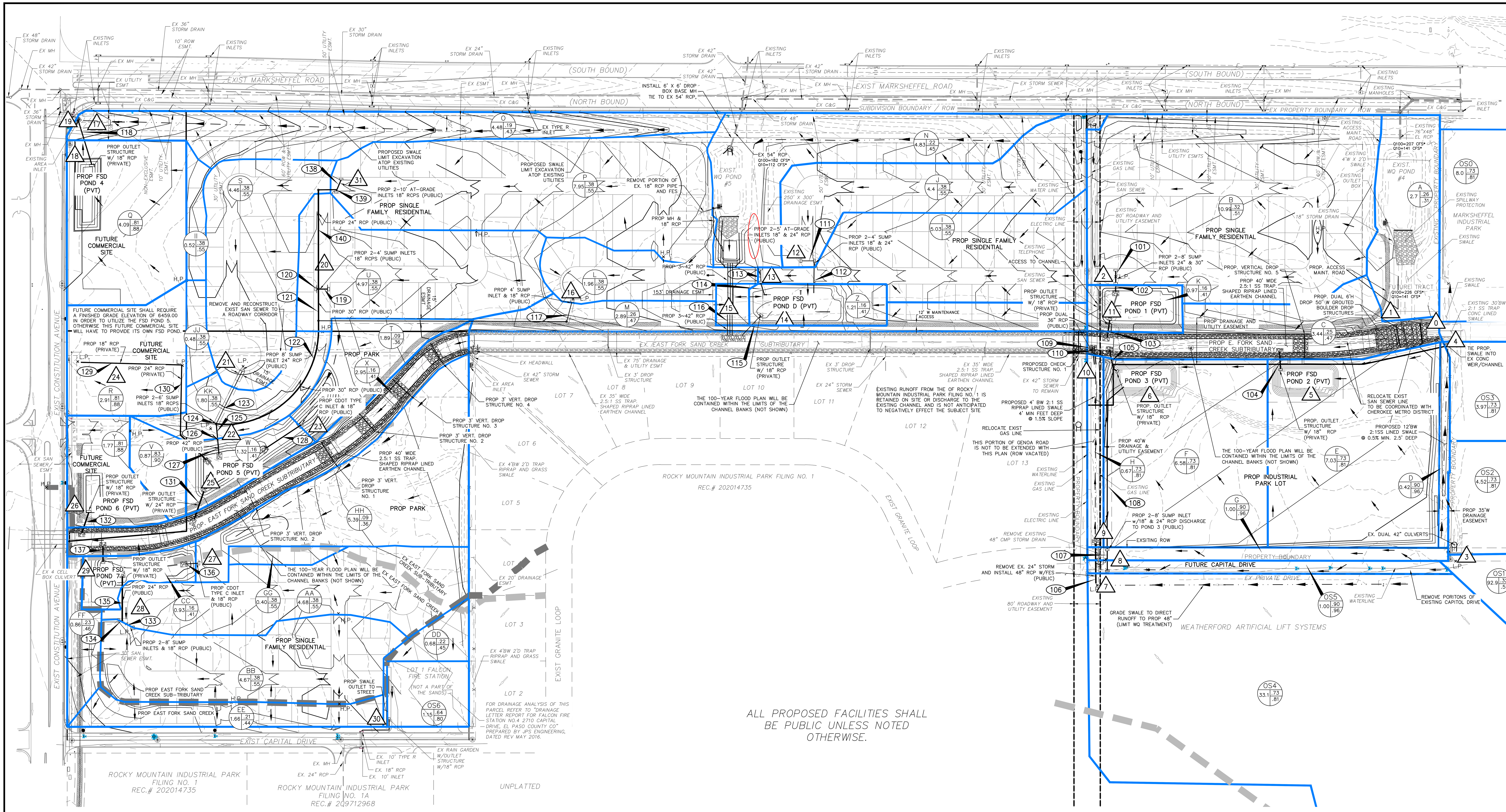
PROJECT NO. 43-089
DESIGNED BY: DLM
DRAWN BY: JWP
CHECKED BY: VAS
SCALE: HORIZONTAL: 1"=120' VERTICAL: NA
DATE: 12-14-17
SHEET 1 OF 1
ECDM-1

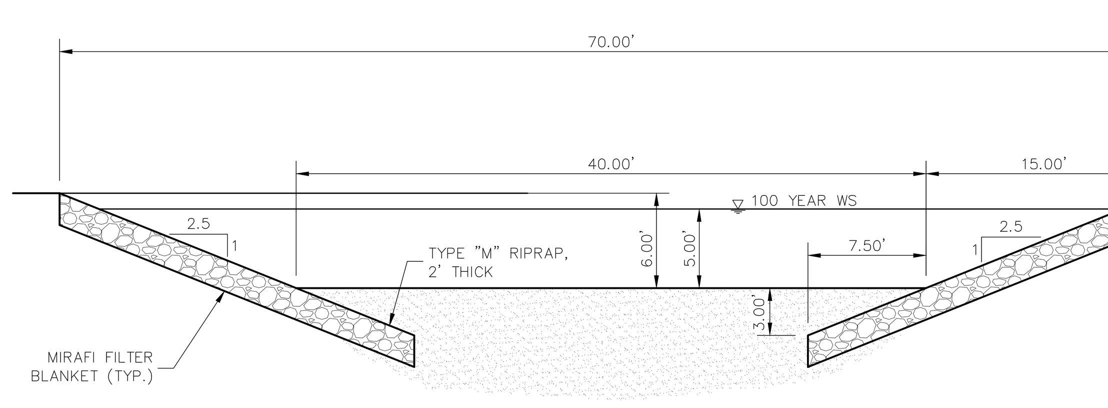
20 BOULDER CRESCENT, SUITE 110
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
M&S CIVIL CONSULTANTS, INC.

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

REVISIONS: NO.	DATE	BY	DESCRIPTION	APRVD. BY	DATE

CAUTION: 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 APPROVED IN WRITING AND MUST BE APPROVED BY THE PREPARER OF THESE PLANS.





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
- EX CONDITION MAJOR BASIN BOUNDARY
- DEVELOPED CONDITION MAJOR BASIN BOUNDARY
- BASIN DESIGNATION (Z; ACRES 25; C5 .25; C100 .35)
- 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

1" = 120'
0 60 120 240
Scale in Feet

THE SANDS
PROPOSED CONDITIONS DRAINAGE MAP

PROJECT NO. 43-089
DATE: 12-15-17
SCALE: HORIZONTAL: 1"=120' VERTICAL: N/A
SHEET 1 OF 1
PCDM-1

DESIGNED BY: DLM
DRAWN BY: JMP
CHECKED BY: VAS

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

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