FINAL DRAINAGE REPORT

FOR

TIMBERLINE STORAGE YARD
EL PASO COUNTY, COLORADO

DECEMBER 2017

Prepared for:
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Project #43-095

PCD Project No. PPR-17-018

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FOR
TIMBERLINE STORAGE YARD

DRAINAGE PLAN STATEMENTS

ENGINEERS STATEMENT

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

COLORADO REGISTERED VIRGIL A. SANCHEZ II 37160 1-3-18 PROFESSIONAL ENGINEER

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

DEVELOPER'S STATEMENT

I, the developer have read and will comply with all the requirements specified in this drainage report and plan.

BY: _____

TITLE: Construction Project Manager
DATE: 1-3-18

ADDRESS: Timberline Landscaping, Inc.
20625 Andalusian View
Pueblo, CO 81008

EL PASO COUNTY'S STATEMENT

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

Approved
By:Jennifer Irvine, County Engineer
Date:02/13/2018
El Paso County Department of Public Works

BY: _____ DATE: _____
Jennifer Irvine, P.E.
County Engineer

CONDITIONS:

This final drainage report contains a section for "FUTURE DRAINAGE CHARACTERISTICS (For Information Purposes Only)". Please note that this portion of the report was not reviewed and future development of the site will require appropriate studies in accordance with the requirements of the EPC LDC, ECM, DCM 1 & 2.

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APPENDIX

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PURPOSE

This document is intended to serve as the Final Drainage Report for the Timberline Storage Yard. The purpose of this document is to identify and analyze the on and offsite drainage patterns and to ensure that post development runoff is routed through the site safely and in a manner that satisfies the requirements set forth by the El Paso County Drainage Criteria Manual. The development plan for the site will consist of a gravel storage yard with an office/warehouse building, asphalt, curb, lighting, an extended detention basin and water quality facility and landscaping. The parcel is zoned "M" and the proposed use is permissible within the Industrial zoning criteria.

GENERAL LOCATION AND DESCRIPTION

Timberline Storage Yard is located in the southeast quarter of the southwest quarter of Section 28, Township 13 South, Range 65 West of the 6th P.M. in El Paso County, Colorado. The parcel is bound to the north, south, and east by other vacant parcels of land. Adjacent to the southwest corner of the site, is an existing development that consists of a light industrial/storage and a maintenance yard. As shown on the enclosed FIRM panel, a channel known as the East Fork of Sand Creek Sub-tributary flows from east to west along the northern boundary of the site. Due to the presence of an existing railroad embankment, the sub-tributary does not influence the subject site. The site is located with the greater Sand Creek Drainage Basin and is tributary to the Sand Creek Channel via the East Fork Sand Creek Sub-Tributary. A vicinity map showing the location of the proposed development has been provided in the appendix of this report.

The proposed "development" will construct improvements on approximately 11.82 acres of the 37.95 acre parcel. The site is currently zoned "M" which is associated with industrial development. In the existing condition, both the parcel and offsite contributing watershed lands are sparsely vegetated, with ground cover consisting primarily of native grasses ranging in density from fair to good. Slopes across the development typically range between 2% to 7% while offsite slopes located to the east of the nearly 38 acres are as steep as 10:1. Offsite flows reaching development are mainly from small fringe areas located along the north and western boundaries. A ridgeline which bisects the parcel, north to south functions to direct runoff to the southern boundary where it has historically collected.

The proposed development will consist of a gravel storage yard with an office/warehouse building, gravel and asphalt parking areas, lighting, landscaping, and an access road. Runoff entering the subject site from offsite areas, as well as flows produced within the development will be collected by proposed storm sewer improvements and routed to a proposed full spectrum detention (FSD) pond located at the southeast corner of the development. The existing drainage swale along the south boundary line will protect right of way improvements from historic runoff. The area directly north of the planned development, which consists of approximately 5.29 acres, is anticipated to be developed in the near future and thus drainage infrastructure planning has been made to accommodate this development should

it occur. Addition detailed discussion regarding these improvements is discussed in subsequent sections of this report.

SOILS

Soils for this project are delineated by the map in the appendix as Blakeland loamy sand (8) and Blendon Sandy Loam (10) is characterized as Hydrologic Soil Types "A" & "B". Soils in the study area are shown as mapped by Soil Conservation Service in the "Soils Survey of El Paso County Area".

HYDROLOGIC CALCULATIONS

Hydrologic calculations were performed using the El Paso County and City of Colorado Springs Storm Drainage Design Criteria manual and where applicable the Urban Storm Drainage Criteria Manual. The Rational Method was used to estimate stormwater 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 El Paso County and City of Colorado Springs Storm Drainage Design Criteria manual. The relevant data sheets are included in the appendix of this report.

FLOODPLAIN STATEMENT

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel No. 08041C0543 F, effective date March 17, 1997 no portion of this site is located within the 100-year floodplain.

DRAINAGE CRITERIA

This drainage analysis has been prepared in accordance with the current El Paso County Drainage Criteria Manual and where applicable the City of Colorado Springs DCM Volume 1 dated May 2014 effective January 2015. Hydrologic calculations were performed to determine runoff quantities for the 5-year and 100-year frequency storms for developed conditions using the Rational Method as required for basins having areas less than 130 acres (in accordance with Chapter 6 of the City of Colorado Springs DCM Volume 1). Full spectrum detention facilities have been designed in accordance with Section 3.2.1. of Chapter 13 of the City of Colorado Springs DCM Volume 1, dated May 2014, effective January 31, 2015.

FOUR STEP PROCESS

Step 1 Employ Runoff Reduction Practices. – Approx. 0.90 acres of the proposed developed 11.48 Acres of ground within the project is being set aside for a Full Spectrum Detention (FSD) Pond. Whenever possible runoff produced within developable area containing impervious surfaces will be routed through landscaped areas or earthen swales to minimize direct connection of impervious surfaces.

Step 3 Stabilize drainage ways –The Timberline Storage Yard site proposes a Full Spectrum Detention (FSD) pond to control developed runoff that is discharging to the historic drainage way that crosses the vacant parcel located to the south of the subject site. The FSD outlet structure has been designed to drain the water quality event storm in 40 hours, while reducing the 100 year peak discharge to approximately 90% of the predevelopment conditions. The development of this site is not anticipated to have negative effects on downstream drainage ways.

Step 3 Provide water quality capture volume. – A Full Spectrum Detention Basin is proposed to reduce peak discharge rates and provide water quality treatment. The WQCV will be released over a 40 hour period while larger event storms will be released in periods of times between 64-80 hours.

Step4 Consider Need for Industrial and Commercial BMP's – This submittal provides a final grading and erosion control plans with BMPs in place. The proposed project will use silt fence, a vehicle tracking control pad, concrete washout area, mulching and reseeding to mitigate the potential for erosion across the site.

EXISTING DRAINAGE CONDITIONS

The Timberline Storage Yard site consists of 37.95 acres and is situated west of the East Fork Reach of the Sand Creek Watershed. There are no existing structures within the planned Timberline Storage Yard site or parent parcel. An existing conditions hydrologic analysis was performed to determine existing flow quantities entering and exiting the subject site so a comparison to post development discharge rates could be made. As shown on the Existing Drainage Map, located in the appendix of this report, the existing site terrain within the parcel generally slopes from north to south at grades that vary between 2% and 7%. An area east of the proposed site contributes to the overall drainage reaching the discharge point located to the south of the subject site.

Basin EX-1 consists of native grass covered un-platted hillside located to the east of the parcel property boundary. Runoff produced by the 22.9 acre area of land has been calculated to be 7.6 cfs in the 5-year storm event and 51.0 cfs in the 100-year storm event. Runoff from this basin is conveyed as sheet flow to the west towards **Basin EX-2**.

Basin EX-2 consists of grass covered un-platted lands to the east of a ridgeline that bisects the nearly 38 acre parent parcel. Runoff produced by the 23.6 acre area has been calculated to reach peak flow rates of 4.5 cfs in the 5-year storm event and 30.4 cfs in the 100-year storm event. Runoff from Basin EX-2 combines with runoff produced within **Basin EX-1** at **Design Point 1** located at the southeast corner of the proposed development boundary. The total calculated surface runoff at **DP1** is 11.5 cfs in the 5-year storm event and 77.3 cfs in the 100-year storm event.

Basin EX-3 consists of native grass covered un-platted lands located within and adjacent to the western half of the parent parcel. Runoff produced by the 24.7 acre area of land has been calculated to be 4.6 cfs in the 5-year storm event and 30.8 cfs in the 100-year storm event. Runoff from **Basin EX-3** combines with runoff from **DP 1** at **Design Point 2**, at a small channelized drainage way located adjacent to the southern boundary of the planned development. The total calculated surface runoff at **DP2** is 13.6 cfs in the 5-year

storm event and 91.6 cfs in the 100-year storm event. Runoff reaching this point continues south through the adjacent un-platted offsite parcel.

PROPOSED DRAINAGE CHARACTERISTICS

General Proposed Conditions Drainage Discussion

The parent parcel housing the proposed development is approximately 37.95 acres in size and is currently zoned "M" for industrial. As previously discussed, of the total 37.95 acres parcel, approximately 11.48 acres are currently being developed to the planned Timberline Storage Yard, which is to consist of a large gravel storage yard, an office/warehouse building, with asphalt and gravel parking areas, lighting, landscaping, and access entryways.

Runoff produced north of the proposed site development area will mimic the historic drainage patterns by sheet flowing to the north development boundary line (see attached proposed drainage map in the appendix) where it will combine with runoff generated onsite within the gravel storage yard and from the north half of the warehouse building (see attached proposed drainage map in the appendix). Proposed earthen swales a proposed rip rap lined rundown will conveyed the collected runoff to a proposed 0.9 acre Full Spectrum Detention pond located along the southern boundary of the site.

As in the historic condition, runoff produced by offsite areas located to both the north and the west of the proposed site will sheet flow on to the proposed development and combine with developed runoff from the proposed west parking lot areas in a proposed curb and gutter section. The combined runoff will be routed to the south and will be released to the Capital Drive curb and gutter. The developed area is less than 1 acre and will not require on-site detention.

Runoff generated from a portion of the parking lot, access roadway, and landscaped area (south of buildings) will combined with flows produced by the proposed south half of the building/warehouse and parking lots on the east half of the site. The combined runoff will be collected by a proposed concrete rundown/access path and conveyed to the proposed FSD pond. The runoff reaching the pond will be detained and discharged via a staged outlet box and proposed RCP storm system to the historic drainage way located south of the site. A proposed concrete pad will be dispersing flows as to not impact the historic drainage way located to the south of the site. Proposed discharge from the site, post construction, is less than historic and therefore its construction is not anticipated to negatively affect downstream facilities or properties.

Proposed Conditions Detailed Drainage Discussion

Basin OS-1, 8.9 acres, (Q5=2.5cfs, Q100=16.6cfs), consists of undeveloped un-platted lands located within the parcel that is planned to be developed in the future with industrial intentions along with a small portion of the existing railroad embankment adjacent to the northern boundary of the parcel.. **Basin OS-1** uses a historic runoff coefficient for the proposed condition when the Timberline Storage Yard is developed. A higher industrial imperviousness value was taken into consideration while studying the future conditions of the parcel (refer to future conditions detailed drainage summary). Flows generated within the basin are directed south to **Basin A.**

Basin OS-2, 1.0 acres, (Q5=0.3cfs, Q100=2.2cfs), consists of undeveloped un-platted offsite lands located along the west boundary of the proposed development. Runoff from **Basin OS-2** is tributary to **Basin A.**

Basin A, 8.3 acres, (Q5=9.4cfs, Q100=25.1cfs), consists primarily of a proposed gravel storage yard as well as the north half of the proposed office/warehouse building, concrete aprons, and asphalt parking areas. Runoff produced within **Basin A** combines with runoff from **Basins OS-1** and **OS-2** at **Design Point 1** (Q5=8.1cfs, Q100=29.6cfs). Runoff reaching DP-1 will be directed to a proposed Full Spectrum Detention Pond at **Design Point 4** via a 3'bw 2:1 SS trapezoidal 25% rundown lined with grouted D50=12" riprap (24" deep). A pair of 4:1SS, 1' min. deep v-shaped earthen swales graded at 0.8% are recommended to be constructed along the northern exterior of the pond embankment to intercept runoff that might otherwise erode the pond side slopes.

Basin OS-3, 0.2 acres, (Q5=0.1cfs, Q100=0.5cfs), consists of undeveloped un-platted offsite lands located along the west boundary of the proposed development. It should be noted that based upon site visitation runoff from **Basin OS-3** appears to be tributary to **Basin B**, despite the illustration of the FIMS contours shown on the provided maps and thus have been included in the calculated of runoff anticipated to reach **Design Point 2**.

Basin OS-4, 0.1 acres, (Q5=0.3cfs, Q100=0.7cfs), consists of a small basin located near the southwest corner of the site. The basin includes a small portion of offsite undeveloped ground as well as a portion of the proposed access road. Runoff generated by this basin are directed westward via the proposed curb and gutter to the combine with flows from **Basin B**.

Basin B, 0.9 acres, (Q5=2.2cfs, Q100=4.4cfs), consists of a portion of the concrete aprons, and gravel and asphalted surfaces for the purpose of parking and driving located along the western side of the planned development. Runoff from **Basin OS-3** and **Basin OS-4** combines with runoff generated in **Basin B** and is directed to via proposed curb and gutter to the Capital Drive curb and gutter at **Design Point 2** (Q5=2.4cfs, Q100=5.4cfs). The developed area is less than 1 acre and will not require on-site detention.

Basin C, 0.9 acres, (Q5=3.2cfs, Q100=6.1cfs), consists of the south half of the proposed building, the east paved parking lot, landscaping, driveways as well as a portion of the proposed paved asphalt access roadway that runs east to west along the proposed development. Runoff produced within **Basin C** is direct via proposed curb and gutter to a low point located at **Design Point 3** (Q5=3.2cfs, Q100=6.1cfs). Runoff reaching DP-3 will be directed to a proposed Full Spectrum Detention Pond via a proposed 12' wide concrete rundown/access path to **Design Point 4.**

Basin D, 0.9 acres, (Q5=0.8cfs, Q100=3.1cfs), consists of a portion of land dedicated to a proposed Full Spectrum Detention (FSD) pond. Runoff from **Design Points 1** & **3** contribute to the proposed FSD pond at **Design Point 4** at a combined peak flow rate of Q5=9.8cfs, Q100=33.7cfs. The proposed full spectrum detention **FSD Pond 1** was sized utilizing the UDFCD UD-Detention Worksheet, Vol 3.07. Based upon the contributing watershed size, characteristics and planned imperviousness the pond required a minimum of 1.876 acre feet of storage in the 100-year event and was limited to 8.3 cfs of discharge via a 24" RCP storm pipe. A proposed concrete pad will be dispersing flows as to not impact the historic drainage way located to the south of the site. Proposed discharge from the site, post construction, is less than historic and therefore its construction is not anticipated to negatively affect downstream facilities or properties. Consideration has been given for future site conditions, see future site discussion within this report. The

crest of the spillway is set above the 100-year water surface at 6539.05 which allows for positive drainage to the future curb line. The proposed embankment has been set at 6541.0. Should the pond outlet or box become clogged storm water shall overtop the emergency spillway and outfall to the historic channel. Let it be noted the FSD, rundowns to the FSD and outlet structure have been sized to detain the additional runoff and imperious area in the future condition. In the future condition, the orifice plate and restrictor plate will have to be re-designed per the additional runoff.

Basin OS-5, 22.9 acres, (Q5=7.6cfs, Q100=50.9cfs), consists of an offsite hillside located directly east of the parent parcel along with a small portion of the existing railroad embankment adjacent to the northern boundary of the parcel. This watershed area was studied in order to quantify offsite flows that are currently directed across the east boundary of the parent parcel and combine with flows from by **Basin OS-6**.

Basin OS-6, 26.1 acres, (Q5=4.9cfs, Q100=33.2cfs), consists of the eastern half of the parent parcel along with a small portion of offsite area located to the east of the property boundary as well as a portion of the existing railroad embankment adjacent to the northern boundary of the parcel. Runoff from **Basin OS-5** combines with runoff from **Basin OS-6** and continues southwesterly overland to **Design Point 5** (Q5=11.3cfs, Q100=76.2cfs)**.**

Basin OS-7, 0.68 acres, (Q5=0.2cfs, Q100=1.4cfs), consists of a small offsite area located between the permanent site improvements and the historic drainage channel. The combined runoff from this primarily undeveloped area, the proposed FSD detention pond outlet pipe and **DP5** combines at **Design Point 6** for a 5 and 100-year peak flow rates of 12.4 cfs and 85.8 cfs. This calculated developed discharge is less than the existing runoff estimated to reaching this location of 13.6 and 91.6 cfs in the 5 year and 100 year events respectively. These flows will follow historic drainage patterns and a portion the historic flow has been reduced by FSD Pond 1. Therefore the runoff is not anticipated to negatively affect downstream facilities.

WATER QUALITY PROVISIONS AND MAINTENANCE

The proposed full spectrum detention (FSD) pond functions to provide detention and water quality for the proposed development as well as all runoff tributary to it. This includes runoff produced onsite, north of the development and parcel, as well as offsite flows adjacent to the west boundary of the parcel. This full spectrum detention pond will function to treat approximately 20.0 acres by providing 0.216 acre-feet of storage for the water quality event 0.516 acre feet of storage at the EURV event storm and 1.88 acre-feet of storage in the 100-year event. The proposed full spectrum detention basin will be private and shall be maintained by the property owner. Access shall be granted to the owner and El Paso County for access and maintenance of the private WQCV facility. A private maintenance agreement document shall accompany this report submittal.

The sizing for the full spectrum detention facility has been determined using the guidelines set forth in the Urban Drainage and Flood Control District Criteria Manual. Refer to the UDFCD UD-Detention Excel Workbook located within the appendix of this report for calculations.

FUTURE DRAINAGE CHARACTERISTICS (For Information Purposes Only)

Additional future condition drainage analysis has been conducted to ensure that the infrastructure proposed with the proposed development functions with future onsite and offsite development and functions to provide a conceptual plan for infrastructure improvements. The analysis will aid the developer in understanding what lands may need to be reserved for future drainage improvements and those potential impacts relate to the developable footprint. A Future Drainage Map for Timberline Storage Yard is provided in the appendix of this report.

The development assumptions included in this future condition analysis include:

- Revised Basin OS1 will be developed assuming industrial use and drainage shall be tributary to the FSD Pond 1.
- Revised Basin OS6 will be developed assuming industrial use and drainage shall be tributary to a Future FSD Pond 2.
- Revised Basin OS5 will be developed assuming industrial use and drainage shall be tributary to a Future FSD Pond 3.
- Lands located to the west of the Timberline Storage Yard boundary (portion of Basins OS1), Basin OS2, OS3, OS4 shall be assumed to remain undeveloped for the purposed of calculating runoff. Should the parcel develop, runoff shall be retained onsite or limited to discharge to Timberline Storage Yard at historic runoff rates.

Future Conditions Detailed Drainage Discussion (For Information Purposes Only)

Basin OS-1, 8.9 acres, (Q5=17.8cfs, Q100=38.6cfs), consists of 3.2 acres of undeveloped un-platted lands located outside the parent parcel as well as 5.7 acres of planned industrial development. Flows generated within the basin are directed south to **Basin A.**

Basin OS-2, 1.0 acres, (Q5=0.3cfs, Q100=2.2cfs), consists of undeveloped un-platted offsite lands located along the west boundary of the proposed development. Runoff from **Basin OS-2** is tributary to **Basin A.**

Basin A, 8.3 acres, (Q5=9.4cfs, Q100=25.1cfs), consists primarily of an existing gravel storage yard as well as portions of an existing office/warehouse building, concrete aprons, and asphalt parking areas. Runoff produced within **Basin A** combines with runoff from **Basins OS-1** and **OS-2** at **Design Point 1** (Q5=19.6cfs, Q100=47.1cfs). Runoff reaching DP-1 will be directed to an existing Full Spectrum Detention Pond via an existing 3'bw 2:1 SS trapezoidal 25% rundown lined with grouted D50=12" riprap (24" deep). A pair of existing 4:1SS, 1' min. deep v-shaped earthen swales graded at 0.8% are constructed along the northern exterior of the pond embankment to intercept runoff that might otherwise erode the pond side slopes.

Basin OS-3, 0.2 acres, (Q5=0.1cfs, Q100=0.5cfs), consists of undeveloped un-platted offsite lands located along the west boundary of the proposed development. It should be noted that based upon site visitation runoff from **Basin OS-3** appears to be tributary to **Basin B**, despite the illustration of the FIMS contours shown on the provided maps and thus have been included in the calculated of runoff anticipated o reach **Design Point 2**.

Basin OS-4, 0.1 acres, (Q5=0.3cfs, Q100=0.7cfs), consists of a small basin located near the southwest corner of the site. The basin includes a small portion of offsite undeveloped ground as well as a portion of the proposed access road. Runoff generated by this basin are directed westward via the proposed curb and gutter to the combine with flows from **Basin B**.

Basin B, 0.9 acres, (Q5=2.2cfs, Q100=4.4cfs), consists of a portion of the concrete aprons, and gravel and asphalted surfaces for the purpose of parking and driving located along the western side of the planned development. Runoff from **Basin OS-3** and **Basin OS-4** combines with runoff generated in **Basin B** and is directed to via proposed curb and gutter to the Capital Drive curb and gutter at **Design Point 2** (Q5=2.4cfs, Q100=5.4cfs). The developed area is less than 1 acre and will not require on-site detention.

Basin C, 0.9 acres, (Q5=3.2cfs, Q100=6.1cfs), consists of the south half of the proposed building, the east paved parking lot, landscaping, driveways as well as a portion of the proposed paved asphalt access roadway that runs east to west along the proposed development. Runoff produced within **Basin C** is direct via proposed curb and gutter to a low point located at **Design Point 3** (Q5=3.2cfs, Q100=6.1cfs). Runoff reaching DP-3 will be directed to a proposed Full Spectrum Detention Pond via a proposed 12' wide concrete rundown/access path to **Design Point 4.**

Basin D, 0.90 acres, (Q5=0.8cfs, Q100=3.1cfs), consists of a portion of land dedicated to an existing Full Spectrum Detention (FSD) pond that has been sized to detain the additional runoff and imperious area associated with the development of **Basin OS1**. Runoff from **Design Points 1** & **3** contribute to the FSD pond at **Design Point 4** at peak flow rates of Q5=21.7cfs, Q100=52.1cfs.

Based upon the contributing watershed size, characteristics and anticipated imperviousness the existing FSD pond has been sized previously to provide a minimum of 1.90 acre-feet of storage in the 100-year event and limit discharge to approximately 21.8 cfs via an existing 24" RCP. The existing concrete pad will be dispersing flows as to not impact the historic drainage way located to the south of the site. Proposed discharge from the site, post construction, is less than historic and therefore its construction is not anticipated to negatively affect downstream facilities or properties. The existing crest of the spillway is set at the 100-year water surface at 6539.05 which allows for positive drainage to the future curb line. The existing embankment is set at 6541.0. Should the pond outlet or box become clogged storm water shall overtop the emergency spillway and outfall to the historic channel. Let it be noted the FSD, rundowns to the FSD and outlet structure have been sized to detain the additional runoff and imperious area in the future condition. In the future condition, the orifice plate and restrictor plate will have to be re-designed and installed per the additional runoff.

It is assumed in the future condition that the 26.6 acre offsite **Basin OS-5**, (Q5=78.4cfs, Q100=148.8cfs), will be developed for industrial use. Runoff generated by **Basin OS-5** would be conveyed to a future Full Spectrum Detention Pond (**Future offsite FSD Pond 2**) located offsite, in this case at **Design Point 5** (Q5=78.4cfs, Q100=148.8cfs). Based upon the anticipated future development and existing site conditions the future FSD pond will need to provide approximately 4.1 acre-feet of storage. Per the UD Detention Worksheet, the future facility could be allowed to discharge up to 25.4cfs to downstream facilities in the 100-year event. Conceptually a future 24" storm sewer system (**Pipe 2**) could be extended into the site to collect and convey drainage to the down-gradient to the west. Additional details regarding the

infrastructure, proposed land use and drainage conveyance systems will need to be amended with subsequent drainage reports once a development is further defined.

In the future condition, **Basin OS-6**, 22.8 acres (Q5=59.6cfs, Q100=114.0cfs), would likely be developed for industrial use. Runoff generated by **Basin OS-6** could be conveyed to a future Full Spectrum Detention Pond (**Future FSD Pond 3**) located at the southwest corner of the basin at **Design Point 6** (Q5=59.6cfs, Q100=114.0cfs). Based upon the anticipated future development and existing site conditions the future FSD pond will need to provide approximately 3.3 acre-feet of storage. Per the UD Detention Worksheet, the future facility would be allowed to discharge approximately 37.0cfs to downstream facilities. Conceptually a future 30" storm sewer system (**Pipe 3**) could be extended into the site to collect and convey drainage to the down-gradient to the west. Additional details regarding the infrastructure, proposed land use and drainage conveyance systems will be amended with subsequent drainage reports.

As depicted on the Future Drainage Map a future 42" pipe (**Pipe 4**) could be constructed to convey the combined drainage discharge from both ponds (Q5=3.6cfs, Q100=62.4cfs) to the historic channel located south of the Timber Storage Yard.

Basin OS-7, 0.68 acres, (Q5=0.2cfs, Q100=1.4cfs), consists of a small offsite area located between the permanent site improvements and the historic drainage channel. The combined runoff from this primarily undeveloped area, Pipe 1 and Pipe 4 would combine at **Design Point 7** for a 5 and 100-year peak flow rates of 5.4 cfs and 85.6 cfs. This calculated developed discharge is less than the existing runoff estimated to reach this location of 13.6 and 91.6 cfs in the 5 year and 100 year events respectively.

OFFSITE DOWNSTREAM CHANNEL ANALYSIS

El Paso County Engineering has requested an analysis of the offsite downstream channel. The existing channel runs north to south on unplatted land owned by Weatherford Artificial (Sch. No. 5300000190). The analysis of the existing channel will be begin at the outfall of the proposed Timberline Storage to the north and will end at the two existing 48" culverts at the southwest end of the property. Runoff will ultimately be routed to the East Fork Sand Creek Subtributary. Runoff tributary to the existing channel has been accounted for, as proposed developed flow from the proposed Timberline Storage site (37.95 acres), offsite developed flow from the BLH NO.2 LLC property (22.9 acres), existing undeveloped flow from the offsite BLH NO.2 LLC property (7.7 acres) and existing undeveloped flow from the offsite Weatherford Artificial property (30.2 acres).

Analysis of the existing channel and results provided by the Hydrologic Engineering Center River Analysis System (HEC-RAS) program. Per the results provided (see Appendix), scour (see shear values) and velocities are below the maximum values as stated in the City of Colorado Springs Drainage Criteria Manual Vol.1 (DCM1). Hence erosion of the existing channel is minimal. Let it be noted that with the development of Timberline Storage, the runoff values have been reduced in part to the release rate by the EDB pond. Proposed discharge from the site, post construction, is less than historic and therefore its construction is not anticipated to negatively affect downstream facilities or properties.

EROSION CONTROL

It is the policy of the El Paso County that we submit a grading and erosion control plan with the drainage report. Proposed silt fence, vehicle traffic control, and concrete washout area are proposed as erosion control measures. The costs for these measures have been provided on the Grading and Erosion Control plan.

CONSTRUCTION COST OPINION

Private Drainage Facilities (**NON-Reimbursable**):

Item	Description	Quantity		Unit Cost		Cost
1.	24" RCP	65	LF	$50	/LF	$3,250.00
2.	24” RCP FES	1	EA	$900	/EA	$900.00
3.	12’x58’x6”ConcRundown	13	CY	$250	/CY	$3,250.00
4.	55’x45’x4”ConcPad	31	CY	$250	/CY	$7,750.00
5.	7’x50’x2’ ‘H’GroutRiprap	26	CY	$150	/CY	$3,900.00
6.	Full Spectrum Det Pond	1	EA	$20,000	/EA	$20,000.00
7.	Modified Type D Outlet'	1	EA	$10,500	/EA	$10,500.00
					Total $	$49,550.00

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 and below is only an estimate of the facility cost and drainage basin fee amounts in 2017.

SUMMARY

The proposed drainage facilities recommended within this report will adequately convey, detain and route runoff from the planned development to the historic drainage way at peak flow rates which are below historic. Future drainage facilities recommended within this report should be reanalyzed with subsequent site specific drainage report and construction documents. Care should be taken at all times to plan for and accommodate safe overland emergency flow routes for all contributing runoff.

REFERENCES

1.) "El Paso County and City of Colorado Springs Drainage Criteria Manuals".

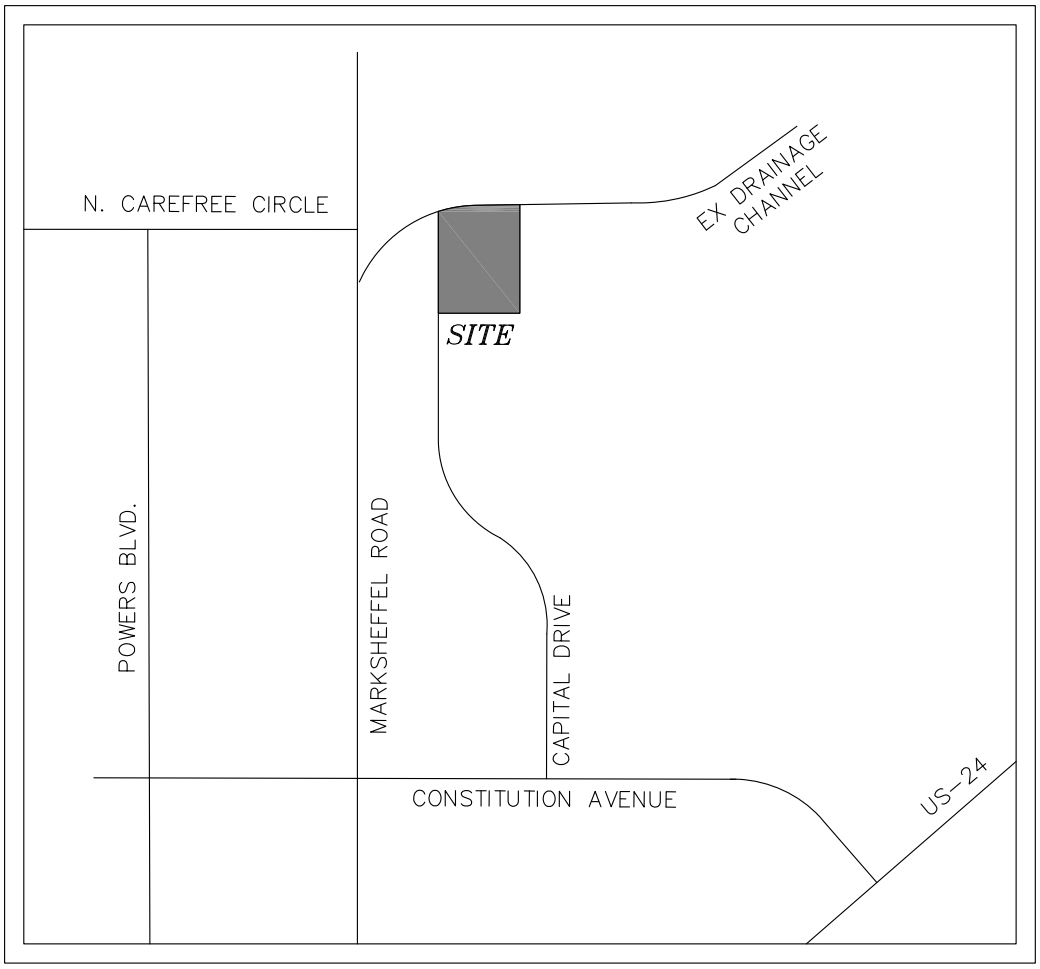
2.) "Urban Storm Drainage Criteria Manual"

3.) SCS Soils Map for El Paso County.

4.) Flood Insurance Rate Map (FIRM), Federal Emergency Management Agency, Effective date March 17, 1997.

APPENDIX

VICINITY MAP

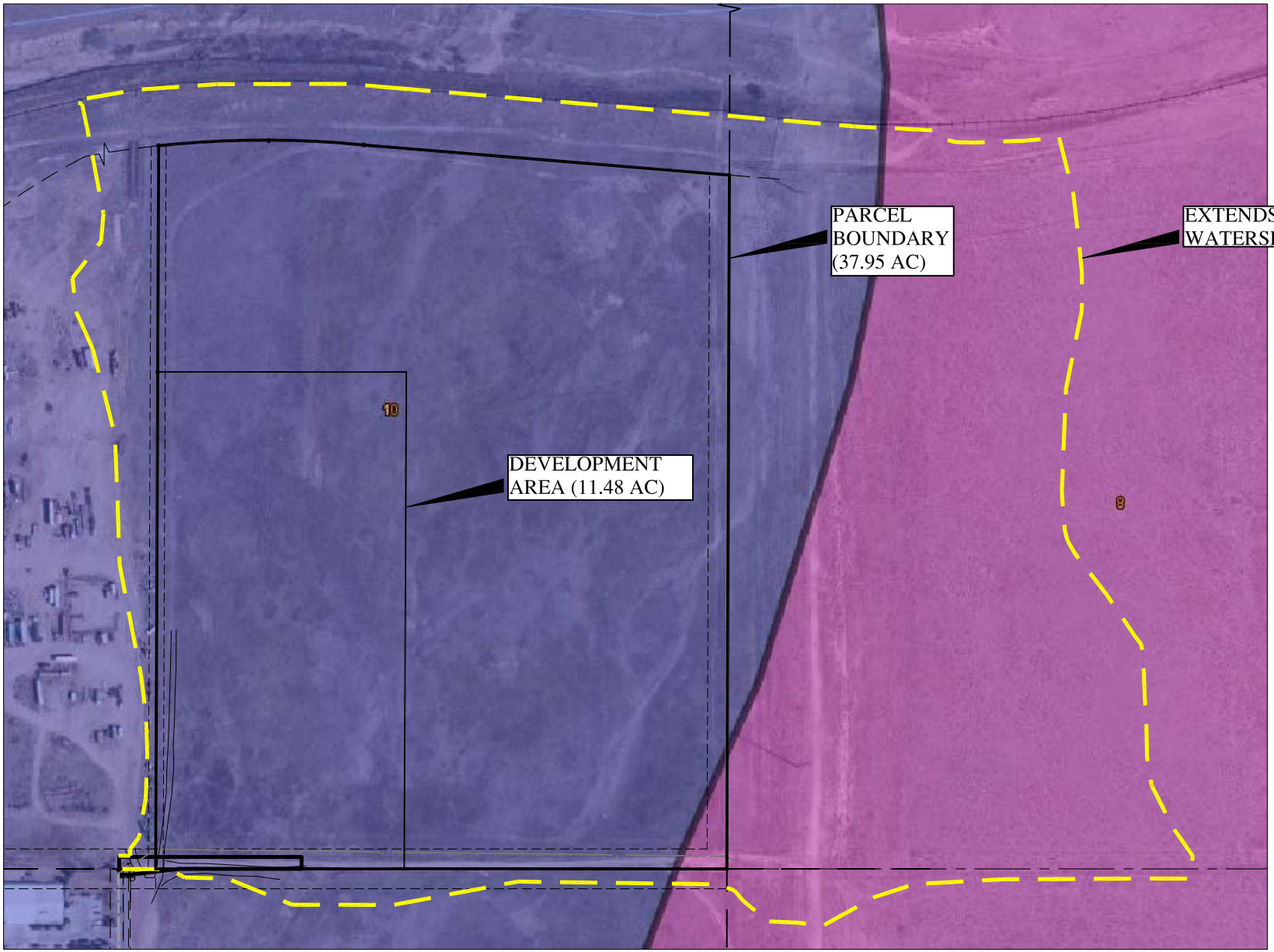


VICINITY MAP

N.T.S.

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

SOILS MAP



NOT TO SCALE

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

HYDROLOGIC TYPE A SOILS

HYDROLOGIC TYPE B SOILS

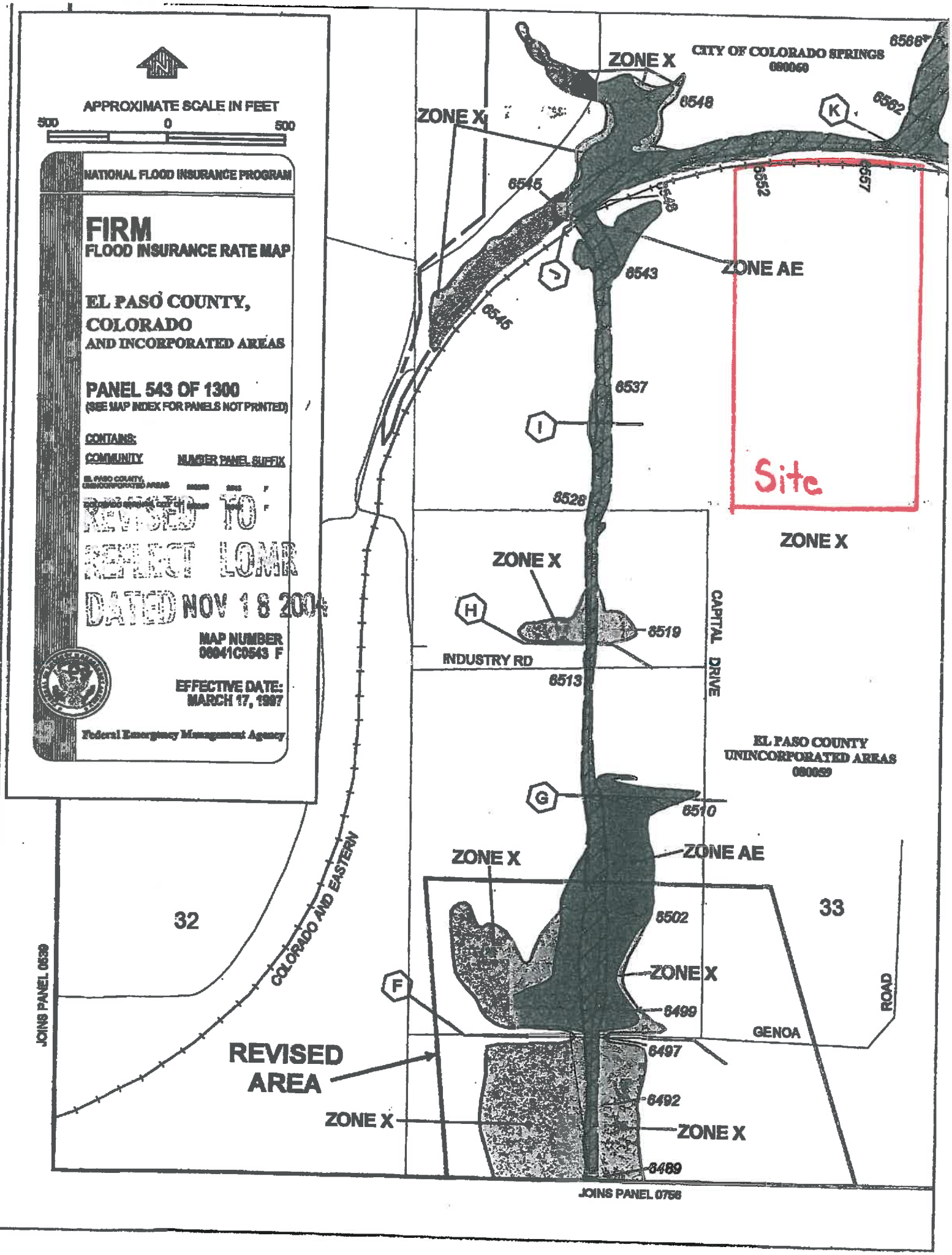
SITE BOUNDARY

ANALYZED WATERSHED BOUNDARY

TIMBERLINE STORAGE YARD SOILS MAP

CIVIL CONSULTANTS, INC.

FIRM PANEL


APPROXIMATE SCALE IN FEET
500 0 500
NATIONAL FLOOD INSURANCE PROGRAM
FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS
PANEL 543 OF 1300
(SEE MAP INDEX FOR PANELS NOT PRINTED)
CONTAINS:
COMMUNITY NUMBER PANEL SUFFIX
REVISED TO REFLECT LOMR DATED NOV 18 2004
MAP NUMBER
08041C0543 F
EFFECTIVE DATE:
MARCH 17, 1997
Federal Emergency Management Agency
ZONE X
CITY OF COLORADO SPRINGS
080060
6568
6548
6562
ZONE X
6545
6552
6557
6548
6543
ZONE AE
6545
6537
6528
Site
ZONE X
ZONE X
6519
INDUSTRY RD
6513
CAPITAL DRIVE
EL PASO COUNTY
UNINCORPORATED AREAS
080059
6510
ZONE X
ZONE AE
32
33
6502
ZONE X
6499
GENOA
ROAD
COLORADO AND EASTERN
6497
REVISED AREA
6492
ZONE X
ZONE X
6489
JOINS PANEL 0539
JOINS PANEL 0758

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Sand Creek East Fork Subtributary				REVISED DATA				
A	650	133	250	7.9	6,423.6	6,423.6	6,423.6	0.0
B	2,090	52	185	10.7	6,446.9	6,446.9	6,446.9	0.0
C	2,202	52	224	8.8	6,448.0	6,448.0	6,448.0	0.0
D	3,567	58	191	10.3	6,467.8	6,467.8	6,467.8	0.0
E	4,408	56	185	10.6	6,480.1	6,480.1	6,480.1	0.0
F	5,507	65	198	9.9	6,497.3	6,497.3	6,497.4	0.1
G	6,747	78	211	9.2	6,510.2	6,510.2	6,510.4	0.2
H	7,397	44	257	7.5	6,516.3	6,516.3	6,517.3	1.0
I	8,347	64	192	9.9	6,535.2	6,535.2	6,535.2	0.0
J	9,257	100	403	4.3	6,545.1	6,545.1	6,446.1	1.0
K	10,737	80	195	8.9	6,557.6	6,557.6	6,558.0	0.4
L	11,540	231	202	5.5	6,577.2	6,577.2	6,577.2	0.0
M	13,300	214	201	5.5	6,601.9	6,601.9	6,601.9	0.0
N	16,170	219	209	5.3	6,639.1	6,639.1	6,639.1	0.0
O	18,910	60	96	7.2	6,674.2	6,674.2	6,674.2	0.0
P	20,650	90	110	6.3	6,697.8	6,697.8	6,697.8	0.0
Q	22,900	100	112	6.1	6,729.2	6,729.2	6,729.3	0.1

NOV 18 2004

[1]Feet above confluence with Sand Creek East Fork

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

EL PASO COUNTY, CO AND INCORPORATED AREAS

FLOODWAY DATA

SAND CREEK EAST FORK SUBTRIBUTARY

HYDROLOGIC CALCULATIONS

TIMBERLINE STORAGE
EXISTING DRAINAGE CALCULATIONS
(Area Runoff Coefficient Summary)

			STREETS / DEVELOPED			*OVERLAND / DEVELOPED*			*OVERLAND / UNDEVELOPED*			*WEIGHTED*	
BASIN	**TOTAL AREA** *(SF)*	**TOTAL AREA** *(Acres)*	**AREA** *(Acres)*	**C_5**	**C_{100}**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**C_5**	**C_{100}**
EX-1	*998724.7*	**22.93**	0.00	0.81	0.88	0.00	0.30	0.50	22.93	0.09	0.36	***0.09***	***0.36***
EX-2	*1029448.0*	**23.63**	0.00	0.81	0.88	0.00	0.30	0.50	23.63	0.09	0.36	***0.09***	***0.36***
EX-3	*1074435.8*	**24.67**	0.00	0.81	0.88	0.00	0.30	0.50	24.67	0.09	0.36	***0.09***	***0.36***

Calculated by: DLM
Date: 5/17/2017
Checked by: VAS

TIMBERLINE STORAGE
EXISTING DRAINAGE CALCULATIONS
(Area Drainage Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*STREET / CHANNEL FLOW*				*Time of Travel (T_t)*	*INTENSITY **		*TOTAL FLOWS*	
BASIN	**AREA TOTAL**	**C_5**	**C_{100}**	**C_5**	**Length**	**Height**	**T_C**	**Length**	**Slope**	**Velocity**	**T_t**	**TOTAL**	**I_5**	**I_{100}**	**Q_5**	**Q_{100}**
	(Acres)	*From DCM Table 5-1*			*(ft)*	*(ft)*	*(min)*	*(ft)*	*(%)*	*(fps)*	*(min)*	*(min)*	*(in/hr)*	*(in/hr)*	*(c.f.s.)*	*(c.f.s.)*
EX-1	22.93	0.09	0.36	0.09	100	4.0	11.5	325	8.0%	2.8	1.9	13.5	3.7	6.2	***7.6***	***51.0***
EX-2	23.63	0.09	0.36	0.09	100	4.0	11.5	1820	1.3%	1.1	26.4	38.0	2.1	3.6	***4.5***	***30.4***
EX-3	24.67	0.09	0.36	0.09	90	2.0	13.3	1911	1.5%	1.2	26.3	39.6	2.1	3.5	***4.6***	***30.8***

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

Calculated by: DLM
Date: 6/6/2017
Checked by: VAS

TIMBERLINE STORAGE
EXISTING 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.)*
1	**EX1, EX2**	4.19	16.76	TAKEN FROM BASIN EX1			13.5	1300	1.5%	1.9	11.6	25.1	2.7	4.6	***11.5***	***77.3***
2	**DP1, EX3**	6.41	25.64	TAKEN FROM BASIN EX2								38.0	2.1	3.6	***13.6***	***91.6***

Calculated by: DLM
Date: 6/6/2017
Checked by: VAS

TIMBERLINE STORAGE
PROPOSED DRAINAGE CALCULATIONS
(Area Runoff Coefficient Summary)

			ROOFS 0.73-0.81 COMMERCIAL AREAS 0.81-0.88 LANDSCAPED AREAS 0.16-0.41 ASPHALT DRIVES 0.90-0.96			*LANDSCAPED AREAS 0.16-0.41 GRAVEL STORAGE YARD 0.30-0.50*			*ASPHALT DRIVES/WALKS 0.9-0.96 GREENBELTS/AGRI. 0.09-0.36*			*WEIGHTED*	
BASIN	**TOTAL AREA** *(SF)*	**TOTAL AREA** *(Acres)*	**AREA** *(Acres)*	**C_5**	**C_{100}**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**C_5**	**C_{100}**
A	*360030.8*	**8.27**	0.39	0.73	0.81	7.78	0.30	0.50	0.10	0.90	0.96	***0.33***	***0.52***
B	*40937.7*	**0.94**	0.01	0.16	0.41	0.45	0.30	0.50	0.48	0.90	0.96	***0.60***	***0.73***
C	*39252.5*	**0.90**	0.31	0.73	0.81	0.19	0.16	0.41	0.41	0.90	0.96	***0.69***	***0.79***
D	*39174.5*	**0.90**	0.00	0.73	0.81	0.88	0.16	0.41	0.02	0.90	0.96	***0.18***	***0.42***
E	*35557.2*	**0.82**	0.00	0.73	0.81	0.77	0.16	0.41	0.05	0.90	0.96	***0.20***	***0.44***
OS1	*388914.7*	**8.93**	0.00	0.81	0.88	0.00	0.30	0.50	8.93	0.09	0.36	***0.09***	***0.36***
OS2	*44967.9*	**1.03**	0.00	0.81	0.88	0.00	0.30	0.50	1.03	0.09	0.36	***0.09***	***0.36***
OS3	*8997.0*	**0.21**	0.00	0.81	0.88	0.00	0.30	0.50	0.21	0.09	0.36	***0.09***	***0.36***
OS4	*5768.8*	**0.13**	0.05	0.90	0.96	0.00	0.30	0.50	0.09	0.09	0.36	***0.38***	***0.57***
OS5	*998724.7*	**22.93**	0.00	0.81	0.88	0.00	0.30	0.50	22.93	0.09	0.36	***0.09***	***0.36***
OS6	*1135543.9*	**26.07**	0.00	0.81	0.88	0.00	0.30	0.50	26.07	0.09	0.36	***0.09***	***0.36***
OS7	*29413.3*	**0.68**	0.00	0.81	0.88	0.00	0.30	0.50	0.68	0.09	0.36	***0.09***	***0.36***

Calculated by: DLM
Date: 6/9/2017
Checked by: VAS

TIMBERLINE STORAGE
PROPOSED DRAINAGE CALCULATIONS
(Area Drainage Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*STREET / CHANNEL FLOW*				*Time of Travel (T_t)*		*INTENSITY **		*TOTAL FLOWS*	
BASIN	**AREA TOTAL**	**C_5**	**C_{100}**	**C_5**	**Length**	**Height**	**T_C**	**Length**	**Slope**	**Velocity**	**T_t**	**TOTAL**	**CHECK**	**I_5**	**I_{100}**	**Q_5**	**Q_{100}**
	(Acres)	*From DCM Table 5-1*			*(ft)*	*(ft)*	*(min)*	*(ft)*	*(%)*	*(fps)*	*(min)*	*(min)*	*(min)*	*(in/hr)*	*(in/hr)*	*(c.f.s.)*	*(c.f.s.)*
A	8.27	0.33	0.52	0.33	100	2.0	11.1	890	1.2%	1.1	13.5	24.6	15.5	3.5	5.8	***9.4***	***25.1***
B	0.94	0.60	0.73	0.60	95	0.7	9.6	337	0.5%	1.1	5.3	14.9	12.4	3.8	6.4	***2.2***	***4.4***
C	0.90	0.69	0.79	0.69	50	1.0	4.2	187	1.9%	2.7	1.1	5.3	11.3	5.1	8.5	***3.2***	***6.1***
D	0.90	0.18	0.42	0.18	47	6.0	4.9	119	0.5%	1.4	1.4	6.3	10.9	4.8	8.1	***0.8***	***3.1***
E	0.82	0.20	0.44	0.20	33	6.0	3.6	145	1.9%	2.8	0.9	4.4	11.0	5.2	8.7	***0.9***	***3.1***
OS1	8.93	0.09	0.36	0.09	90	2.0	13.3	575	1.9%	1.4	6.9	20.2	13.7	3.1	5.2	***2.5***	***16.6***
OS2	1.03	0.09	0.36	0.09	100	2	14.5					14.5	10.6	3.6	6.0	***0.3***	***2.2***
OS3	0.21	0.09	0.36	0.09	50	1	10.3					10.3	10.3	4.1	6.9	***0.1***	***0.5***
OS4	0.13	0.38	0.57	0.38	25	0.5	5.2					5.2	10.1	5.1	8.6	***0.3***	***0.7***
OS5	22.93	0.09	0.36	0.09	100	4	11.5	355	8.6%	2.9	2.0	13.6	12.5	3.7	6.2	***7.6***	***50.9***
OS6	26.07	0.09	0.36	0.09	100	4	11.5	1890	1.4%	1.2	26.9	38.5	21.1	2.1	3.5	***4.9***	***33.2***
OS7	0.68	0.09	0.36	0.09	100	2	14.5	300	2.0%	2.8	1.8	16.3	12.2	3.4	5.7	***0.2***	***1.4***

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

Calculated by: DLM
Date: 6/6/2017
Checked by: VAS

TIMBERLINE STORAGE
PROPOSED DRAINAGE CALCULATIONS
(Basin Routing Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*PIPE / CHANNEL FLOW*				*Time of Travel (T_t)*	*INTENSITY **		*TOTAL FLOWS*		
DESIGN POINT	**CONTRIBUTING BASINS** *DPS AND/OR PIPES*	**CA_5**	**CA_{100}**	**C_5**	**Length** *(ft)*	**Height** *(ft)*	**T_C** *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	**T_t** *(min)*	**TOTAL** *(min)*	**I_5** *(in/hr)*	**I_{100}** *(in/hr)*	**Q_5** *(c.f.s.)*	**Q_{100}** *(c.f.s.)*	COMMENTS
1	**OS1, OS2, A**	3.60	7.89	TAKEN FROM BASIN OS-1			20.2	990	1.2%	1.1	15.1	35.3	2.2	3.8	***8.1***	***29.6***	DRAINAGE SWALE INTO FSD
2	**B, OS3, OS4**	0.63	0.84	TAKEN FROM BASIN B								12.4	3.8	6.4	***2.4***	***5.4***	OUTFALL CAPITAL DR. C&G
3	**C**	0.62	0.72	TAKEN FROM BASIN C								5.3	5.1	8.5	***3.2***	***6.1***	DRAINAGE SWALE INTO FSD
4	**DP1**	3.60	7.89	TAKEN FROM BASIN DP1								35.3					
	DP3	0.62	0.72														
	D	0.16	0.38														
		4.39	8.98									35.3	2.2	3.8	***9.8***	***33.7***	PROPOSED FSD POND
5	**OS5, OS6**	4.41	17.64	TAKEN FROM BASIN OS5			13.6	1320	1.5%	1.5	14.7	28.2	2.6	4.3	***11.3***	***76.2***	HISTORIC DRAINAGE PATTERNS
6	**DP5**			TAKEN FROM DESIGN POINT 5								35.3			***11.3***	***76.2***	
	PIPE 1														***0.8***	***8.3***	
	OS7														***0.2***	***1.4***	HISTORIC DRAINAGE PATTERNS
												35.3	2.2	3.8	***12.4***	***85.8***	TOTAL DISCHARGE

Calculated by: DLM
Date: 6/6/2017
Checked by: VAS

TIMBERLINE STORAGE
PROPOSED DRAINAGE CALCULATIONS
(Storm Sewer Routing Summary)

PIPE RUN	*Contributing Pipes/Design Points*	*Equivalent CA_5*	*Equivalent CA_{100}*	*Maximum T_C*	*Intensity**		*Flow*		*Pipe Size*
					I_5	*I_{100}*	*Q_5*	*Q_{100}*	
1	**DP4**	ETENTION SHEET POND 1					*0.8*	*8.3*	**PROP 24" RCP**

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

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

Calculated by: DLM
Date: 6/6/2017
Checked by: VAS

TIMBERLINE STORAGE
FUTURE DRAINAGE CALCULATIONS
(Area Runoff Coefficient Summary)

			ROOFS 0.73-0.81 COMMERCIAL AREAS 0.81-0.88 LANDSCAPED AREAS 0.16-0.41 ASPHALT DRIVES 0.90-0.96			*LANDSCAPED AREAS 0.16-0.41 GRAVEL STORAGE YARD 0.30-0.50*			*ASPHALT DRIVES/WALKS 0.9-0.96 GREENBELTS/AGRI. 0.09-0.36*			*WEIGHTED*	
BASIN	**TOTAL AREA** *(SF)*	**TOTAL AREA** *(Acres)*	**AREA** *(Acres)*	C_5	C_{100}	**AREA** *(Acres)*	C_5	C_{100}	**AREA** *(Acres)*	C_5	C_{100}	C_5	C_{100}
A	*360030.8*	**8.27**	0.39	0.73	0.81	7.78	0.30	0.50	0.10	0.90	0.96	***0.33***	***0.52***
B	*40937.7*	**0.94**	0.01	0.16	0.41	0.45	0.30	0.50	0.48	0.90	0.96	***0.60***	***0.73***
C	*39252.5*	**0.90**	0.31	0.73	0.81	0.19	0.16	0.41	0.41	0.90	0.96	***0.69***	***0.79***
D	*39174.5*	**0.90**	0.00	0.73	0.81	0.88	0.16	0.41	0.02	0.90	0.96	***0.18***	***0.42***
E	*35557.2*	**0.82**	0.00	0.73	0.81	0.77	0.16	0.41	0.05	0.90	0.96	***0.20***	***0.44***
OS1	*388914.7*	**8.93**	5.80	0.73	0.81	0.00	0.30	0.50	3.12	0.09	0.36	***0.51***	***0.65***
OS2	*44967.9*	**1.03**	0.00	0.73	0.81	0.00	0.30	0.50	1.03	0.09	0.36	***0.09***	***0.36***
OS3	*8997.0*	**0.21**	0.00	0.73	0.81	0.00	0.30	0.50	0.21	0.09	0.36	***0.09***	***0.36***
OS4	*5768.8*	**0.13**	0.05	0.90	0.96	0.00	0.30	0.50	0.09	0.09	0.36	***0.38***	***0.57***
OS5	*1157755*	**26.58**	0.00	0.81	0.88	25.10	0.73	0.81	1.48	0.09	0.36	***0.69***	***0.79***
OS6	*992116.3*	**22.78**	0.00	0.81	0.88	21.06	0.73	0.81	1.72	0.09	0.36	***0.68***	***0.78***
OS7	*29413.3*	**0.68**	0.00	0.81	0.88	0.00	0.30	0.50	0.68	0.09	0.36	***0.09***	***0.36***

Calculated by: DLM
Date: 6/9/2017
Checked by: VAS

TIMBERLINE STORAGE
FUTURE DRAINAGE CALCULATIONS
(Area Drainage Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*STREET / CHANNEL FLOW*				*Time of Travel (T_t)*		*INTENSITY **		*TOTAL FLOWS*	
BASIN	**AREA TOTAL**	**C_5**	**C_{100}**	**C_5**	**Length**	**Height**	**T_C**	**Length**	**Slope**	**Velocity**	**T_t**	**TOTAL**	**CHECK**	**I_5**	**I_{100}**	**Q_5**	**Q_{100}**
	(Acres)	*From DCM Table 5-1*			*(ft)*	*(ft)*	*(min)*	*(ft)*	*(%)*	*(fps)*	*(min)*	*(min)*	*(min)*	*(in/hr)*	*(in/hr)*	*(c.f.s.)*	*(c.f.s.)*
A	8.27	0.33	0.52	0.33	100	2.0	11.1	890	1.2%	1.1	13.5	24.6	15.5	3.5	5.8	***9.4***	***25.1***
B	0.94	0.60	0.73	0.60	95	0.7	9.7	337	0.5%	1.1	5.3	15.0	12.4	3.8	6.4	***2.2***	***4.4***
C	0.90	0.69	0.79	0.69	50	1.0	4.2	187	1.9%	2.8	1.1	5.3	11.3	5.1	8.5	***3.2***	***6.1***
D	0.90	0.18	0.42	0.18	47	6.0	4.9	119	0.5%	1.4	1.4	6.3	10.9	4.8	8.1	***0.8***	***3.1***
E	0.82	0.20	0.44	0.20	33	6.0	3.6	145	1.9%	2.8	0.9	4.4	11.0	5.2	8.7	***0.9***	***3.1***
OS1	8.93	0.51	0.65	0.51	90	2.0	7.8	575	1.9%	2.8	3.5	11.3	13.7	3.9	6.6	***17.8***	***38.6***
OS2	1.03	0.09	0.36	0.09	100	2	14.5					14.5	10.6	3.6	6.0	***0.3***	***2.2***
OS3	0.21	0.09	0.36	0.09	50	1	10.3					10.3	10.3	4.1	6.9	***0.1***	***0.5***
OS4	0.13	0.38	0.57	0.38	25	0.5	5.2					5.2	10.1	5.1	8.6	***0.3***	***0.7***
OS5	26.58	0.69	0.79	0.69	100	3	5.1	570	5.3%	2.3	4.1	9.2	13.7	4.2	7.1	***78.4***	***148.8***
OS6	22.78	0.68	0.78	0.68	100	3	5.3	1321	2.6%	3.2	6.9	12.1	17.9	3.8	6.4	***59.6***	***114.0***
OS7	0.68	0.09	0.36	0.09	100	2	14.5	300	2.0%	2.8	1.8	16.3	12.2	3.4	5.7	***0.2***	***1.4***

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

Calculated by: DLM
Date: 6/6/2017
Checked by: VAS

TIMBERLINE STORAGE
FUTURE DRAINAGE CALCULATIONS
(Basin Routing Summary)

From Area Runoff Coefficient Summary				*OVERLAND*				*PIPE / CHANNEL FLOW*				*Time of Travel (T_t)*	*INTENSITY **		*TOTAL FLOWS*		
DESIGN POINT	**CONTRIBUTING BASINS** *DPS AND/OR PIPES*	**CA_5**	**CA_{100}**	**C_5**	**Length** *(ft)*	**Height** *(ft)*	**T_C** *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	**T_t** *(min)*	**TOTAL** *(min)*	**I_5** *(in/hr)*	**I_{100}** *(in/hr)*	**Q_5** *(c.f.s.)*	**Q_{100}** *(c.f.s.)*	COMMENTS
1	**OS1, OS2, A**	7.32	10.50	TAKEN FROM BASIN OS-1			11.3	990	1.2%	1.1	15.1	26.3	2.7	4.5	***19.6***	***47.1***	DRAINAGE SWALE INTO FSD
2	**B, OS3, OS4**	0.63	0.84	TAKEN FROM BASIN B								12.4	3.8	6.4	***2.4***	***5.4***	OUTFALL CAPITAL DR. C&G
3	**C**	0.62	0.72	TAKEN FROM BASIN C								5.3	5.1	8.5	***3.2***	***6.1***	DRAINAGE SWALE INTO FSD
4	**DP1**	7.32	10.50	TAKEN FROM BASIN DP1								26.3					
	DP3	0.62	0.72														
	D	0.16	0.38														
		8.10	11.60									26.3	2.7	4.5	***21.7***	***52.1***	EX FSD POND
5	**OS5**	18.46	20.86	TAKEN FROM BASIN OS5								9.2	4.2	7.1	***78.4***	***148.8***	OFFSITE FUTURE FSD POND 2 (ASSUMES LIMITING DISCHARGE IS BASED UPON EXISTING COND)
6	**OS6**	15.53	17.67	TAKEN FROM BASIN OS6								12.1	3.8	6.4	***59.6***	***114.0***	FUTURE FSD POND 3
7	**OS7**			FLOW RATE COMPUTATION UTILIZES DIRECT ADDITION											***0.2***	***1.4***	
	PIPE 1														***1.6***	***21.8***	
	PIPE 4														***3.6***	***62.4***	
															5.4	***85.6***	

Calculated by: DLM
Date: 6/6/2017
Checked by: VAS

TIMBERLINE STORAGE
FUTURE DRAINAGE CALCULATIONS
(Storm Sewer Routing Summary)

PIPE RUN	*Contributing Pipes/Design Points*	*Equivalent CA_5*	*Equivalent CA_{100}*	*Maximum T_C*	*Intensity**		*Flow*		*Pipe Size*
					I_5	*I_{100}*	*Q_5*	*Q_{100}*	
1	**EX POND 1 OUTLET (DP4)**	UD-DETENTION WORKSHEET					*0.6*	*21.8*	**24" RCP**
2	**FUT OFFSITE POND 2 OUTLET (DP5)**						*1.6*	*25.4*	**24" RCP**
3	**FUTURE POND 3 OUTLET (DP6)**						*2.0*	*37.0*	**30" RCP**
4	**PIPE 5+PIPE 6**						*3.6*	*62.4*	**42" RCP**

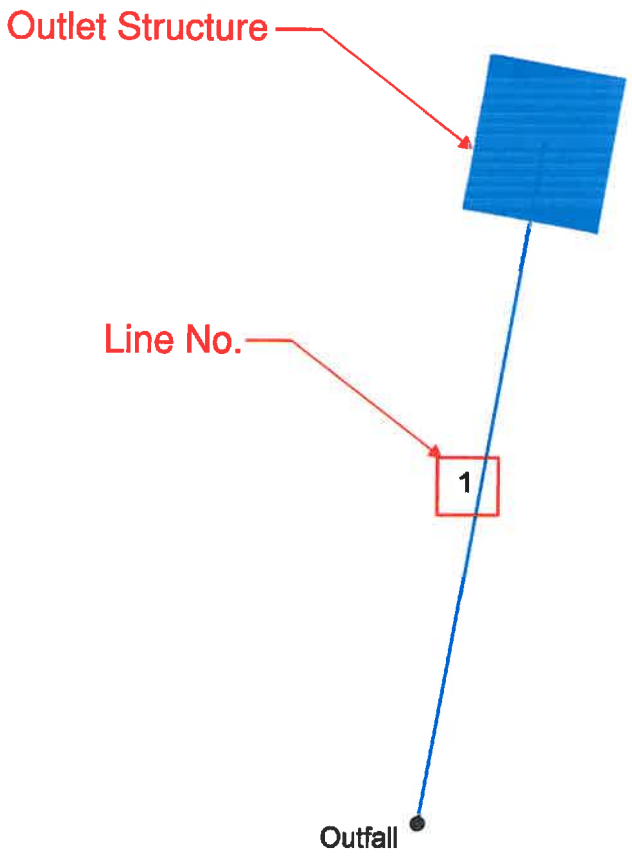
* Intensity equations assume a minimum travel time of 5 minutes.

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

Calculated by: DLM
Date: 6/6/2017
Checked by: VAS

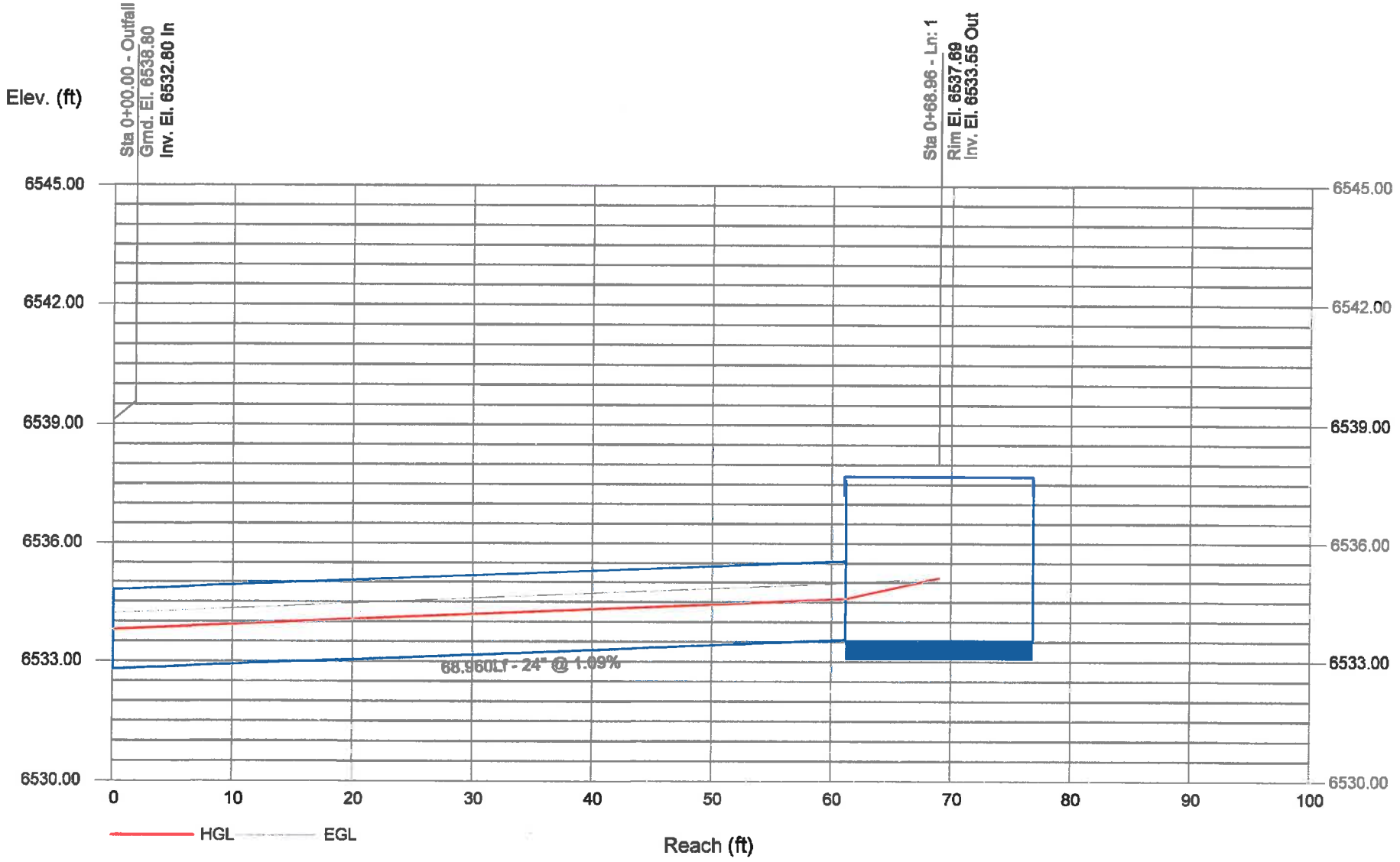
HYDRAULIC CALCULATIONS / EDB WQCV CALCULATIONS

STORM 1 PLAN VIEW



Project File: Storm 1 (Future Cond.).stm	Number of lines: 1	Date: 12/1/2017

STORM 1 PROFILE - PROPOSED CONDITION



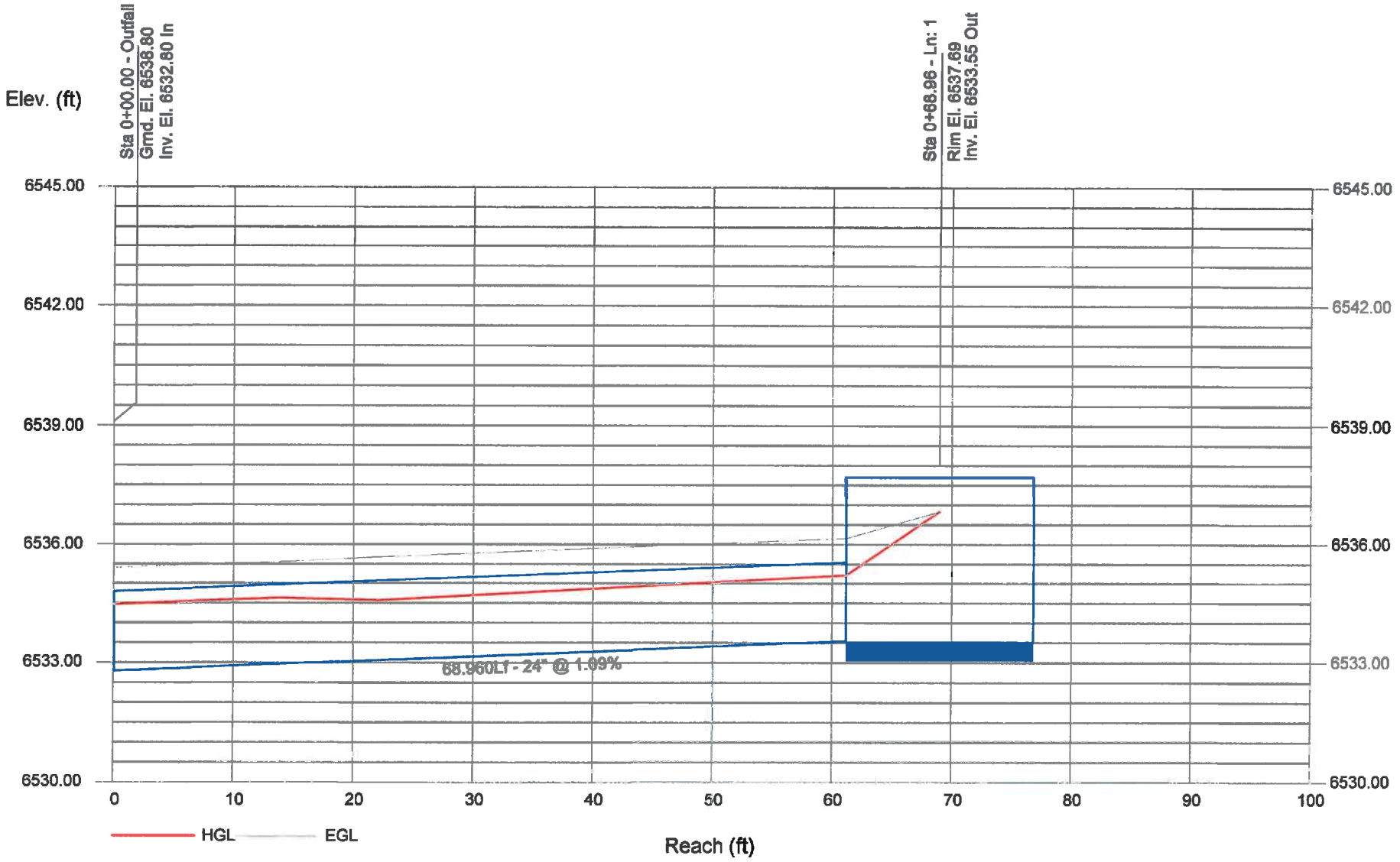
STORM 1 SUMMARY - PROPOSED CONDITION

Line No.	Line ID	Line Size (in)	Line Type	Junct Type	J-Loss Coeff	n-val Pipe	Flow Rate (cfs)	Invert Dn (ft)	Invert Up (ft)	Line Slope (%)	HGL Dn (ft)	HGL Up (ft)	Minor Loss (ft)	HGL Jnct (ft)	Vel Ave (ft/s)
1	Storm 1, Outlet Struct.	24	Cir	Generic	1.50	0.012	8.30	6532.80	6533.55	1.09	6533.80	6534.58	n/a	6535.12 i	5.20

Timberline Storage Yard | Number of lines: 1 | Date: 12/1/2017

NOTES: i Inlet control; ** Critical depth

STORM 1 PROFILE - FUTURE CONDITION



STORM 1 SUMMARY - FUTURE CONDITION

Line No.	Line ID	Line Size (in)	Line Type	Junct Type	J-Loss Coeff	n-val Pipe	Flow Rate (cfs)	Invert Dn (ft)	Invert Up (ft)	Line Slope (%)	HGL Dn (ft)	HGL Up (ft)	Minor Loss (ft)	HGL Jnct (ft)	Vel Ave (ft/s)
1	Storm 1, Outlet Struct.	24	Cir	Generic	1.50	0.012	21.80	6532.80	6533.55	1.09	6534.47	6535.22 j	n/a	6536.84 i	7.78

Timberline Storage Yard | Number of lines: 1 | Date: 12/1/2017

NOTES: i Inlet control; ** Critical depth

TIMBERLINE STORAGE (PROPOSED CONDITIONS)

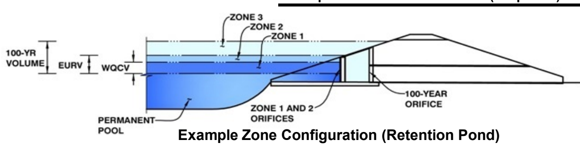
(Weighted Percent Imperviousness of Proposed WQ Sand Filter Basin				
Contributing Basins	***Area (Acres)***	***C_5***	***Impervious % (I)***	***(Acres)*(I)***
A	8.27	0.33	43	355.40
C	0.90	0.69	75	67.58
D	0.90	0.18	25	22.48
OS1	8.93	0.09	2	17.86
OS2	1.03	0.09	2	2.06
Totals	***20.03***			***465.39***
Imperviousness of WQ SFB	***23.2***			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Timberline Storage

Basin ID: Full Spectrum Detention Pond 1 (Proposed)



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	20.03	acres
Watershed Length =	1,880	ft
Watershed Slope =	0.015	ft/ft
Watershed Imperviousness =	26.90%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	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) =	0.236	acre-feet
Excess Urban Runoff Volume (EURV) =	0.548	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.416	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.597	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.939	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	1.640	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	2.097	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	2.694	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	0.388	acre-feet
Approximate 5-yr Detention Volume =	0.560	acre-feet
Approximate 10-yr Detention Volume =	0.837	acre-feet
Approximate 25-yr Detention Volume =	0.987	acre-feet
Approximate 50-yr Detention Volume =	1.041	acre-feet
Approximate 100-yr Detention Volume =	1.245	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) =	0.236	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.312	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.697	acre-feet
Total Detention Basin Volume =	1.245	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)
6533.81	**Top of Micropool**	--	0.00	--	--	--	0	0.000		
6534.22		--	0.41	--	--	--	65	0.001	13	0.000
6535.00		--	1.00	--	--	--	1,705	0.039	519	0.012
6536.00		--	2.00	--	--	--	18,958	0.435	10,678	0.245
6537.00		--	3.00	--	--	--	21,298	0.489	30,995	0.712
6538.00		--	4.00	--	--	--	23,732	0.545	53,510	1.228
6539.00		--	5.00	--	--	--	26,339	0.605	78,545	1.803
6540.00		--	6.00	--	--	--	29,593	0.679	106,511	2.445
6541.00		--	7.00	--	--	--	32,791	0.753	137,703	3.161
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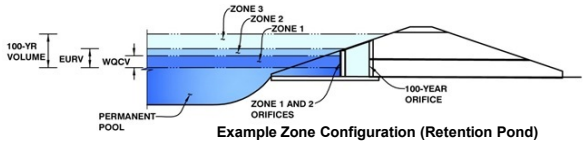
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: TIMBERLINE STORAGE

Basin ID: FULL SPECTRUM DETENTION POND 1 (PROPOSED)



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.97	0.236	Orifice Plate
Zone 2 (EURV)	2.66	0.312	Orifice Plate
Zone 3 (100-year)	4.04	0.697	Weir&Pipe (Restrict)
		1.245	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 =	3.89	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	10.90	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	1.30	2.59					
Orifice Area (sq. inches)	1.31	1.31	10.00					

	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 =	3.89	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	12.00	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 =	4.62	N/A	feet
Over Flow Weir Slope Length =	3.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	32.73	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	25.20	N/A	ft^2
Overflow Grate Open Area w/ Debris =	12.60	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 =	7.05		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.77	N/A	ft^2
Outlet Orifice Centroid =	0.35	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.15	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.30	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	45.00	feet
Spillway End Slopes =	10.00	H:V
Freeboard above Max Water Surface =	0.50	feet

Calculated Parameters for Spillway

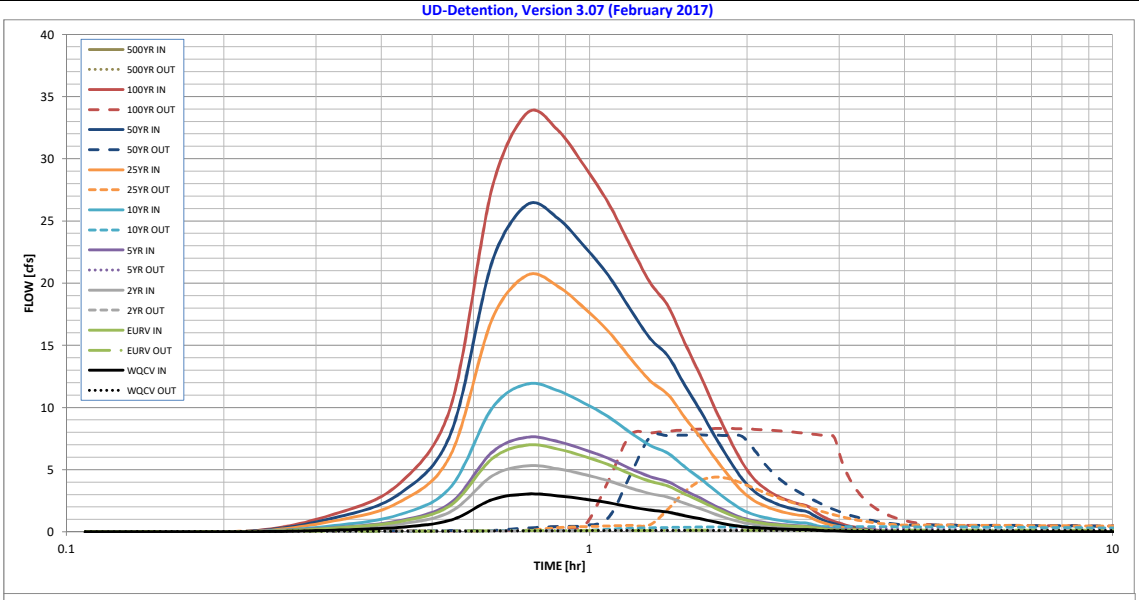
Spillway Design Flow Depth=	0.37	feet
Stage at Top of Freeboard =	6.17	feet
Basin Area at Top of Freeboard =	0.69	acres

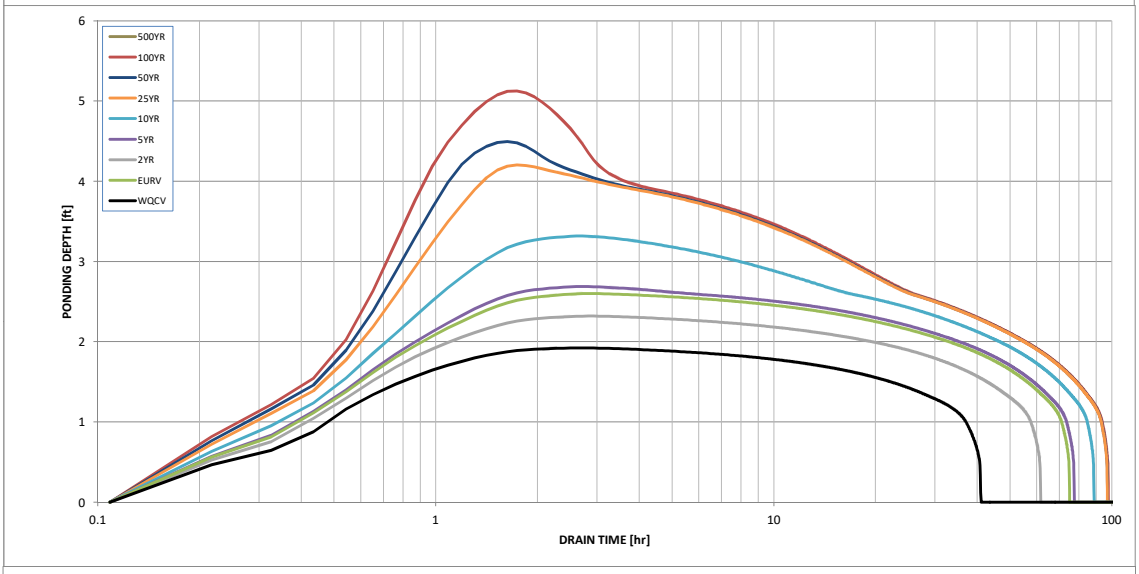
Routed Hydrograph Results

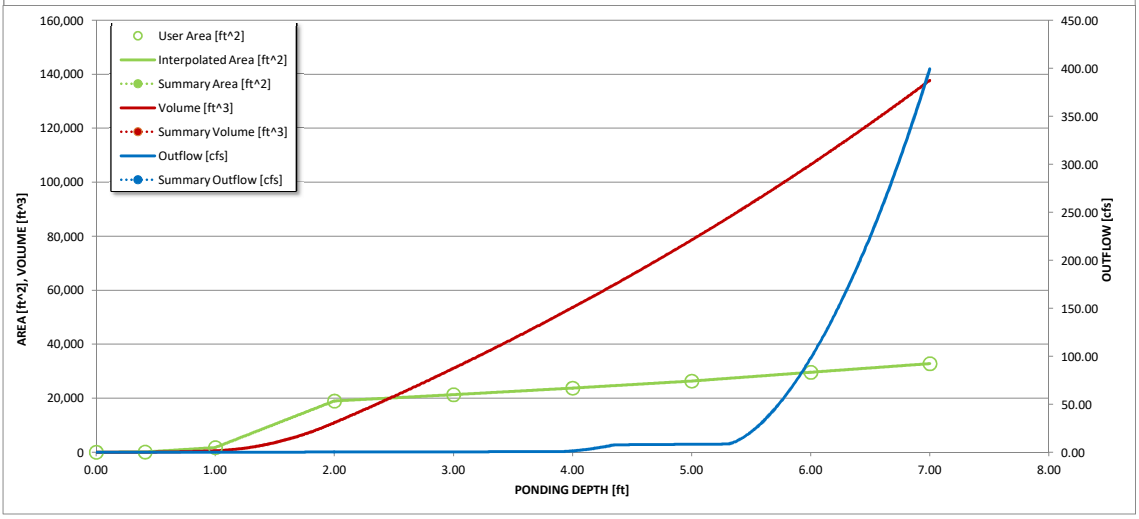
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.236	0.548	0.416	0.597	0.939	1.640	2.097	2.694	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.236	0.547	0.415	0.597	0.938	1.640	2.096	2.693	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.01	0.14	0.49	0.67	0.92	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.2	0.3	2.8	9.7	13.5	18.4	0.0
Peak Inflow Q (cfs) =	3.0	7.0	5.3	7.6	11.9	20.7	26.3	33.7	#N/A
Peak Outflow Q (cfs) =	0.1	0.2	0.1	0.2	0.4	4.4	7.8	8.3	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	0.2	0.5	0.6	0.5	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	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	N/A	0.1	0.3	0.3	#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	58	72	81	84	82	79	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**40**	73	60	75	86	92	91	90	#N/A
Maximum Ponding Depth (ft) =	1.92	2.60	2.32	2.69	3.32	4.20	4.50	5.13	#N/A
Area at Maximum Ponding Depth (acres) =	0.40	0.47	0.45	0.47	0.51	0.56	0.57	0.61	#N/A
Maximum Volume Stored (acre-ft) =	0.216	0.516	0.387	0.558	0.866	1.339	1.503	1.876	#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			

Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected Worksheet Protected

Stormwater Facility Name: **Pond 1**

Facility Location & Jurisdiction: **Timberline Storage Yard, El Paso County / El Paso County**

User Input: Watershed Characteristics

Watershed Slope =	0.015	ft/ft
Watershed Length =	1833	ft
Watershed Area =	20.03	acres
Watershed Imperviousness =	26.9%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent

Location for 1-hr Rainfall Depths (use dropdown): User Input

WQCV Treatment Method = Extended Detention

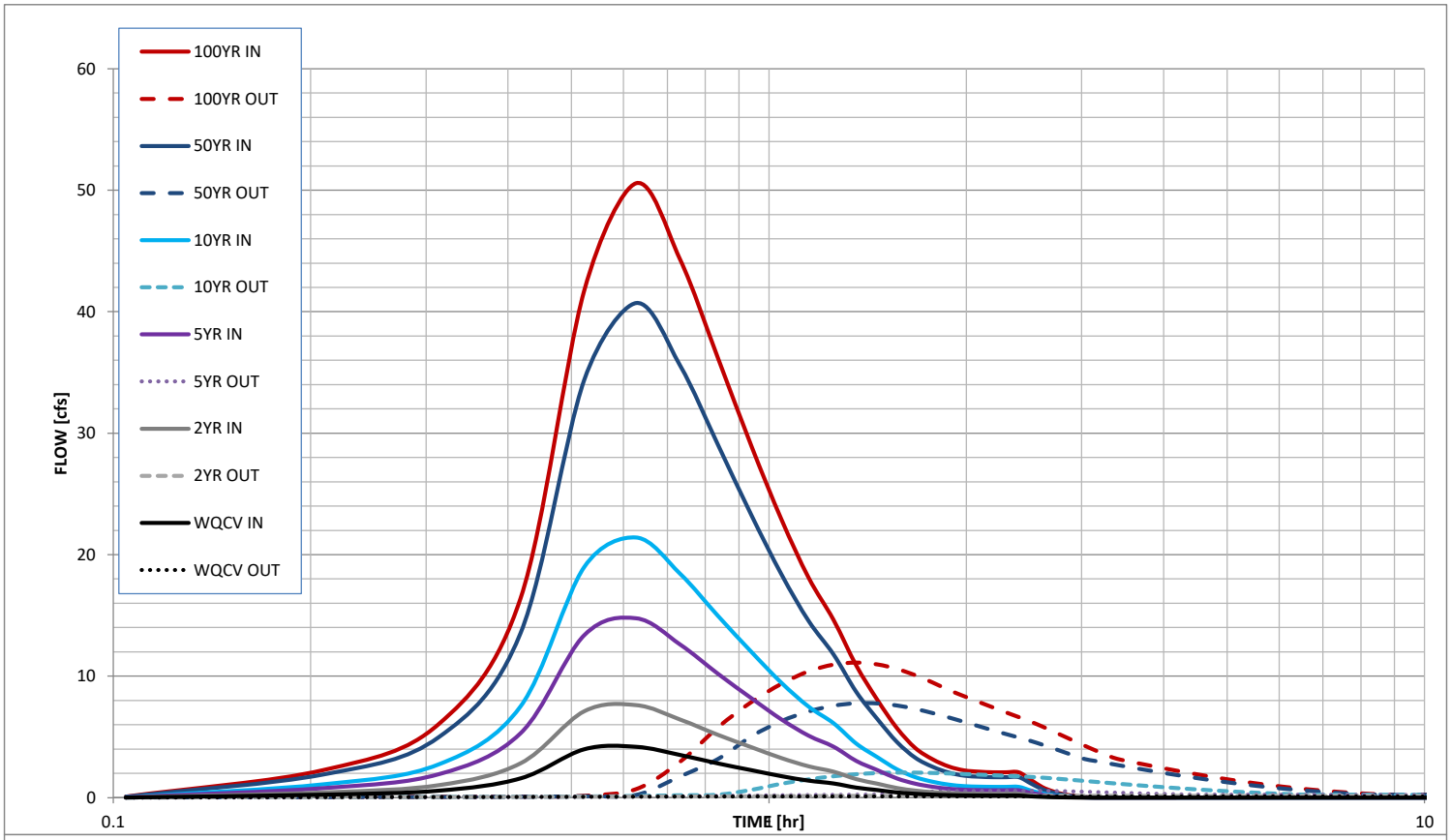
User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	0	0.00	0.00
0.41	65	0.41	0.03
1.00	1,705	1.00	0.05
2.00	18,958	2.00	0.10
3.00	21,298	3.00	0.25
4.00	23,732	4.00	3.20
5.00	26,339	5.00	8.70
6.00	29,593	6.00	15.60
7.00	32,791	7.00	21.30

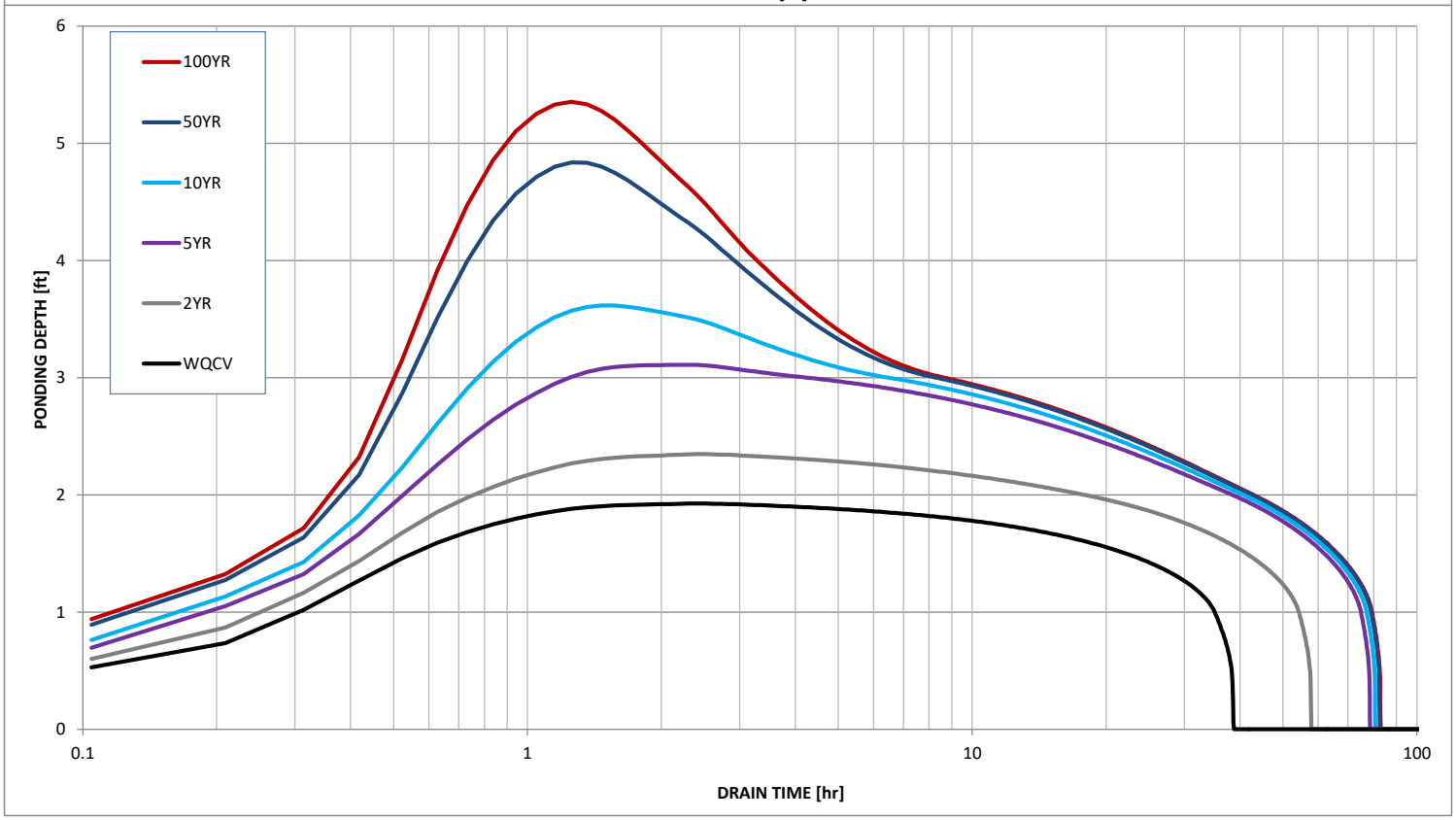
After completing and printing this worksheet to a pdf, go to:
https://maperture.digitaldataservices.com/gvh/?viewer=cswdif
create a new stormwater facility, and
attach the pdf of this worksheet to that record.

Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.50	1.19	1.50	1.75	2.25	2.52	in
Calculated Runoff Volume =	0.236	0.429	0.833	1.211	2.307	2.855	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	0.235	0.429	0.832	1.211	2.306	2.855	acre-ft
Time to Drain 97% of Inflow Volume =	36.5	54.2	**72.0**	72.0	68.0	65.6	hours
Time to Drain 99% of Inflow Volume =	37.9	56.4	75.9	77.2	76.5	**75.7**	hours
Maximum Ponding Depth =	1.93	2.35	3.11	3.62	4.84	5.35	ft
Maximum Ponded Area =	0.40	0.45	0.49	0.52	0.59	**0.63**	acres
Maximum Volume Stored =	0.216	0.400	0.762	1.021	1.701	2.019	acre-ft

Stormwater Detention and Infiltration Design Data Sheet





TIMBERLINE STORAGE (FUTURE CONDITIONS)

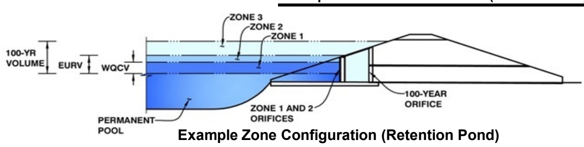
(Weighted Percent Imperviousness of Future FSD Pond 1)				
Contributing Basins	***Area (Acres)***	***C_5***	***Impervious % (I)***	***(Acres)*(I)***
A	8.27	0.33	43	355.40
C	0.90	0.69	75	67.58
D	0.90	0.18	14	12.59
OS1	8.93	0.51	72	642.83
OS2	1.03	0.09	2	2.06
Totals	***20.03***			***1080.48***
Imperviousness of WQ SFB	***54.0***			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: **Timberline Storage**

Basin ID: **Full Spectrum Detention Pond 1 (rework Future)**



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**	
Watershed Area =	20.03	acres
Watershed Length =	1,295	ft
Watershed Slope =	0.015	ft/ft
Watershed Imperviousness =	54.00%	percent
Percentage Hydrologic Soil Group A =	1.6%	percent
Percentage Hydrologic Soil Group B =	98.4%	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) =	0.363	acre-feet
Excess Urban Runoff Volume (EURV) =	1.165	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.944	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	1.281	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	1.704	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	2.315	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	2.746	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	3.312	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	0.884	acre-feet
Approximate 5-yr Detention Volume =	1.203	acre-feet
Approximate 10-yr Detention Volume =	1.573	acre-feet
Approximate 25-yr Detention Volume =	1.715	acre-feet
Approximate 50-yr Detention Volume =	1.792	acre-feet
Approximate 100-yr Detention Volume =	1.982	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) =	0.363	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.802	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.817	acre-feet
Total Detention Basin Volume =	1.982	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		
	--	0.41	--	--	--	65	0.001	13	0.000
	--	1.00	--	--	--	1,705	0.039	519	0.012
	--	2.00	--	--	--	18,958	0.435	10,678	0.245
	--	3.00	--	--	--	21,298	0.489	30,995	0.712
	--	4.00	--	--	--	23,732	0.545	53,510	1.228
	--	5.00	--	--	--	26,339	0.605	78,545	1.803
	--	6.00	--	--	--	29,593	0.679	106,511	2.445
	--	7.00	--	--	--	32,791	0.753	137,703	3.161
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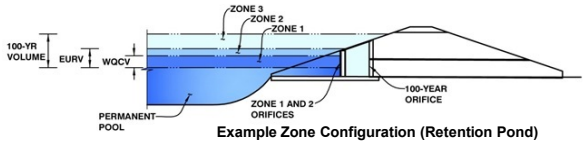
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: TIMBERLINE STORAGE

Basin ID: FULL SPECTRUM DETENTION POND 1 (FUTURE)



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.26	0.363	Orifice Plate
Zone 2 (EURV)	3.89	0.802	Orifice Plate
Zone 3 (100-year)	5.30	0.817	Weir&Pipe (Restrict)
		1.982	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 Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	3.89	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	10.90	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	1.30	2.59					
Orifice Area (sq. inches)	1.80	1.80	5.75					

	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)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.89	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.62	N/A	feet
Overflow Weir Front Edge Length =	12.00	N/A	feet	Over Flow Weir Slope Length =	3.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	12.06	N/A	should be ≥ 4
Horiz. Length of Weir Sides =	2.91	N/A	feet	Overflow Grate Open Area w/o Debris =	25.20	N/A	ft^2
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	12.60	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			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 Orifice Area =	2.09	N/A	ft^2
Outlet Pipe Diameter =	24.00	N/A	inches	Outlet Orifice Centroid =	0.71	N/A	feet
Restrictor Plate Height Above Pipe Invert =	15.15		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.84	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.30	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.50	feet
Spillway Crest Length =	45.00	feet	Stage at Top of Freeboard =	6.30	feet
Spillway End Slopes =	10.00	H:V	Basin Area at Top of Freeboard =	0.70	acres
Freeboard above Max Water Surface =	0.50	feet			

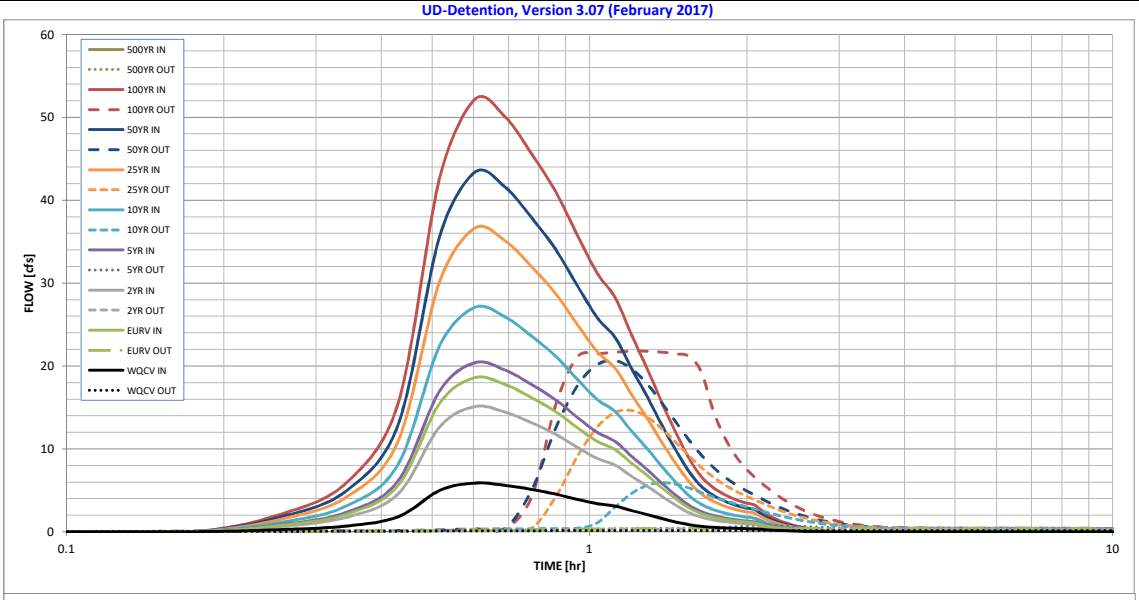
Calculated Parameters for Spillway

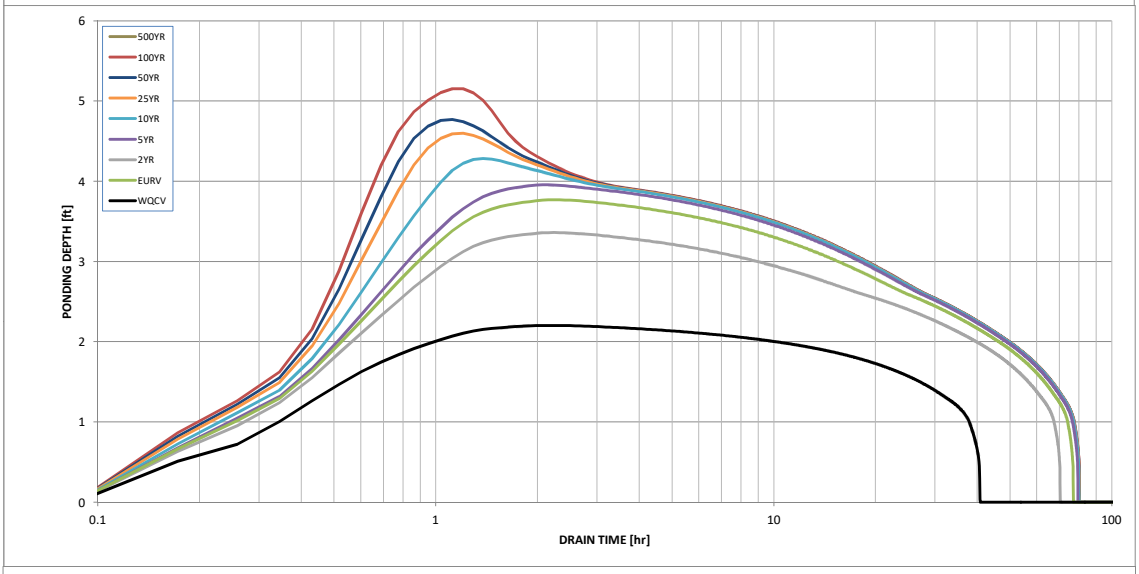
Routed Hydrograph Results

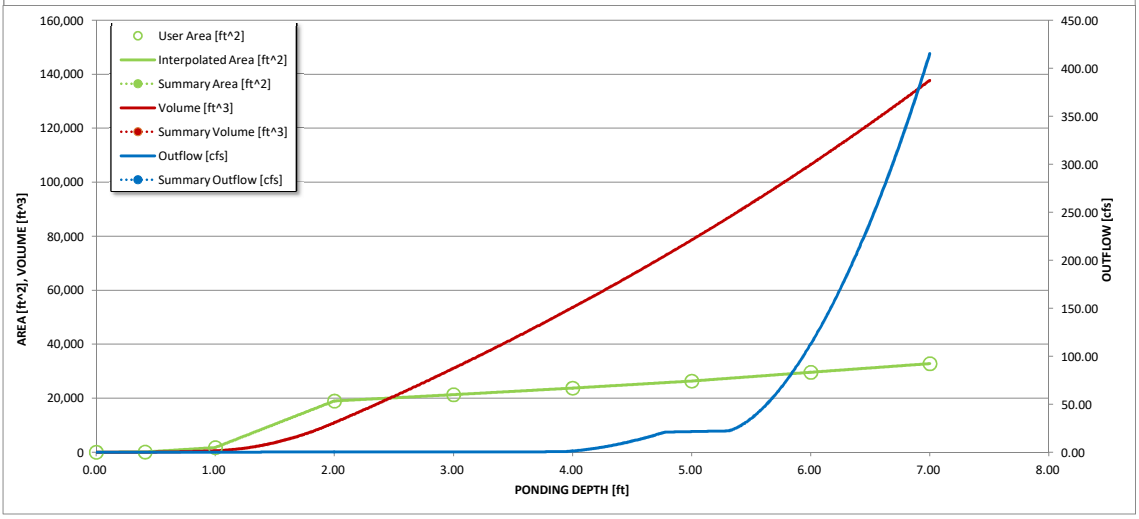
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.363	1.165	0.944	1.281	1.704	2.315	2.746	3.312	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.363	1.166	0.944	1.281	1.705	2.316	2.748	3.314	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.19	0.63	0.88	1.18	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.2	0.4	3.8	12.6	17.5	23.7	0.0
Peak Inflow Q (cfs) =	5.9	18.6	15.1	20.4	27.1	36.6	43.4	52.1	#N/A
Peak Outflow Q (cfs) =	0.1	0.4	0.4	0.8	5.9	14.6	20.6	21.8	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.0	1.6	1.2	1.2	0.9	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	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	0.0	0.2	0.6	0.8	0.8	#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	70	65	72	70	68	66	65	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**40**	74	68	77	76	75	74	74	#N/A
Maximum Ponding Depth (ft) =	2.20	3.77	3.36	3.96	4.29	4.60	4.77	5.15	#N/A
Area at Maximum Ponding Depth (acres) =	0.45	0.53	0.51	0.54	0.56	0.58	0.59	0.62	#N/A
Maximum Volume Stored (acre-ft) =	0.338	1.099	0.891	1.201	1.383	1.560	1.660	1.895	#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			

TIMBERLINE STORAGE (FUTURE CONDITIONS)

(Weighted Percent Imperviousness of Future FSD Pond 2)				
Contributing Basins	***Area (Acres)***	***C_5***	***Impervious % (I)***	***(Acres)*(I)***
OS-6	22.78	0.68	87	1981.50
Totals	***22.78***			***1981.50***
Imperviousness of WQ Pond 2	***87.0***			

TIMBERLINE STORAGE (FUTURE CONDITIONS)

(Weighted Percent Imperviousness of Future Offsite FSD Pond 3)				
Contributing Basins	***Area (Acres)***	***C_5***	***Impervious % (I)***	***(Acres)*(I)***
Column1	**Column2**	**Column3**	**Column4**	**Column5**
OS-5	26.58	0.69	87	2312.32
Totals	***26.58***	0.00		***2312.32***
Imperviousness of WQ Pond 2	***87.0***			

CIVIL CONSULTANTS, INC.

20 BOULDER CRESCENT, STE 110
COLORADO SPRINGS, CO 80903
(719) 955-5485

PROJECT: Future Conditions (Ponds)

DATE: 6/7/2017

% Soil Types for Pond Calcs

Future Pond (FSD - Pond 3)

HSG A = 0.37 Acres
HSG B = 22.41 Acres
Total Area = 22.78

% HSG A = 0.37/22.78 = 0.016 = 1.6%
% HSG B = 100% - 1.6% = 98.4%

Future Offsite Pond (FSD - Pond 2)

HSG A = 21.0 Acres
HSG B = 5.58 Acres
Total Area = 26.58

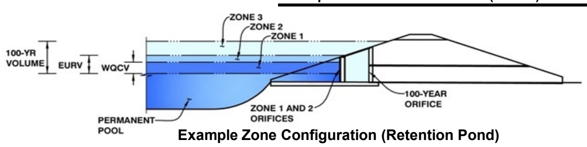
% HSG A = 21.0/26.58 = 0.79 = 79.0%
% HSG B = 100 - 79.0 = 21%

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Timberline Storage

Basin ID: Full Spectrum Detention Pond 2 (Future)



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	26.58	acres
Watershed Length =	756	ft
Watershed Slope =	0.050	ft/ft
Watershed Imperviousness =	87.00%	percent
Percentage Hydrologic Soil Group A =	79.0%	percent
Percentage Hydrologic Soil Group B =	21.0%	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) =	0.835	acre-feet
Excess Urban Runoff Volume (EURV) =	3.002	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	2.169	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	2.816	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	3.396	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	4.000	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	4.539	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	5.214	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	2.055	acre-feet
Approximate 5-yr Detention Volume =	2.671	acre-feet
Approximate 10-yr Detention Volume =	3.198	acre-feet
Approximate 25-yr Detention Volume =	3.702	acre-feet
Approximate 50-yr Detention Volume =	3.994	acre-feet
Approximate 100-yr Detention Volume =	4.260	acre-feet

Note: L / W Ratio < 1
L / W Ratio = 0.5

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) =	0.835	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.167	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.258	acre-feet
Total Detention Basin Volume =	4.260	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	--	--	--	112	0.003	17	0.000
	--	0.50	--	--	--	462	0.011	63	0.001
	--	1.50	--	--	--	19,038	0.437	9,628	0.221
	--	2.50	--	--	--	26,335	0.605	32,503	0.746
	--	3.50	--	--	--	29,086	0.668	60,214	1.382
	--	4.50	--	--	--	31,938	0.733	90,726	2.083
	--	5.50	--	--	--	34,891	0.801	124,140	2.850
	--	6.50	--	--	--	37,939	0.871	160,555	3.686
	--	7.50	--	--	--	41,102	0.944	200,076	4.593
	--	8.50	--	--	--	44,366	1.019	242,810	5.574
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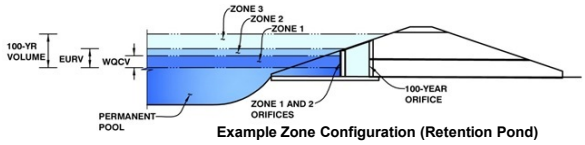
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Timberline Storage Yard

Basin ID: Future Offsite FSD Pond 2



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.65	0.835	Orifice Plate
Zone 2 (EURV)	5.69	2.167	Orifice Plate
Zone 3 (100-year)	7.15	1.258	Weir&Pipe (Restrict)
		4.260	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 =	5.69	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	10.90	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	1.90	3.79					
Orifice Area (sq. inches)	4.80	8.00	18.00					

	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 =	5.69	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	20.00	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 =	6.42	N/A	feet
Over Flow Weir Slope Length =	3.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	20.41	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	41.99	N/A	ft^2
Overflow Grate Open Area w/ Debris =	21.00	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 =	14.95		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	2.06	N/A	ft^2
Outlet Orifice Centroid =	0.70	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.82	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	52.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	0.00	feet

Calculated Parameters for Spillway

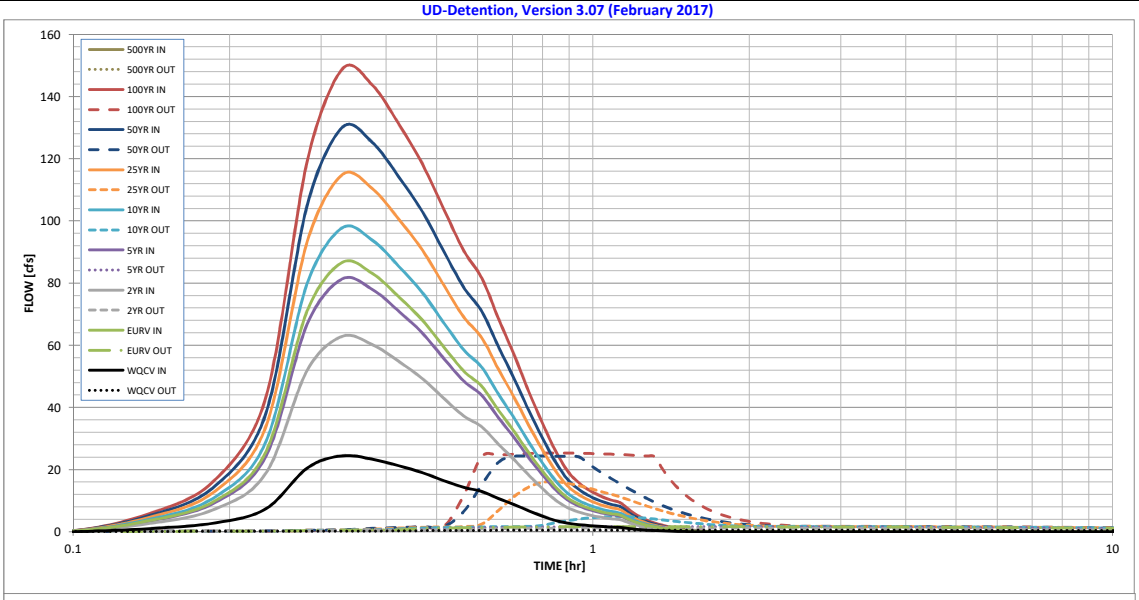
Spillway Design Flow Depth=	0.93	feet
Stage at Top of Freeboard =	8.43	feet
Basin Area at Top of Freeboard =	1.01	acres

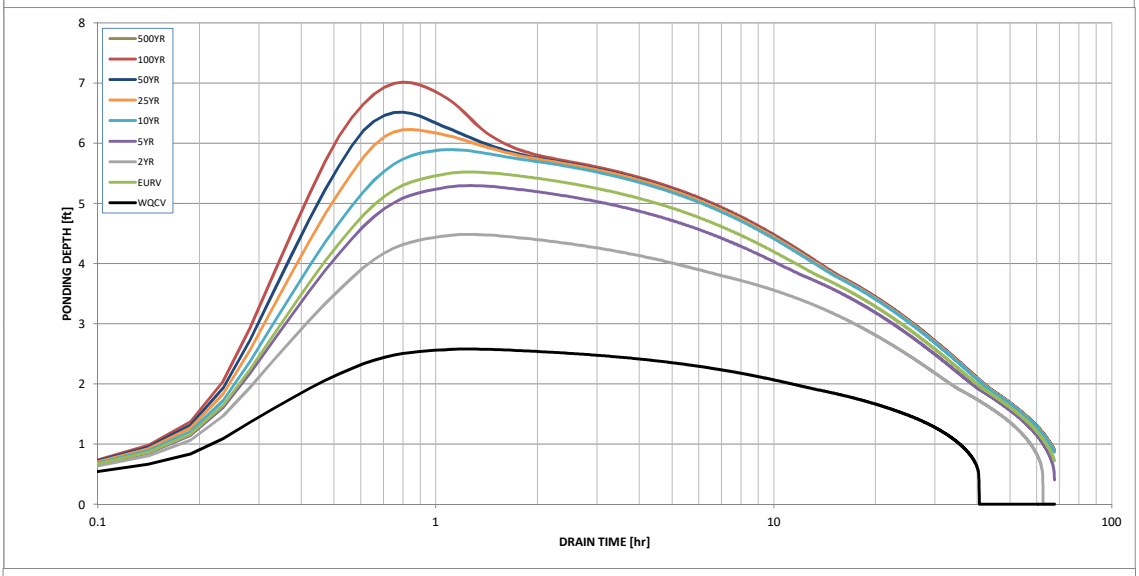
Routed Hydrograph Results

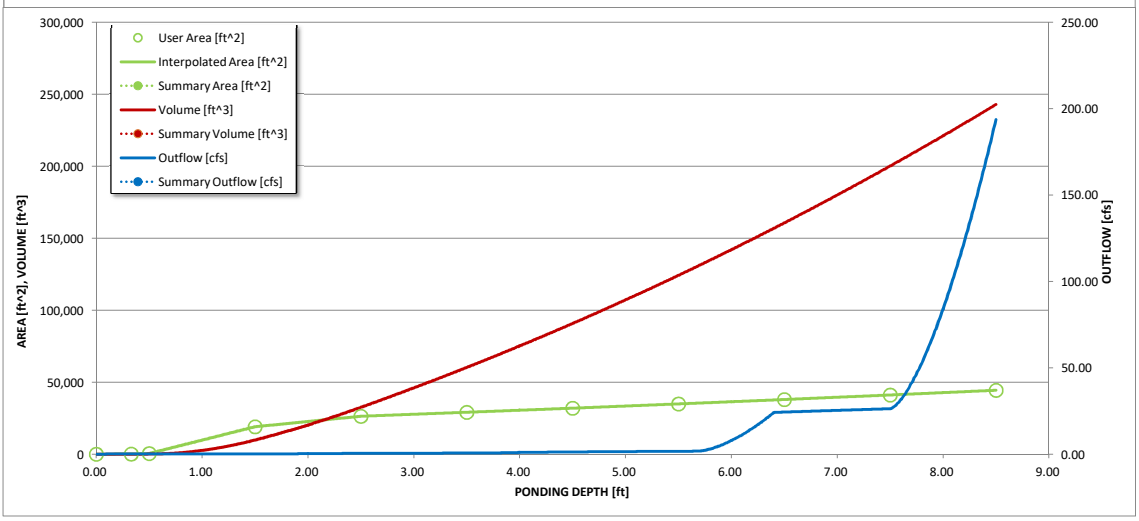
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.835	3.002	2.169	2.816	3.396	4.000	4.539	5.214	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.834	2.998	2.166	2.812	3.390	3.994	4.533	5.204	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.00	0.01	0.08	0.24	0.52	0.96	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.1	0.3	2.2	6.3	13.9	25.4	0.0
Peak Inflow Q (cfs) =	24.5	86.6	62.9	81.3	97.8	114.8	130.0	148.8	#N/A
Peak Outflow Q (cfs) =	0.5	1.7	1.3	1.6	4.9	16.1	24.4	25.4	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	4.7	2.3	2.6	1.7	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	0.1	0.3	0.5	0.6	#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	62	57	61	63	62	61	60	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**40**	66	61	65	68	67	67	67	#N/A
Maximum Ponding Depth (ft) =	2.58	5.52	4.48	5.29	5.89	6.23	6.52	7.01	#N/A
Area at Maximum Ponding Depth (acres) =	0.61	0.80	0.73	0.79	0.83	0.85	0.87	0.91	#N/A
Maximum Volume Stored (acre-ft) =	0.789	2.866	2.068	2.683	3.168	3.445	3.695	4.139	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







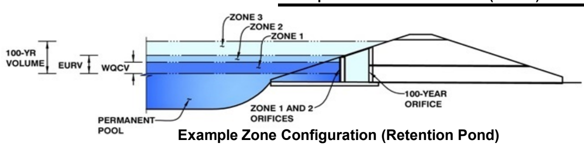
S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Timberline Storage

Basin ID: Full Spectrum Detention Pond 3 (Future)



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	22.78	acres
Watershed Length =	753	ft
Watershed Slope =	0.025	ft/ft
Watershed Imperviousness =	87.00%	percent
Percentage Hydrologic Soil Group A =	1.6%	percent
Percentage Hydrologic Soil Group B =	98.4%	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	

Note: L / W Ratio < 1

L / W Ratio = 0.6

			Optional User Override 1-hr Precipitation	
Water Quality Capture Volume (WQCV) =	0.716	acre-feet		
Excess Urban Runoff Volume (EURV) =	2.222	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	1.886	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.462	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	3.007	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	3.587	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	4.045	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	4.647	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet		inches
Approximate 2-yr Detention Volume =	1.770	acre-feet		
Approximate 5-yr Detention Volume =	2.315	acre-feet		
Approximate 10-yr Detention Volume =	2.845	acre-feet		
Approximate 25-yr Detention Volume =	3.053	acre-feet		
Approximate 50-yr Detention Volume =	3.172	acre-feet		
Approximate 100-yr Detention Volume =	3.310	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.716	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.506	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.088	acre-feet
Total Detention Basin Volume =	3.310	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	--	--	--	112	0.003	17	0.000
	--	0.50	--	--	--	462	0.011	63	0.001
	--	1.50	--	--	--	19,038	0.437	9,628	0.221
	--	2.50	--	--	--	26,335	0.605	32,503	0.746
	--	3.50	--	--	--	29,086	0.668	60,214	1.382
	--	4.50	--	--	--	31,938	0.733	90,726	2.083
	--	5.50	--	--	--	34,891	0.801	124,140	2.850
	--	6.50	--	--	--	37,939	0.871	160,555	3.686
	--	7.50	--	--	--	41,102	0.944	200,076	4.593
	--	8.50	--	--	--	44,366	1.019	242,810	5.574
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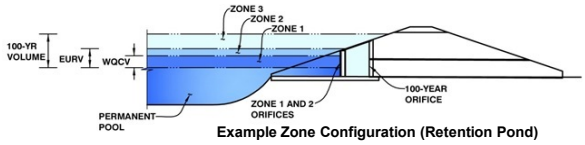
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Timberline Storage Yard

Basin ID: Future Onsite FSD Pond 3



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.45	0.716	Orifice Plate
Zone 2 (EURV)	4.69	1.506	Orifice Plate
Zone 3 (100-year)	6.07	1.088	Weir&Pipe (Restrict)
		3.310	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 =	4.69	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	10.90	inches
Orifice Plate: Orifice Area per Row =	4.18	sq. inches (use rectangular openings)

Calculated Parameters for Plate

WQ Orifice Area per Row =	2.903E-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	1.56	3.13					
Orifice Area (sq. inches)	4.18	4.18	4.18					

	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 =	4.69	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	10.00	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 =	5.42	N/A	feet
Over Flow Weir Slope Length =	3.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	6.37	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	21.00	N/A	ft^2
Overflow Grate Open Area w/ Debris =	10.50	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 =	30.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	19.10		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	3.30	N/A	ft^2
Outlet Orifice Centroid =	0.90	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.85	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.25	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	52.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

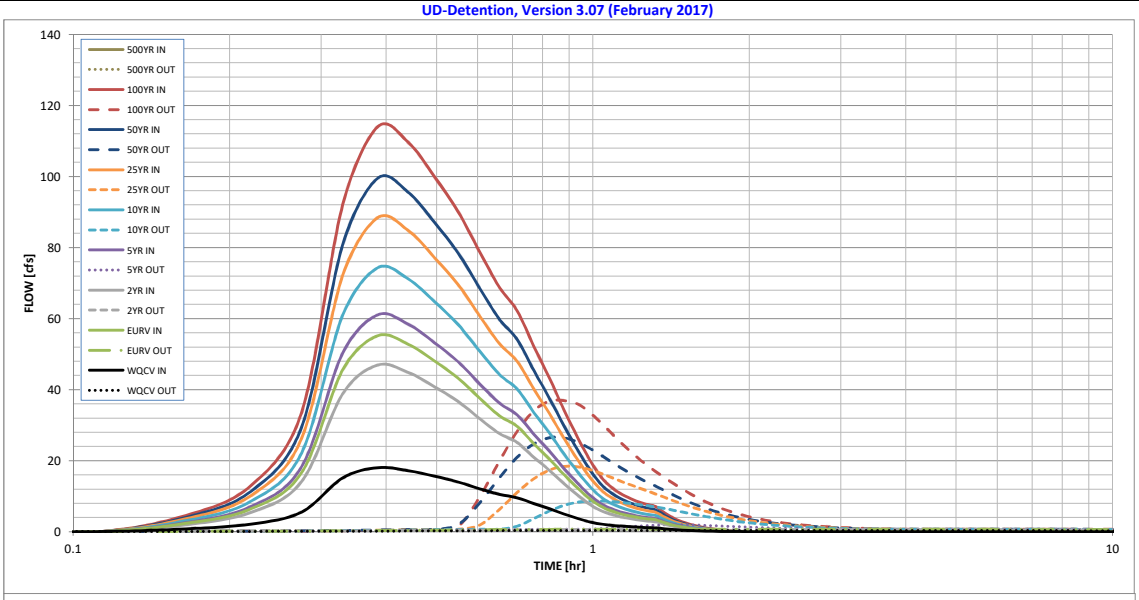
Spillway Design Flow Depth=	0.78	feet
Stage at Top of Freeboard =	8.03	feet
Basin Area at Top of Freeboard =	0.98	acres

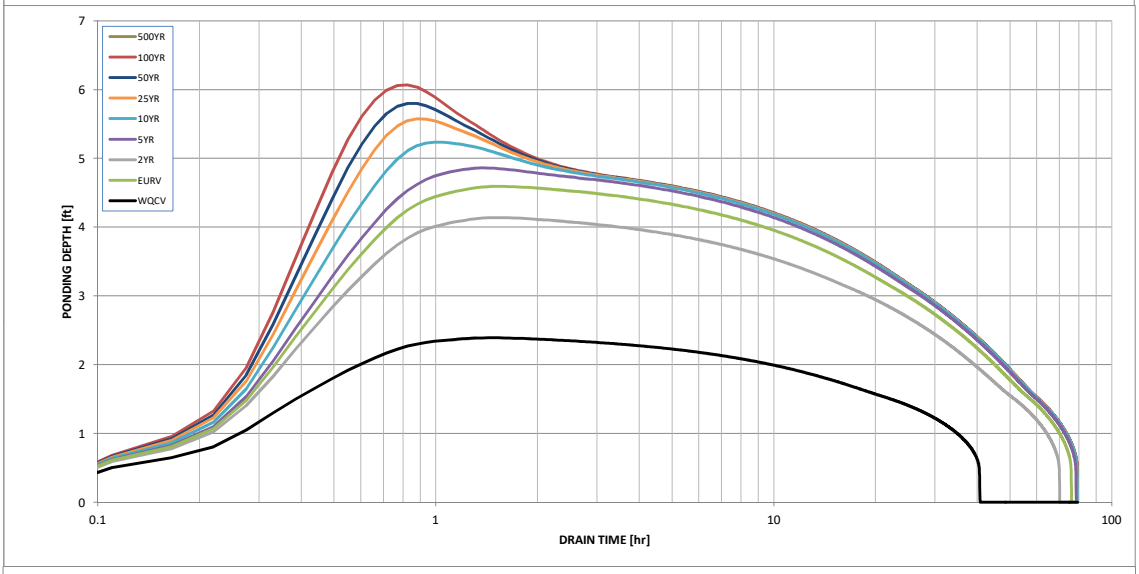
Routed Hydrograph Results

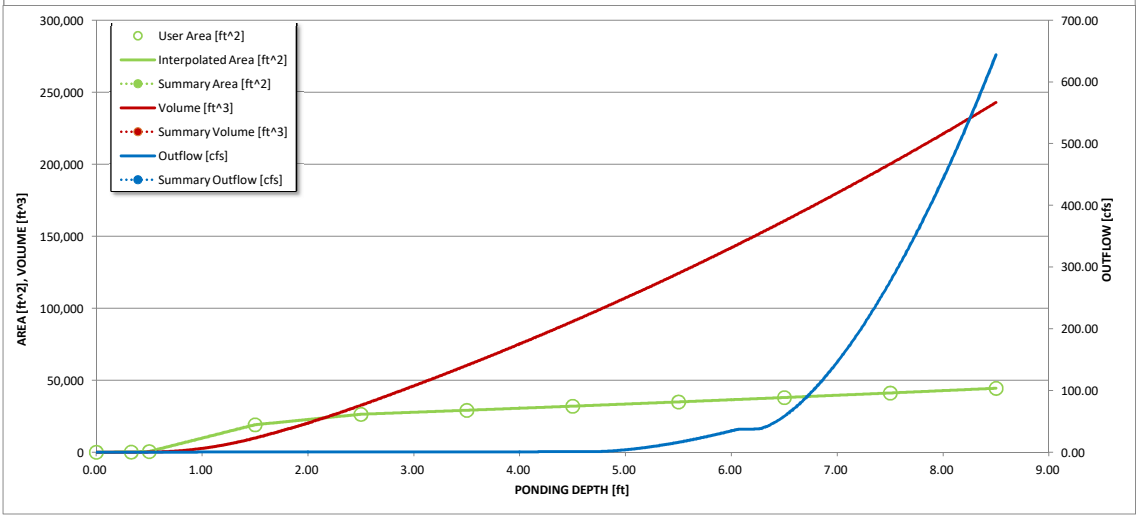
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.716	2.222	1.886	2.462	3.007	3.587	4.045	4.647	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.716	2.224	1.888	2.466	3.011	3.592	4.051	4.653	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.02	0.03	0.28	0.88	1.22	1.63	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.4	0.6	6.4	20.1	27.8	37.0	0.0
Peak Inflow Q (cfs) =	18.0	55.1	46.9	61.0	74.3	88.4	99.5	114.0	#N/A
Peak Outflow Q (cfs) =	0.3	0.7	0.6	2.0	8.6	18.4	26.4	37.0	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	3.1	1.3	0.9	1.0	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	0.1	0.4	0.8	1.2	1.7	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	38	70	65	71	71	70	68	67	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**40**	74	68	76	76	76	75	75	#N/A
Maximum Ponding Depth (ft) =	2.39	4.59	4.14	4.86	5.24	5.57	5.80	6.07	#N/A
Area at Maximum Ponding Depth (acres) =	0.58	0.74	0.71	0.76	0.78	0.81	0.82	0.84	#N/A
Maximum Volume Stored (acre-ft) =	0.675	2.149	1.816	2.351	2.636	2.906	3.085	3.309	#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			

MS
CIVIL CONSULTANTS, INC.

20 BOULDER CRESCENT, STE 110
COLORADO SPRINGS, CO 80903
(719) 955-5485

PROJECT: TIMBERLINE STORAGE

DATE: 12-1-17

SURCHARGE VOL 0.3% OF WQCV

MICRO POOL 125 SQ FT > 10 SQ.FT. OK

INITIAL SURCHARGE

PROPOSED WQCV = 0.216 Ac-ft x 0.003 = 0.000648 x 43560 = 28.23 ft^3

FUTURE WQCV = 0.338 Ac-ft x 0.003 = 0.001014 x 43560 = 44.17 ft^3

MICROPOOL ACTUAL 12 ft w x 10 ft L x 0.42 ft DEEP = 52.1 ft^3 > 44.17 ft^3 OK

MIN FOREBAY VOLUME 3% OF WQCV

PROPOSED WQCV = 0.216 Ac-FT x 0.03 = 0.000648 x 43560 = 28 ft^3

DP 8 = 6.1 cfs DP 4 = 33.7 cfs

6.1/33.7 = 0.18 ≅ 18%

282 ft^3 x 0.18 = 50.76 ft^3 ≅ 51 ft^3 DP 3

282 ft^3 − 51 ft^3 = 231 ft^3 DP 1

FUTURE WQCV = 0.338 Ac-ft x 0.03 = 0.0101 x 43560 = 442 ft^3

DP 3 = 6.1 cfs DP 4 = 52.1 cfs

6.1/52.1 = 0.12 ≅ 12%

442 ft^3 x 0.12 = 53.04 ft^3 DP 3

442 ft^3 − 53 ft^3 = 389 ft^3 DP 1

FOREBAY ACTUAL DP 1 = 277 sq ft x 1.42 ft = 393 ft^3 > 389 ft^3 OK

FOREBAY ACTUAL DP 3 = 101 sq ft x 0.67 ft = 68 ft^3 > 53.04 ft^3 OK

FOREBAY DEPTH DP 1 = 2 ft & DP 3 = 0.67 ft < 30" OK

FOREBAY RELEASE AND CONFIGURATION RELEASE 2% OF UNDETAINED 100 YR PEAK DISCHARGE

100 YR PEAK DISCHARGE Q_{100} = 23.7 cfs x 0.02 = 0.47 cfs

0.47 cfs x 12% = 0.056 cfs DP 3

0.47 cfs − 0.056 cfs = 0.41 cfs DP 1

$Q = C L H^{3/2}$ C = 3.1

DP 1 = $Q = 3.1\ (0.083')\ (1.42')^{3/2}$ = 0.44 cfs ≅ 0.41 cfs OK

DP 3 = $Q = 3.1\ (0.042')\ (0.67)^{3/2}$ = 0.07 cfs ≅ 0.06 cfs OK

CIVIL CONSULTANTS, INC.

20 BOULDER CRESCENT, STE 110
COLORADO SPRINGS, CO 80903
(719) 955-5485

PROJECT: _____

DATE: _____

Size LF channel

Peak

Total tributary flow occurs in Future With OS-1 Development (Flows to NE channel increase from 29.1 cfs to 46.3 cfs)

SW Forebay = 6.1 x 0.02 = 0.122 cfs

NE Forebay (Future) 47.1 x 0.02 = 0.942 cfs

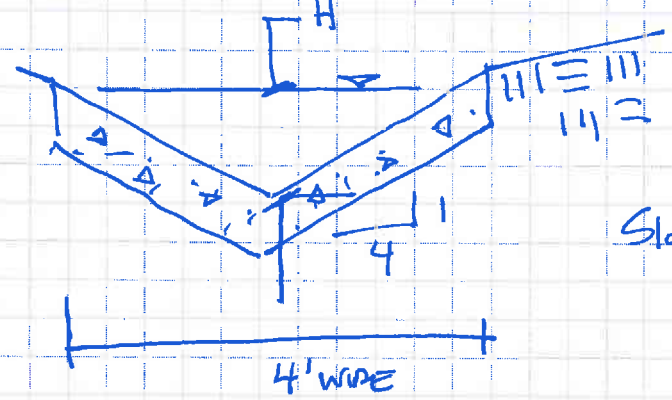
Peak Combined (2% of Contributing 100yr)

= 0.122

+ 0.942

1.064 cfs

Solved in Flowmaster

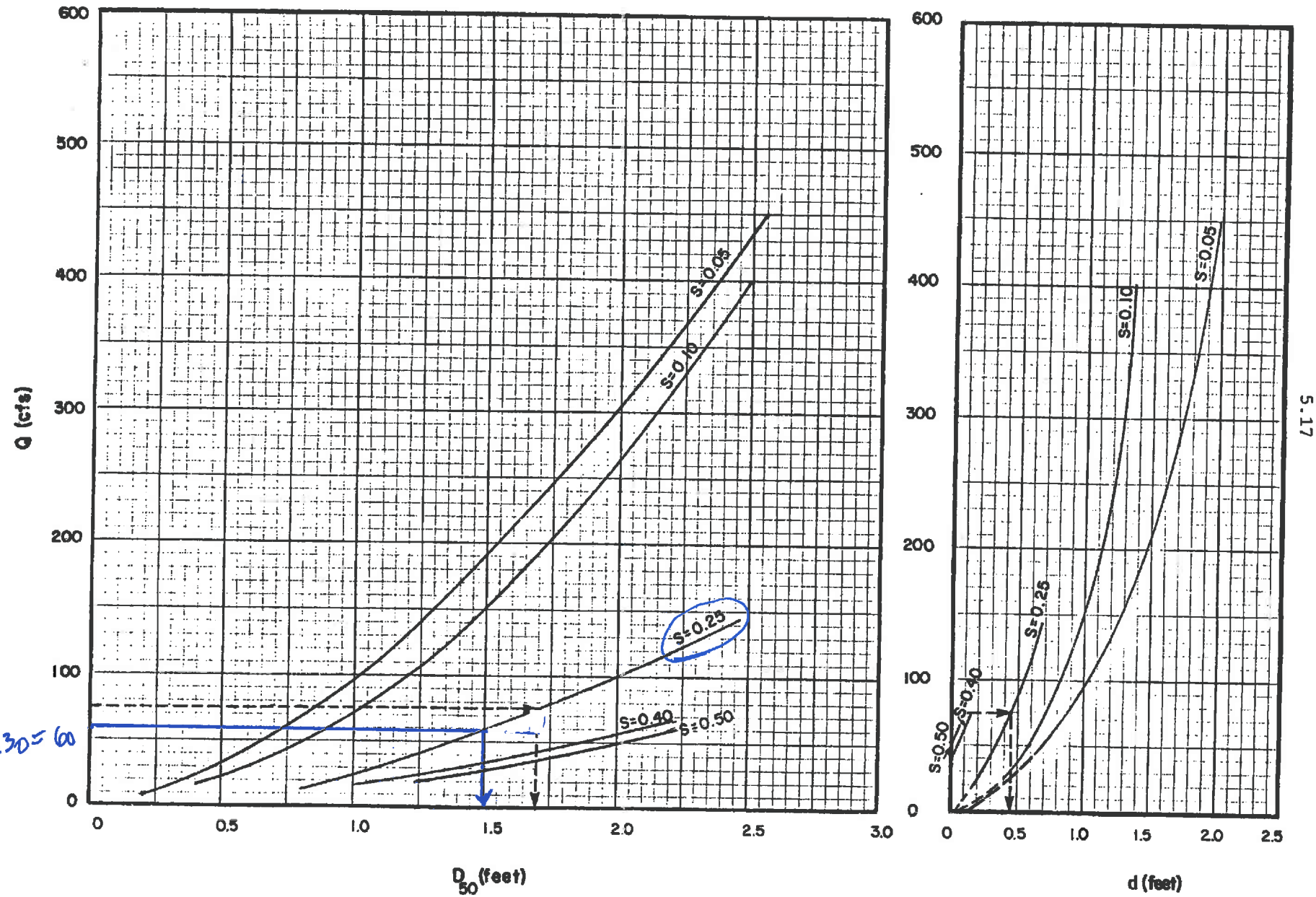


H = 0.5'

Slope = 0.5%

Q capacity = 3.14 cfs > 1.064 cfs OK

3'W Riprap Rundown at NE Corner of Pond



2x30=60

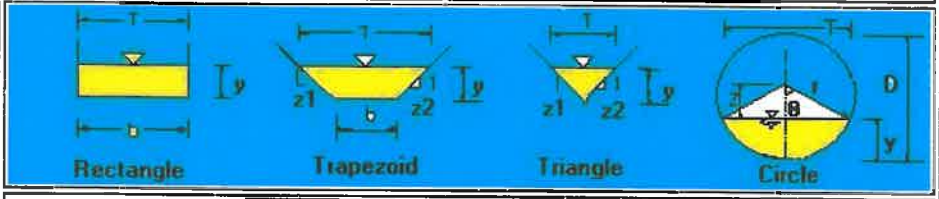
Figure 5.4. Steep slope riprap design, trapezoidal channels, 2:1 sideslopes, 6 ft base width.

Using 3' wide channel w~30cfs assume 60'cfs

Use D_{50} = 12"/24" Assume Maint. Maybe Req'd in 100yr.

The open channel flow calculator

Select Channel Type: Trapezoid



Velocity(V)&Discharge(Q) | Select unit system: Feet(ft)

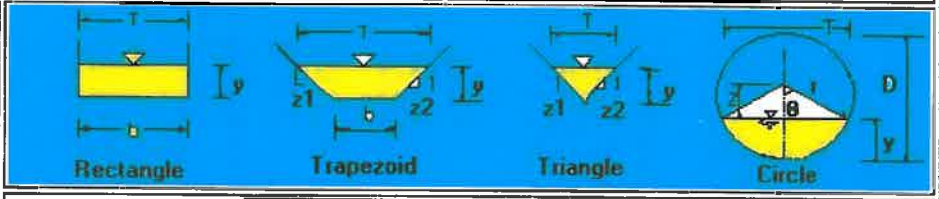
Channel slope: .25 ft/ft	Water depth(y): 0.67 ft	Bottom W(b) 3 ft
Flow velocity 12.3996 ft/s	LeftSlope (Z1): 4 to 1 (H:V	RightSlope (Z2): 4 to 1 (H:V
Flow discharge 47.1879 ft^3/s	Input n value 0.035 or select n	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 8.52 ft	Flow area 3.81 ft^2	Top width(T) 8.36 ft
Specific energy 3.06 ft	Froude number 3.24	Flow status Supercritical flow
Critical depth 1.22 ft	Critical slope 0.0203 ft/ft	Velocity head 2.39 ft

DP 1 Q_{100} = 47.1 cfs (FUTURE)

RIPRAP RUNDOWN POND 1

The open channel flow calculator

Select Channel Type: Triangle



Velocity(V)&Discharge(Q) | Select unit system: Feet(ft)

Channel slope: .055 ft/ft	Water depth(y): 0.5 ft	Bottom W(b) 0 ft
Flow velocity 8.3626 ft/s	LeftSlope (Z1): 12 to 1 (H:V	RightSlope (Z2): 12 to 1 (H:V
Flow discharge 25.0878 ft^3/s	Input n value 0.0165 or select n	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 12.04 ft	Flow area 3 ft^2	Top width(T) 12 ft
Specific energy 1.59 ft	Froude number 2.95	Flow status Supercritical flow
Critical depth 0.77 ft	Critical slope 0.0054 ft/ft	Velocity head 1.09 ft

DP 3 Q_{100} = 6 CFS (FUTURE & PROPOSED)

CONCRETE ACCESS ROAD RUNDOWN INTO POND 1

4' Triangular LF Channel-SW Forebay

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Discharge	0.26	ft^3/s

Results

Normal Depth	0.20	ft
Flow Area	0.15	ft^2
Wetted Perimeter	1.62	ft
Hydraulic Radius	0.10	ft
Top Width	1.57	ft
Critical Depth	0.19	ft
Critical Slope	0.00560	ft/ft
Velocity	1.69	ft/s
Velocity Head	0.04	ft
Specific Energy	0.24	ft
Froude Number	0.95	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.20	ft
Critical Depth	0.19	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00560	ft/ft

4' Triangular LF Channel-NW Forebay

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Discharge	0.58	ft^3/s

Results

Normal Depth	0.27	ft
Flow Area	0.28	ft^2
Wetted Perimeter	2.19	ft
Hydraulic Radius	0.13	ft
Top Width	2.12	ft
Critical Depth	0.26	ft
Critical Slope	0.00503	ft/ft
Velocity	2.06	ft/s
Velocity Head	0.07	ft
Specific Energy	0.33	ft
Froude Number	1.00	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.27	ft
Critical Depth	0.26	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00503	ft/ft

4' Triangular LF Channel-Combined

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Discharge	0.84	ft^3/s

Results

Normal Depth	0.30	ft
Flow Area	0.37	ft^2
Wetted Perimeter	2.51	ft
Hydraulic Radius	0.15	ft
Top Width	2.44	ft
Critical Depth	0.31	ft
Critical Slope	0.00479	ft/ft
Velocity	2.26	ft/s
Velocity Head	0.08	ft
Specific Energy	0.38	ft
Froude Number	1.02	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.30	ft
Critical Depth	0.31	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00479	ft/ft

4' Triangular LF Channel-Combined Future

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Discharge	1.18	ft^3/s

Results

Normal Depth	0.35	ft
Flow Area	0.48	ft^2
Wetted Perimeter	2.86	ft
Hydraulic Radius	0.17	ft
Top Width	2.77	ft
Critical Depth	0.35	ft
Critical Slope	0.00458	ft/ft
Velocity	2.46	ft/s
Velocity Head	0.09	ft
Specific Energy	0.44	ft
Froude Number	1.04	
Flow Type	Supercritical	

GVF Input Data

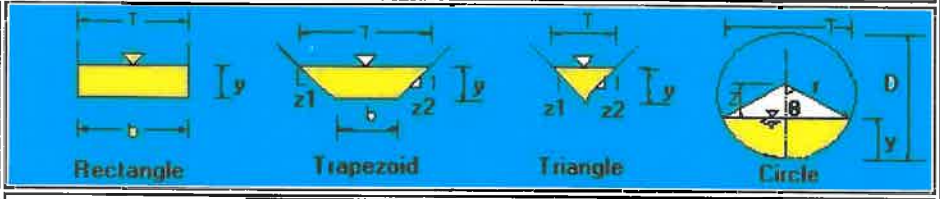
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.35	ft
Critical Depth	0.35	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00458	ft/ft

The open channel flow calculator

Select Channel Type: Trapezoid



Velocity(V)&Discharge(Q) | Select unit system: Feet(ft)

Channel slope: 0.25 ft/ft	Water depth(y): 0.175 ft	Bottom W(b) 45 ft
Flow velocity 6.5707 ft/s	LeftSlope (Z1): 4 to 1 (H:V	RightSlope (Z2): 4 to 1 (H:V
Flow discharge 52.5489 ft^3/s	Input n value 0.035 or select n	
Calculate!	Status: Calculation finished	Reset
Wetted perimeter 46.44 ft	Flow area 8 ft^2	Top width(T) 46.4 ft
Specific energy 0.85 ft	Froude number 2.79	Flow status Supercritical flow
Critical depth 0.35 ft	Critical slope 0.0258 ft/ft	Velocity head 0.67 ft

DP 4 Q_{100} = 52.1 cfs (FUTURE)

SPILLWAY RUNDOWN POND 1

NORTH AMERICAN GREEN

A tensar company

Material and Performance Specification Sheet

North American Green
14649 Highway 41 North
Evansville, IN 47725
800-772-2040
FAX: 812-867-0247
www.nagreen.com

SC150 Erosion Control Blanket

The extended-term double net erosion control blanket shall be a machine-produced mat of 70% agricultural straw and 30% coconut fiber with a functional longevity of up to 24 months. (NOTE: functional longevity may vary depending upon climatic conditions, soil, geographical location, and elevation). The blanket shall be of consistent thickness with the straw and coconut evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with a heavyweight photodegradable polypropylene netting having ultraviolet additives to delay breakdown and an approximate 0.63 x 0.63 (1.59 x 1.59 cm) mesh, and on the bottom side with a lightweight photodegradable polypropylene netting with an approximate 0.50 x 0.50 in (1.27 x 1.27 cm) mesh. The blanket shall be sewn together on 1.50 inch (3.81 cm) centers with degradable thread.

The SC150 shall meet requirements established by the Erosion Control Technology Council (ECTC) Specification and the US Department of Transportation, Federal Highway Administration's (FHWA) *Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects, FP-03 Section 713.17 as a type 3.B Extended-term Erosion Control Blanket.*

The SC150 is also available with the DOT System™, which consists of installation staple patterns clearly marked on the erosion control blanket with environmentally safe paint. The blanket shall be manufactured with a colored thread stitched along both outer edges (approximately 2-5 inches [5-12.5 cm] from the edge) as an overlap guide for adjacent mats.

Material Content		
Matrix	70% Straw Fiber	0.35 lbs/yd² (0.19 kg/m²)
	30% Coconut Fiber	0.15 lbs/yd² (0.08 kg/m²)
Nettings	Top – Heavyweight photodegradable with UV additives	3.0 lb/1000 ft² (1.47 kg/100 m²)
	Bottom – Lightweight Photodegradable	1.5 lb/1000 ft² (0.73 kg/100 m²)
Thread	Degradable	

SC150 is available in the following standard roll sizes:

Width	6.67 ft (2.03 m)	16 ft (4.87 m)
Length	108 ft (32.92 m)	108 ft (32.92 m)
Weight ± 10%	44 lbs (19.95 kg)	105.6 lbs (47.9 kg)
Area	80.0 yd² (66.9 m²)	192 yd² (165.5 m²)

Index Value Properties:

Property	Test Method	Typical
Thickness	ASTM D6525	0.39 in (9.91 mm)
Resiliency	ECTC Guidelines	75%
Water Absorbency	ASTM D1117	285%
Mass/Unit Area	ASTM 6475	11.44 oz/yd² (388 g/m²)
Swell	ECTC Guidelines	30%
Smolder Resistance	ECTC Guidelines	Yes
Stiffness	ASTM D1388	1.11 oz-in
Light Penetration	ECTC Guidelines	8.7%
Tensile Strength –MD	ASTM D6818	146.6 lbs/ft (2.17 kN/m)
Elongation – MD	ASTM D6818	26.9%
Tensile Strength – TD	ASTM D6818	147.6 lbs/ft (2.19 kN/m)
Elongation – TD	ASTM D6818	25.2%

Performance Design Values:

Maximum Permissible Shear Stress	
Unvegetated Shear Stress	2.00 lbs/ft² (96 Pa)
Unvegetated Velocity	8.00 ft/s (2.44 m/s)

Slope Design Data: C Factors			
	Slope Gradients (S)		
Slope Length (L)	≤ 3:1	3:1 – 2:1	≥ 2:1
≤ 20 ft (6 m)	0.001	0.048	0.100
20-50 ft	0.051	0.079	0.145
≥ 50 ft (15.2 m)	0.10	0.110	0.190

Bench Scale Testing* (NTPEP):

Test Method	Parameters	Results
ECTC Method 2 Rainfall	50 mm (2 in)/hr for 30 min	SLR** = 5.47
	100mm (4 in)/hr for 30 min	SLR** = 5.67
	150 mm (6 in)/hr for 30 min	SLR** = 5.88
ECTC Method 3 Shear Resistance	**Shear at 0.50 inch soil loss**	**2.72 lbs/ft²**
ECTC Method 4 Germination	Top Soil, Fescue, 21 day incubation	538% improvement of biomass

* Bench Scale tests should not be used for design purposes

** Soil Loss Ratio = Soil loss with Bare Soil/Soil Loss with RECP (soil loss is based on regression analysis)

Roughness Coefficients- Unveg.	
Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.050
0.50 – 2.0 ft	0.050 – 0.018
≥ 2.0 ft (0.60 m)	0.018

Product Participant of: QDOR

Updated 3/09

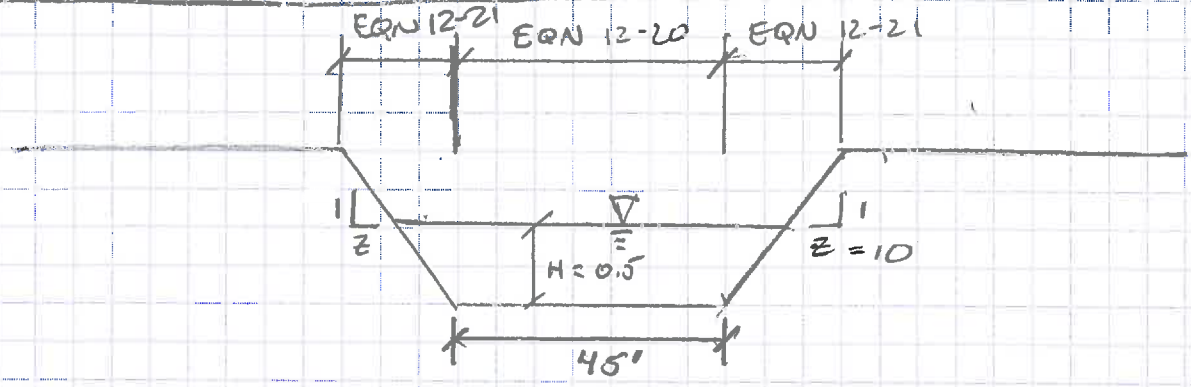
CIVIL CONSULTANTS, INC.

20 BOULDER CRESCENT, STE 110
COLORADO SPRINGS, CO 80903
(719) 955-5485

PROJECT: TIMBERLINE STORAGE

DATE: 11/30/17 FUTURE POND 1 SPILLWAY

SIZE SPILLWAY FUTURE POND 1



FROM UDFCD 12-33 STORAGE

$Q_{100} = 52.1$ cfs $C = 3.0$

EQN 12-20 $Q = CLH^{1.5}$ $Q = 3.0\ (45)(0.5)^{1.5} = 47.72 \cong 48$ cfs

EQN 12-21 $Q = \frac{2}{5}\ C Z H^{2.5}$ $Q = \frac{2}{5}\ (3.0)(10)(0.5)^{2.5} = 2.12$ cfs $\cong 2.1$ cfs

$Q_T = 48$ cfs $+ 2(2.1)$ cfs $= 52.2$ cfs > 52.1 cfs OK

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: existingswale
Project File : existingswale.prj
Run Date and Time: 12/4/2017 3:05:07 PM

Project in English units

PLAN DATA

Plan Title: swale analysis
Plan File : o:\43095A\Tim Emick\Documents\Reports\Drainage\HEC-RAS\existingswale.p01

Geometry Title: existingswale
Geometry File : o:\43095A\Tim Emick\Documents\Reports\Drainage\HEC-RAS\existingswale.g01

Flow Title : ex flow w timberline
Flow File : o:\43095A\Tim Emick\Documents\Reports\Drainage\HEC-RAS\existingswale.f01

Plan Summary Information:
Number of: Cross Sections = 7 Multiple Openings = 0
Culverts = 0 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: ex flow w timberline
Flow File : o:\43095A\Tim Emick\Documents\Reports\Drainage\HEC-RAS\existingswale.f01

Flow Data (cfs)

River	Reach	RS	5YR	100YR
existing swale	existing swale	1074.48	5.2	84.2
existing swale	existing swale	620.87	11.6	126.9
existing swale	existing swale	400	12.1	130.6
existing swale	existing swale	175.88	13.5	139.7

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
existing swale	existing swale	5YR	Normal S = 0.022	Normal S = 0.02

GEOMETRY DATA

Geometry Title: existingswale
Geometry File : o:\43095A\Tim Emick\Documents\Reports\Drainage\HEC-RAS\existingswale.g01

CROSS SECTION

RIVER: existing swale
REACH: existing swale RS: 1074.48

INPUT
Description:
Station Elevation Data num= 16

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6530.367.099998	6530.27	15.57	6530.18	39.4	6530.13	43.03	6529.97	
51.38	6526.41	52.96	6526.23	60	6526.81	61.75	6526.94	62.19	6526.94
65.05	6527.42	69.31	6528.1	92.52	6528.97	97.37	6529.07	108.59	6529.46
120	6529.84								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	0	.03	120	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	120	171.67	171.67	171.67	.1	.3

CROSS SECTION

RIVER: existing swale
REACH: existing swale RS: 902.81

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6527.85	13.59	6527.47	16.76	6527.42	41.75	6526.87	46.77	6526.29
60	6525.4	61.9	6525.27	68.4	6525.78	74.5	6525.91	81.3	6526.18
88.72	6527.19	94.11	6528.08	112.71	6528.74	119.25	6529.01	120	6529.03

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	0	.03	120	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	120	113.78	113.78	113.78	.1	.3

CROSS SECTION

RIVER: existing swale
REACH: existing swale RS: 789.03

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6527.76	23.05	6526.62	32.69	6526.3162.39999	6524.94	75.97	6524.47	
80.31	6524.36	80.54	6524.36	89.43	6524.3	98.67	6525.33	108.83	6526.49
138.32	6527.86	155.36	6528.39	165.31	6529.02				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	0	.03	165.31	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	165.31	168.16	168.16	168.16	.1	.3

CROSS SECTION

RIVER: existing swale
REACH: existing swale RS: 620.87

INPUT
Description:
Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6527.58.9100037	6527.56	29.14	6526.6337.42999	6526.2761.32001	6523.27			
62.03999	6523.1362.46001	6523.1367.78999	6523.29	80	6523.59	92.41	6523.94		
94.9	6523.98	99.08	6524.02	135.86	6524.35	139.15	6524.37	146.21	6524.49
196.17	6525.18	220	6525.61						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	0	.03	220	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	220	220.87	220.87	220.87	.1	.3

CROSS SECTION

RIVER: existing swale
REACH: existing swale RS: 400

INPUT
Description:
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6522.56	4.61	6522.47	22.67	6522.23	33.53	6521.75	52.72	6521.63
60	6521.57	64.2	6521.54	82.04	6521.44	92.49	6521.58	141.05	6521.75
142.01	6521.75	142.24	6521.82	145	6522.82				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	0	.03	145	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	145	224.12	224.12	224.12	.1	.3

CROSS SECTION

RIVER: existing swale
REACH: existing swale RS: 175.88

INPUT
Description:
Station Elevation Data num= 22

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6521.19	30.5	6520.75	32.22	6520.71	32.78	6520.71	34.03	6520.69
35.09	6520.67	102.35	6519.63	112.29	6519.49	130	6519.57	137.9	6519.62
140.38	6519.68	167.91	6519.68	168.26	6519.65	168.7	6519.66	170	6519.67
172.6	6519.69	199.67	6519.87	210.95	6519.98	228.11	6520.84	235.11	6522.39
243.44	6522.22	245	6522.17						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	0	.03	245	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	245	147.52	147.52	147.52	.1	.3

CROSS SECTION

RIVER: existing swale
REACH: existing swale RS: 28.36

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	6521.52	32.07	6521.08	36.97	6521.01	45.59	6520.75	61.39	6520.37
86.45	6519.71	95.58	6519.39	102.08	6519.42	106.63	6519	119.68	6518.2
124.79	6518.04	125.48	6518.02	136.36	6518.56	140.39	6518.81	149.97	6518.72

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	0	.03	149.97	.035

Bank Sta: Left	Right	Coeff Contr.	Expan.
0	149.97	.1	.3

SUMMARY OF MANNING'S N VALUES

River:existing swale

Reach	River Sta.	n1	n2	n3
existing swale	1074.48	.035	.03	.035
existing swale	902.81	.035	.03	.035
existing swale	789.03	.035	.03	.035
existing swale	620.87	.035	.03	.035
existing swale	400	.035	.03	.035
existing swale	175.88	.035	.03	.035
existing swale	28.36	.035	.03	.035

SUMMARY OF REACH LENGTHS

River: existing swale

Reach	River Sta.	Left	Channel	Right

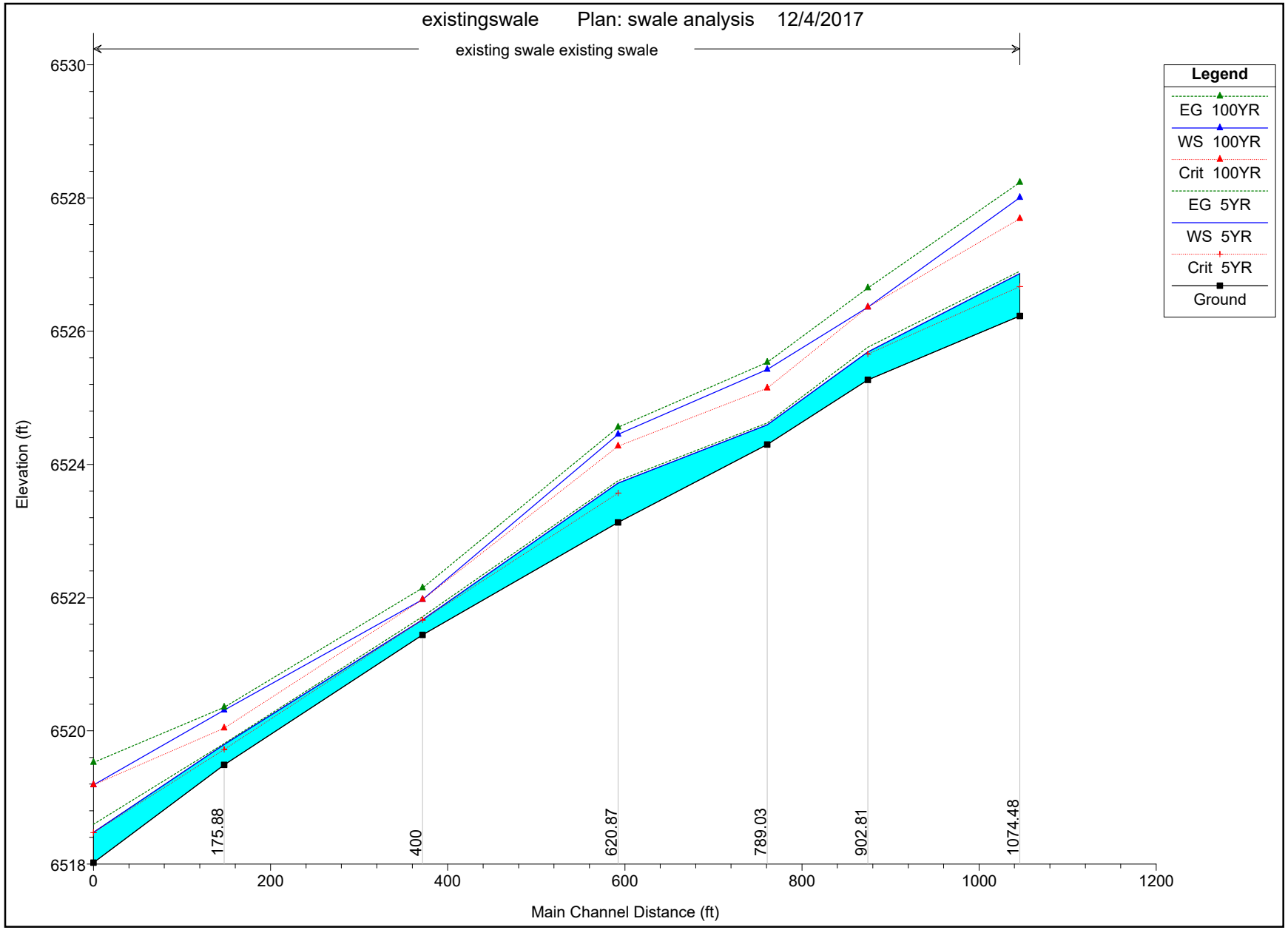
existing swale	1074.48	171.67	171.67	171.67
existing swale	902.81	113.78	113.78	113.78
existing swale	789.03	168.16	168.16	168.16
existing swale	620.87	220.87	220.87	220.87
existing swale	400	224.12	224.12	224.12
existing swale	175.88	147.52	147.52	147.52
existing swale	28.36			

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: existing swale

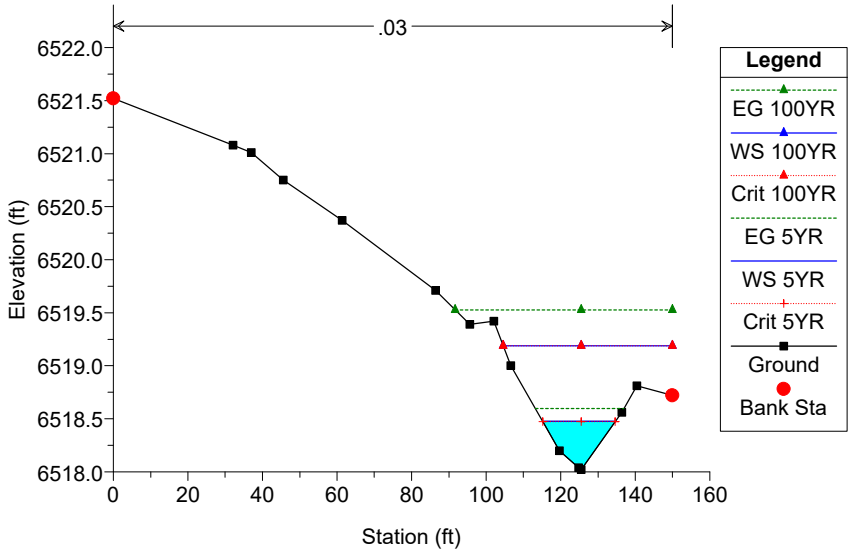
Reach	River Sta.	Contr.	Expan.
existing swale	1074.48	.1	.3
existing swale	902.81	.1	.3
existing swale	789.03	.1	.3
existing swale	620.87	.1	.3
existing swale	400	.1	.3
existing swale	175.88	.1	.3
existing swale	28.36	.1	.3

HEC-RAS Plan: exsw River: existing swale Reach: existing swale

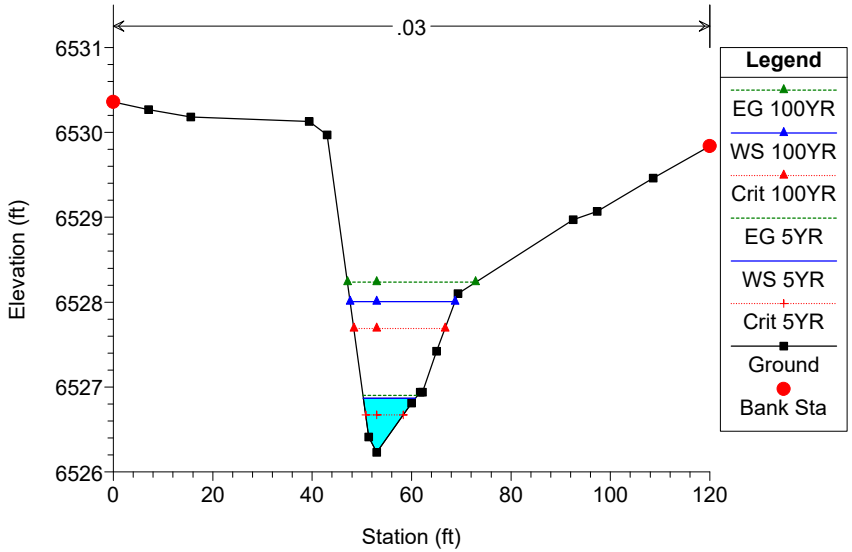
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Max Chl Dpth	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Shear Chan	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	(lb/sq ft)	
existing swale	1074.48	5YR	5.20	6526.23	6526.87	0.64	6526.67	6526.90	0.003696	1.46	3.57	10.45	0.08	0.44
existing swale	1074.48	100YR	84.20	6526.23	6528.01	1.78	6527.69	6528.23	0.005784	3.82	22.03	21.10	0.37	0.66
existing swale	902.81	5YR	5.20	6525.27	6525.69	0.42	6525.66	6525.76	0.015218	2.15	2.42	11.55	0.20	0.83
existing swale	902.81	100YR	84.20	6525.27	6526.36	1.09	6526.36	6526.65	0.017093	4.28	19.66	36.48	0.57	1.03
existing swale	789.03	5YR	5.20	6524.30	6524.59	0.29		6524.62	0.006992	1.38	3.77	19.65	0.08	0.55
existing swale	789.03	100YR	84.20	6524.30	6525.43	1.13	6525.14	6525.53	0.004633	2.60	32.35	47.61	0.20	0.56
existing swale	620.87	5YR	11.60	6523.13	6523.72	0.59	6523.57	6523.75	0.004583	1.48	7.86	26.87	0.08	0.48
existing swale	620.87	100YR	126.90	6523.13	6524.45	1.32	6524.27	6524.56	0.006887	2.66	47.79	91.93	0.22	0.65
existing swale	400	5YR	12.10	6521.44	6521.67	0.23	6521.67	6521.71	0.025559	1.70	7.12	71.62	0.16	0.95
existing swale	400	100YR	130.60	6521.44	6521.97	0.53	6521.97	6522.15	0.019209	3.35	38.96	114.13	0.41	1.01
existing swale	175.88	5YR	13.50	6519.49	6519.80	0.31	6519.72	6519.81	0.004447	0.93	14.50	96.91	0.04	0.42
existing swale	175.88	100YR	139.70	6519.49	6520.31	0.82	6520.04	6520.35	0.002691	1.67	83.55	159.13	0.09	0.41
existing swale	28.36	5YR	13.50	6518.02	6518.48	0.46	6518.47	6518.60	0.019987	2.77	4.87	19.54	0.31	0.98
existing swale	28.36	100YR	139.70	6518.02	6519.19	1.17	6519.19	6519.53	0.015570	4.65	30.01	45.39	0.64	1.01


existingswale Plan: swale analysis 12/4/2017
existing swale existing swale
Legend
EG 100YR
WS 100YR
Crit 100YR
EG 5YR
WS 5YR
Crit 5YR
Ground
Elevation (ft)
6530
6528
6526
6524
6522
6520
6518
0
200
400
600
800
1000
1200
Main Channel Distance (ft)
175.88
400
620.87
789.03
902.81
1074.48

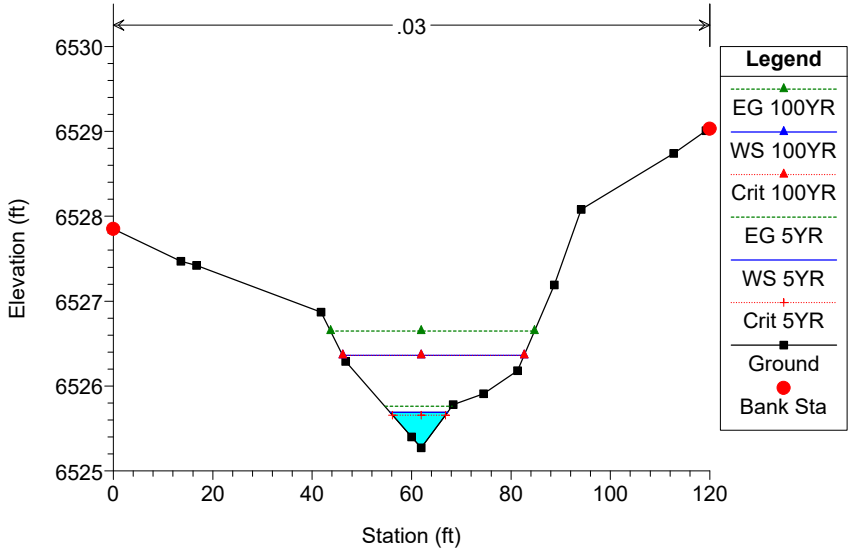
existingswale Plan: swale analysis 12/4/2017



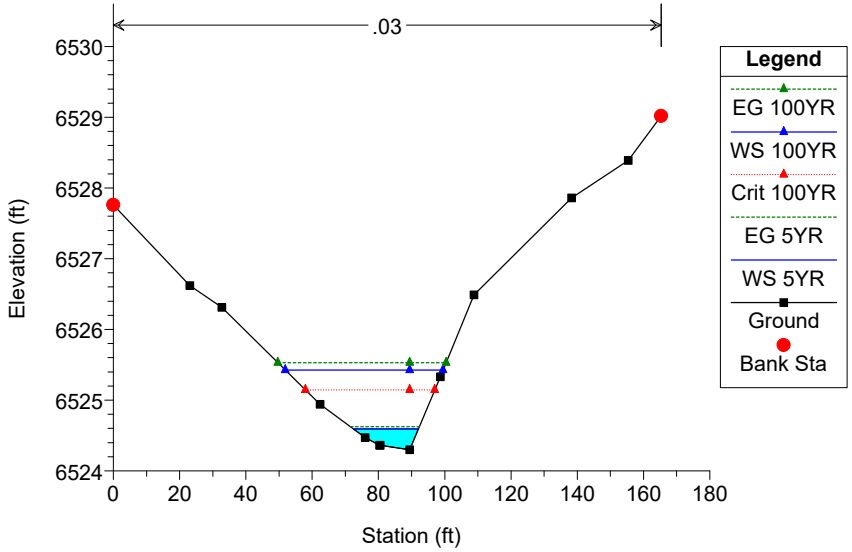
existingswale Plan: swale analysis 12/4/2017



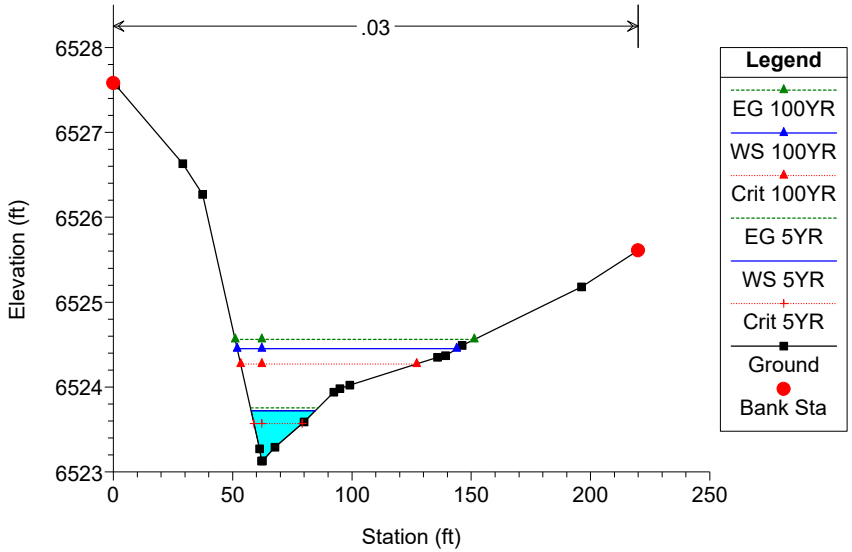
existingswale Plan: swale analysis 12/4/2017



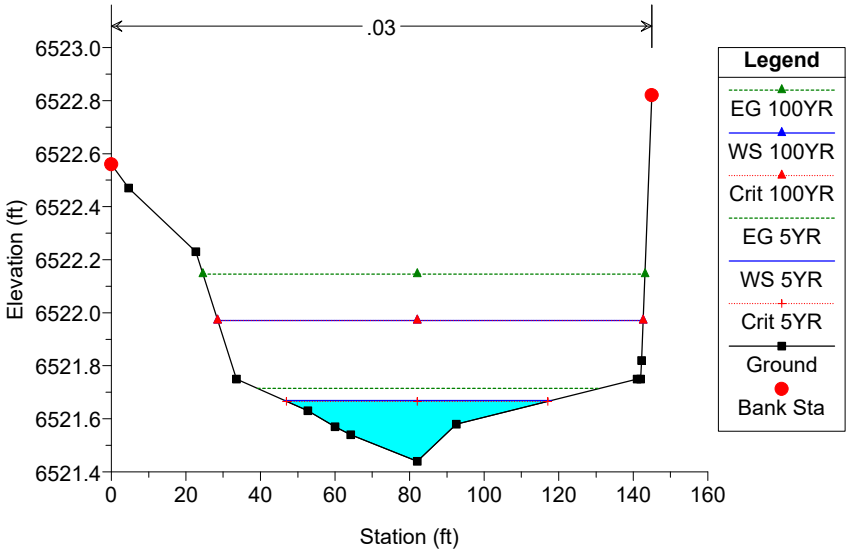
existingswale Plan: swale analysis 12/4/2017



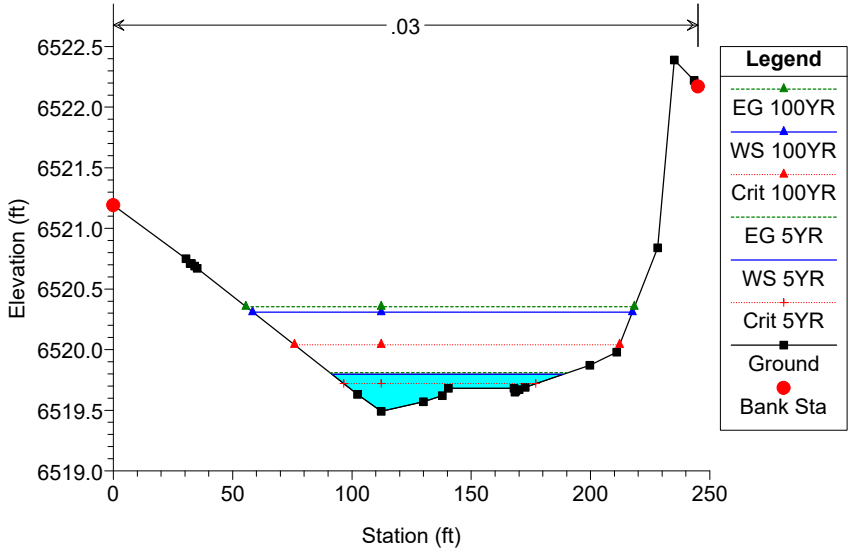
existingswale Plan: swale analysis 12/4/2017



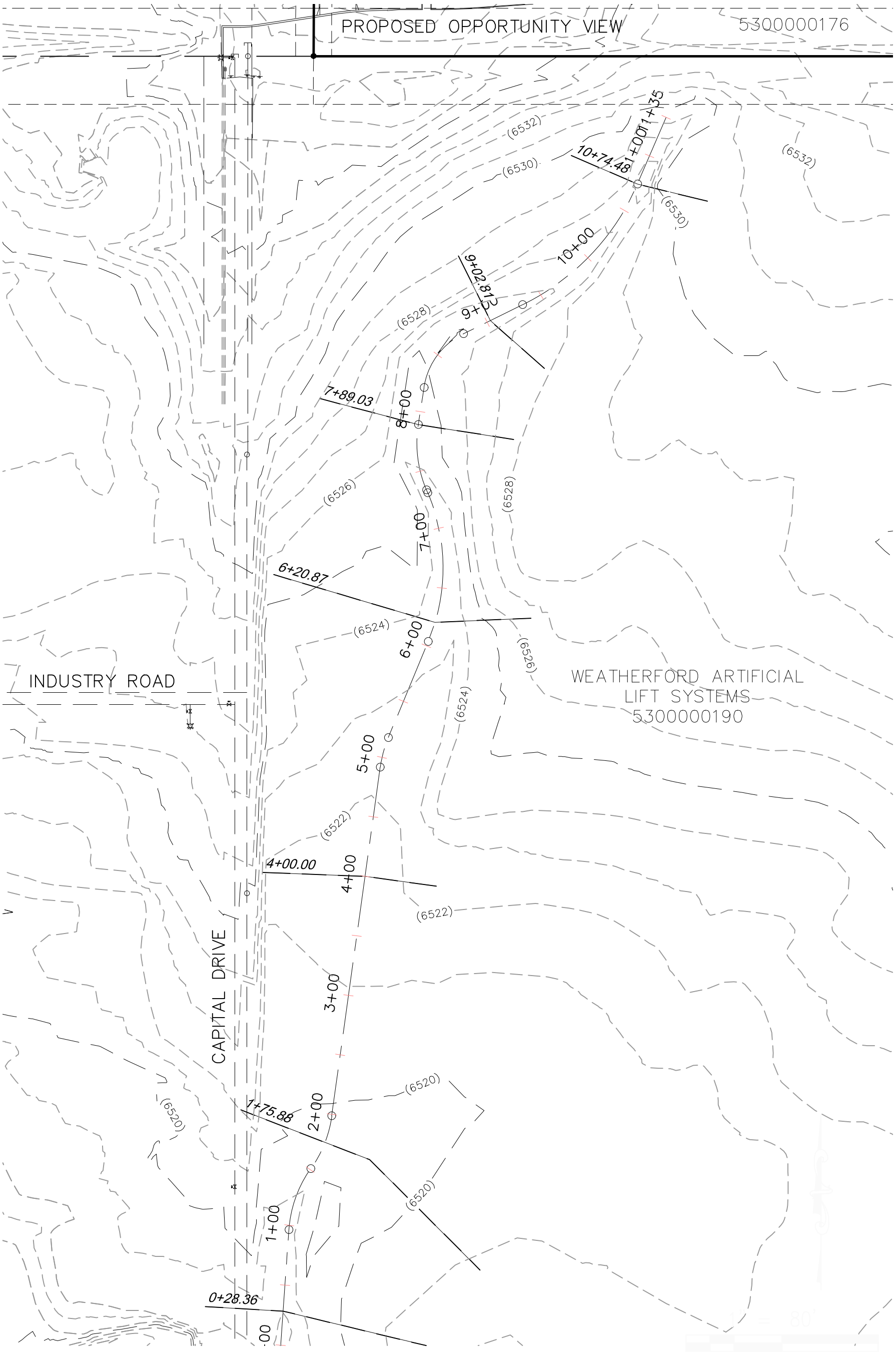
existingswale Plan: swale analysis 12/4/2017



existingswale Plan: swale analysis 12/4/2017



OFF-SITE SWALE HEC-RAS WORK MAP



5YR EVENT / 100YR EVENT

CROSS SECTION ID	FLOW CFS	DEPTH FT	VELOCITY FT/S	SHEAR LB/SF	FLOW CFS	DEPTH FT	VELOCITY FT/S	SHEAR LB/SF
10+74.48	5.2	0.6	1.5	0.1	84.2	1.8	3.8	0.4
9+02.81	5.2	0.4	2.2	0.2	84.2	1.1	4.3	0.6
7+89.03	5.2	0.3	1.4	<0.1	84.2	1.1	2.6	0.2
6+20.87	11.6	0.6	1.5	<0.1	126.9	1.3	2.7	0.2
4+00.00	12.1	0.2	1.7	0.2	130.6	0.5	3.4	0.4
1+75.88	13.5	0.3	0.9	<0.1	139.7	0.8	1.7	0.1
0+28.36	13.5	0.4	2.8	0.3	139.7	1.2	4.7	0.6

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

GRADING AND EROSION CONTROL PLAN

TIMBERLINE STORAGE YARD

GRADING AND EROSION CONTROL PLAN

GRADING AND EROSION CONTROL NOTES:

1. CONSTRUCTION MAY NOT COMMENCE UNTIL A CONSTRUCTION PERMIT IS OBTAINED FROM DEVELOPMENT SERVICES AND A PRECONSTRUCTION CONFERENCE IS HELD WITH DEVELOPMENT SERVICES INSPECTIONS.

2. 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.

3. 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.

4. A SEPARATE STORMWATER MANAGEMENT PLAN (SMWP) 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.

5. 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.

6. 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.

7. 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.

8. 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).

9. 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.

10. 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.

11. 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.

12. 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.

13. EROSION CONTROL BLANKETING IS TO BE USED ON SLOPES STEEPER THAN 3:1.

14. 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.

15. VEHICLE TRACKING OF SOILS AND CONSTRUCTION DEBRIS OFF-SITE SHALL BE MINIMIZED. MATERIALS TRACKED OFFSITE SHALL BE CLEANED UP AND PROPERLY DISPOSED OF IMMEDIATELY.

16. 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.

17. 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.

18. 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.

19. NO CHEMICALS ARE TO BE USED BY THE CONTRACTOR, WHICH HAVE THE POTENTIAL TO BE RELEASED IN STORMWATER UNLESS PERMISSION FOR THE USE OF A SPECIFIC CHEMICAL IS GRANTED IN WRITING BY THE ECM ADMINISTRATOR. IN GRANTING THE USE OF SUCH CHEMICALS, SPECIAL CONDITIONS AND MONITORING MAY BE REQUIRED.

20. 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.

21. NO PERSON SHALL CAUSE THE IMPEDIMENT OF STORMWATER FLOW IN THE FLOW LINE OF THE CURB AND GUTTER OR IN THE DITCHLINE.

22. 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.

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

24. PRIOR TO ACTUAL CONSTRUCTION THE PERMITEE SHALL VERIFY THE LOCATION OF EXISTING UTILITIES.

25. A WATER SOURCE SHALL BE AVAILABLE ON SITE DURING EARTHWORK OPERATIONS AND UTILIZED AS REQUIRED TO MINIMIZE DUST FROM EARTHWORK EQUIPMENT AND WIND.

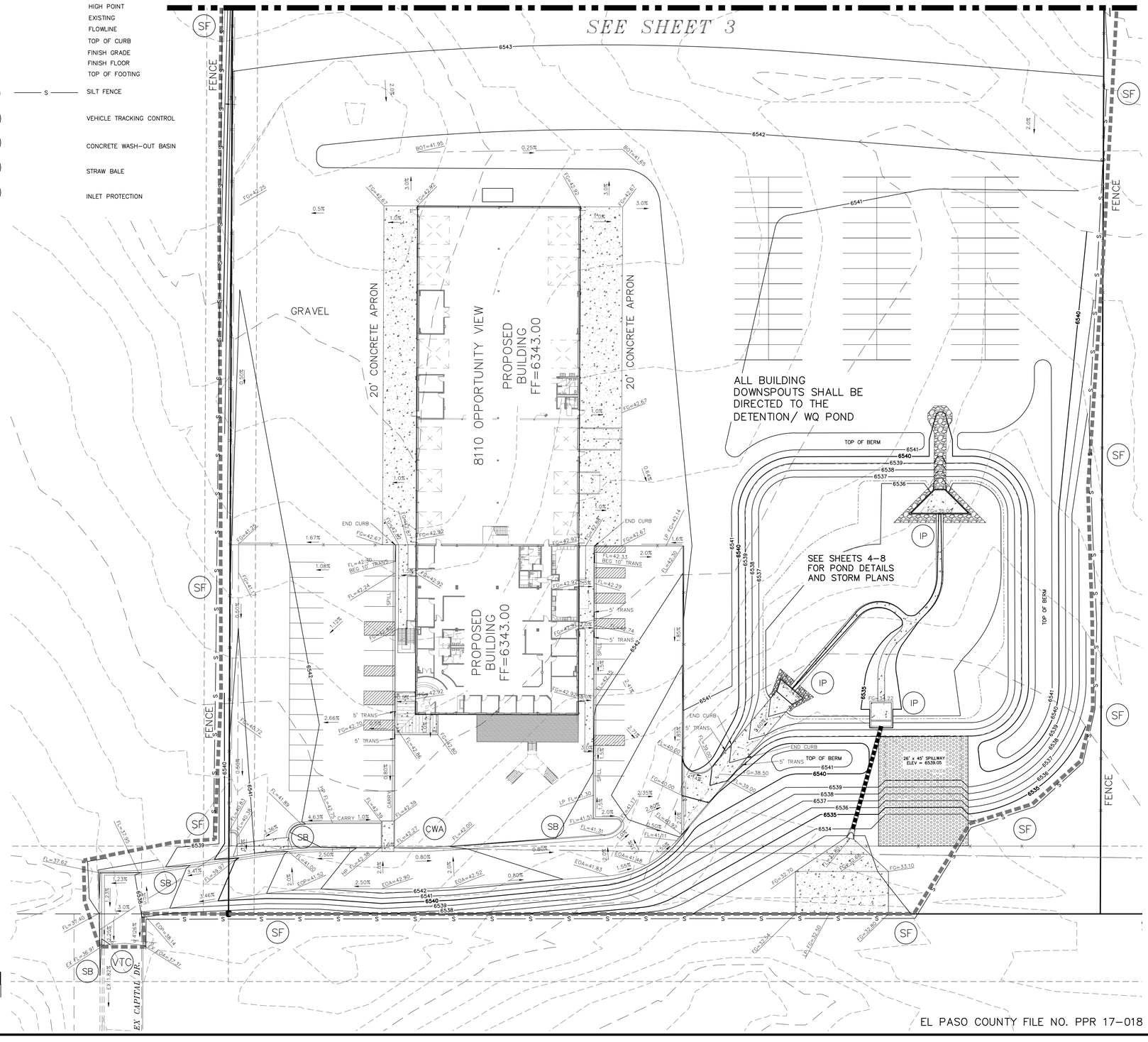
26. THE SOILS REPORT FOR THIS SITE HAS BEEN PREPARED BY CTL THOMPSON, INC. # CS18748-125 DATED MAY 5, 2017. AND SHALL BE CONSIDERED A PART OF THESE PLANS.

27. 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 CONSTRUCTION ACTIVITY SHALL SUBMIT A PERMIT APPLICATION FOR STORMWATER DISCHARGE TO THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT, 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

LEGEND

	EX MAJ CONT
	EX MIN CONT
	PROP MAJ CONT
	PROP MIN CONT
LP	LOW POINT
HP	HIGH POINT
EX	EXISTING
FL	FLOWLINE
TC	TOP OF CURB
FG	FINISH GRADE
FF	FINISH FLOOR
TOF	TOP OF FOOTING
SF — S —	SILT FENCE
VTC	VEHICLE TRACKING CONTROL
CWA	CONCRETE WASH-OUT BASIN
SB	STRAW BALE
IP	INLET PROTECTION



1" = 50'

0 25 50 5

Scale in Feet

EL PASO COUNTY FILE NO. PPR 17-018

TIMBERLINE STORAGE YARD	
GRADING AND EROSION CONTROL PLAN	
PROJECT NO. 43-095	SCALE: HORIZONTAL: 1"=50' VERTICAL: N/A
DESIGNED BY: GW	DATE: 12/02/2017
DRAWN BY: GW	SHEET 2 OF 8
CHECKED BY: VAS	GR02

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

CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF MCS CIVIL CONSULTANTS, INC.

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

REVISIONS:			
NO.	DATE:	BY:	DESCRIPTION:

APP'V'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: Q:\43095A\Tim Emick\dwg\Dev Plan\43095 Grading Plan.dwg Plotstamp: 12/2/2017 7:18 PM

PROPOSED/EXISTING DRAINAGE MAP

TIMBERLINE STORAGE YARD

COUNTY OF EL PASO, STATE OF COLORADO

EXISTING DRAINAGE MAP

DECEMBER 2017

EXISTING SUBTRIBUTARY OF EAST FORK SAND CREEK

EXISTING RAILROAD EMBANKMENT/TRACK

PROPERTY BOUNDARY

H.P.

L.P.

HIP.

UNPLATTED

40' RESERVED R.O.W. FOR ROADWAY & UTILITY PURPOSES

SITE OF FUTURE DEVELOPMENT

15' RAILROAD SPUR EASEMENT

15' RAILROAD SPUR EASEMENT

EX1 22.9 0.09 0.36

EX2 23.6 0.09 0.36

EX3 24.7 0.09 0.36

EXISTING DIRT TRAVELWAY

EXISTING CAPITAL DRIVE

40' RESERVED R.O.W. FOR ROADWAY & UTILITY PURPOSES

1

2

LEGEND

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

6 — SURFACE DESIGN POINT (DP)

BASIN BOUNDARY

(6920) — EXISTING CONTOUR

PARCEL BOUNDARY

TIMBERLINE STORAGE YARD SITE BOUNDARY

EXISTING FLOW DIRECTION ARROW

H.P. — HIGH POINT

L.P. — LOW POINT

BASIN SUMMARY			
BASIN	AREA (ACRES)	Q_5	Q_{100}
EX1	22.93	7.6	51.0
EX2	23.63	4.5	30.4
EX3	24.67	4.6	30.8

DESIGN POINT SUMMARY			
DESIGN POINT	Q_5	Q_{100}	BASIN & DES. PTS
1	11.5	77.3	EX1,EX2
2	13.6	91.6	DP1,EX3

1" = 80'

0 40 80 160

Scale in Feet

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

FOR BURIED UTILITY INFORMATION

48 HRS BEFORE YOU DIG

CALL 1-800-922-1987

M&S CIVIL CONSULTANTS, INC.

20 BOULDER CRESCENT, SUITE 110

COLORADO SPRINGS, CO 80903

PHONE: 719.955.5485

TIMBERLINE STORAGE YARD

EXISTING DRAINAGE MAP

PROJECT NO. 43-095	SCALE: HORIZONTAL: 1"=80' VERTICAL: N/A	DATE: 12/1/2017	
DESIGNED BY: CMN		SHEET 1 OF 1	EDM
DRAWN BY: CMN			
CHECKED BY: VAS			

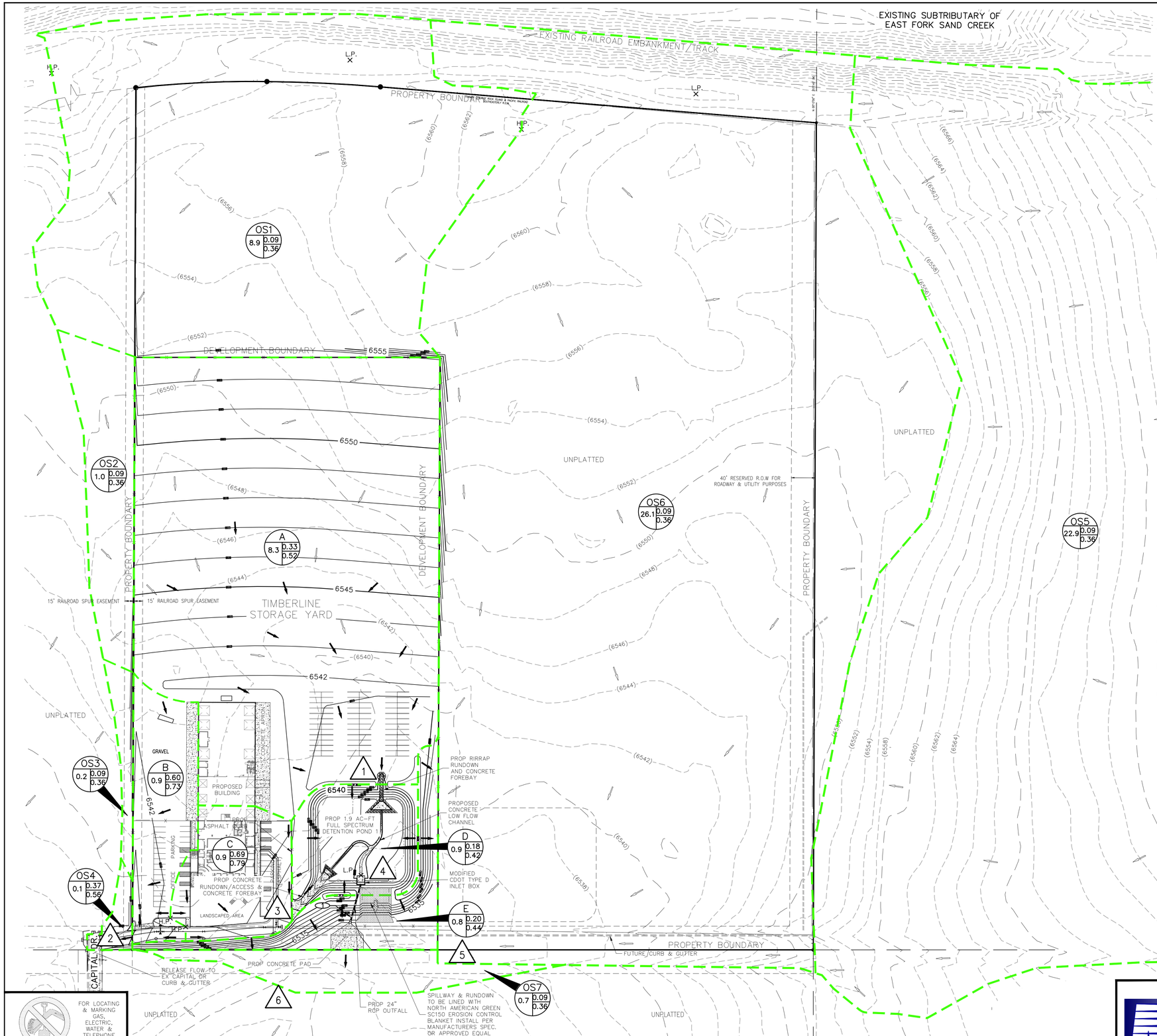
File: O:\43095A\Tim Emick\dwg\Eng Exhibits\Existing Drainage Map 43-095.dwg Plotstamp: 12/2/2017 12:21 PM

TIMBERLINE STORAGE YARD

COUNTY OF EL PASO, STATE OF COLORADO

PROPOSED DRAINAGE MAP

DECEMBER 2017



LEGEND

- BASIN DESIGNATION (Z / 25 / .25 / .35 / C5 / C100 / ACRES)
- PIPE RUN (PR) REFERENCE LABEL (4)
- SURFACE DESIGN POINT (DP) (6)
- BASIN BOUNDARY
- EXISTING CONTOUR (6920)
- PROP CONTOUR 6538
- PARCEL BOUNDARY
- TIMBERLINE STORAGE YARD SITE BOUNDARY
- STORM SEWER PIPE
- FUTURE STORM SEWER PIPE
- INLET
- EXISTING FLOW DIRECTION ARROW
- EMERGENCY OVERFLOW DIRECTION
- FLOW DIRECTION
- FLARED END SECTION
- H.P. HIGH POINT
- L.P. LOW POINT

1" = 80'

0 40 80 160

Scale in Feet

BASIN SUMMARY

BASIN	AREA (ACRES)	Q_5	Q_{100}
A	8.27	9.4	25.1
B	0.94	2.2	4.4
C	0.90	3.2	6.1
D	0.90	0.8	3.1
E	0.82	0.9	3.1
OS1	8.93	2.5	16.6
OS2	1.03	0.3	2.2
OS3	0.21	0.1	0.5
OS4	0.13	0.3	0.7
OS5	22.93	7.6	50.9
OS6	26.07	4.9	33.2
OS7	0.68	0.2	1.4

DESIGN POINT SUMMARY

DESIGN POINT	Q_5	Q_{100}	BASIN	STRUCTURE
1	8.1	29.6	OS1, OS2, A	RIP RAP RUNDOWN INTO FULL-SPECTRUM DETENTION POND
2	2.4	5.4	B, OS3, OS4	OUTFALL TO CAPITAL DR. C&G
3	3.2	6.1	C	CONCRETE RUNDOWN INTO FULL-SPECTRUM DETENTION POND
4	9.8	33.7	DP1, DP3, D	PROPOSED FULL-SPECTRUM DETENTION POND1
5	11.3	76.2	OS5, OS6	HISTORIC DRAINAGE PATTERNS
6	12.4	85.8	DP5, PIPE 1, OS7	HISTORIC DRAINAGE PATTERNS TOTAL DISCHARGE

STORM SEWER SUMMARY

PIPE RUN	Q_5	Q_{100}	PIPE SIZE	CONTRIBUTING STRUCTURES
1	0.8	8.3	24" RCP	POND 1 OUTFALL

POND 1 FULL SPECTRUM DETENTION BASIN DATA

WQ WATER SURFACE EL=7035.72
WQ VOLUME=0.216 AC-FT.
EURV WATER SURFACE EL=6536.40
EURV VOLUME=0.516 AC-FT
100-YR WATER SURFACE EL=6538.93
SPILLWAY CREST EL=6539.05
TOP OF EMBANKMENT EL=6541.0
100-YR VOLUME=1.876 AC-FT
100-YR INFLOW=33.7 CFS
100-YR RELEASE=8.3 CFS

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

TIMBERLINE STORAGE YARD

PROPOSED DRAINAGE MAP

PROJECT NO. 43-095	SCALE: HORIZONTAL: 1"=80' VERTICAL: N/A	DATE: 12/01/2017	
DESIGNED BY: CMN DRAWN BY: CMN CHECKED BY: VAS		SHEET 1 OF 1	PDM

TIMBERLINE STORAGE YARD

COUNTY OF EL PASO, STATE OF COLORADO

FUTURE DRAINAGE MAP

DECEMBER 2017

EXISTING SUBTRIBUTARY OF EAST FORK SAND CREEK

EXISTING RAILROAD EMBANKMENT/TRACK

PROPERTY BOUNDARY

FUTURE INDUSTRIAL DEVELOPMENT

DEVELOPMENT BOUNDARY

OS1 8.9 | 0.51 | 0.65

OS2 1.0 | 0.09 | 0.36

A 8.3 | 0.33 | 0.52

OS6 22.8 | 0.68 | 0.78

OS5 26.6 | 0.69 | 0.79

40' RESERVED R.O.W FOR ROADWAY & UTILITY PURPOSES

15' RAILROAD SPUR EASEMENT

EXISTING TIMBERLINE STORAGE YARD

6546 6544 6542

UNPLATTED

EXISTING GRAVEL STORAGE YARD

EXISTING GRAVEL LOT

EXISTING BUILDING

CONCRETE APRON

EXISTING OFFICE PARKING

6538 6540

OS3 0.2 | 0.09 | 0.36

B 0.9 | 0.60 | 0.73

C 0.9 | 0.69 | 0.79

D 0.9 | 0.18 | 0.42

OS4 0.1 | 0.38 | 0.57

EX FULL SPECTRUM DETENTION POND 1

MODIFIY ORIFICE PLATE AND RESTRICTOR PLATE ON EXISTING FSD OUTFALL STRUCTURE

FUTURE FSD OUTFALL STRUCTURE W/30" RCP OUTFALL

FUTURE STORM WATER COLLECTION SYSTEM TO BE SIZED AND CONSTRUCTED WITH FUTURE ROADWAY IMPROVMENTS

EX 24" RCP OUTFALL PIPE

FUTURE FULL SPECTRUM DETENTION POND 3

FUTURE 24" RCP OUTLET PIPE

FUTURE FULL SPECTRUM DETENTION POND 2

FUTURE 30" RCP OUTFALL PIPE

FUTURE CURB & GUTTER

FUTURE 42" RCP OUTFALL PIPE

FUTURE 24" RCP OUTFALL PIPE

FUTURE RIPRAP PAD

OS7 0.7 | 0.09 | 0.36

CAPITAL DR.

PROPERTY BOUNDARY

L.P. H.P.

1" = 80'

0 40 80 160

Scale in Feet

LEGEND

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

PIPE RUN (PR) REFERENCE LABEL

SURFACE DESIGN POINT (DP)

BASIN BOUNDARY

(6920) EXISTING CONTOUR

6538 PROP CONTOUR

PARCEL BOUNDARY

TIMBERLINE STORAGE YARD SITE BOUNDARY

STORM SEWER PIPE

FUTURE STORM SEWER PIPE

INLET

EXISTING FLOW DIRECTION ARROW

EMERGENCY OVERFLOW DIRECTION

FLOW DIRECTION

FLARED END SECTION

H.P. HIGH POINT

L.P. LOW POINT

BASIN SUMMARY

BASIN	AREA (ACRES)	Q_5	Q_{100}
A	8.27	9.4	25.1
B	0.94	2.2	4.4
C	0.90	3.2	6.1
D	0.90	0.8	3.1
E	0.82	0.9	3.1
OS1	8.93	17.8	38.6
OS2	1.03	0.3	2.2
OS3	0.21	0.1	0.5
OS4	0.13	0.3	0.7
OS5	26.58	78.4	148.8
OS6	22.78	59.6	114.0
OS7	0.68	0.2	1.4

DESIGN POINT SUMMARY

DESIGN POINT	Q_5	Q_{100}	BASIN	STRUCTURE
1	19.6	47.1	OS1, OS2, A	RIP RAP RUNDOWN INTO FSD
2	2.4	5.4	B, OS3, OS4	OUTFALL CAPITAL DR.
3	3.2	6.1	C	DRAINAGE SWALE INTO FSD
4	21.7	52.1	DP1, DP3, D	EX FSD POND
5	78.4	148.8	OS5	FUTURE FSD POND 2
6	59.6	114.0	OS6	FUTURE FSD POND 3
7	5.4	85.6	OS7, PIPE1, PIPE4	HISTORIC CHANNEL

STORM SEWER SUMMARY

PIPE RUN	Q_5	Q_{100}	PIPE SIZE	CONTRIBUTING STRUCTURES
1	0.6	21.8	24" RCP	EX POND1 OUTLET
2	1.6	25.4	24" RCP	FUT POND2 OUTLET
3	2.0	37.0	30" RCP	FUT POND3 OUTLET
4	3.6	62.4	42" RCP	PIPE5, PIPE6

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SHEET 1 OF 1

FDM