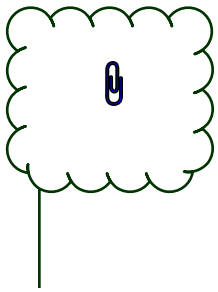
FINAL DRAINAGE REPORT

FOR

TIMBERLINE STORAGE YARD
EL PASO COUNTY, COLORADO

JUNE 2017



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Project #43-095

PCD Project No. PPR-17-018

FINAL DRAINAGE REPORT
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 master plan of the drainage basin.

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

Review 2: Comment remains. Replace with the County's standard statement:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by 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 omissions on my part in preparing this report.

DEVELOPER'S STATEMENT

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

BY:_____

TITLE:_____
DATE:_____

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.

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

CONDITIONS:

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TIMBERLINE STORAGE YARD

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APPENDIX

FINAL DRAINAGE REPORT
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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, a storm 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 11.48 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 construction of a diversion channel 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. 1.30 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 drainageways –The Timberline Storage Yard site proposes a Full Spectrum Detention (FSD) pond to control developed runoff that is discharging to the historic drainageway 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 drainageways.

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 drainageway located adjacent to the southern boundary of the planned development. The total calculated surface runoff at **DP3** is 13.6 cfs in the 5-year

Revise to DP2

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 combine with runoff generated onsite within the gravel storage yard and from a portion of the eastern 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 1.5 acres 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 and the west half of the proposed buildings in a proposed curb and gutter section. The combined runoff will be collected by a proposed sump inlet proposed underground storm sewer system and conveyed east to the proposed FSD pond.

Runoff generated from small offsite areas and within the proposed west entrance and access roadway, and landscaped area (south of buildings) will combined with flows produced by the proposed buildings parking lots on the east half of the site. The combined runoff will be collected by a proposed sump inlet and storm sewer system and conveyed underground to the north 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 drainageway located south of the site. A proposed diversion swale will be constructed to the east and south of the development to protect the proposed improvements by conveying offsite flows around the site to the historic drainage way. Proposed discharge from the site, post construction, is less than historic and therefore it construction is not anticipated to negatively affect downstream facilities or properties.

Proposed Conditions Detailed Drainage Discussion

Basin OS-1, 8.0 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, 8.0 acres, (Q5=8.7cfs, Q100=23.7cfs), consists primarily of a proposed gravel storage yard as well as portions 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=7.7cfs, Q100=29.1cfs). Runoff reaching DP-1 will be directed to a proposed Full Spectrum Detention Pond via a 3'bw 2:1 SS trapezoidal 25% rundown lined with D50=12" riprap (24" deep). A pair of 4:1SS, 1' min. deep v-shaped earthen swales graded at 1% 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 B, 1.0 acres, (Q5=3.5cfs, Q100=7.0cfs), consists of a portion of the office/warehouse buildings, 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** combines with runoff generated in **Basin B** and is directed to via proposed curb and gutter to a proposed 5' CDOT sump inlet at **Design Point 2** (Q5=3.6cfs, Q100=7.6cfs). Flows captured by the sump inlet are directed to the east underground via a proposed 18" RCP storm drain (**Pipe 2**).

Basin OS-4, 0.1 acres, (Q5=0.2cfs, Q100=0.6cfs), 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 porion of the proposed access road. Runoff generated by this basin are directed westward via the proposed curb and gutter to the combine flows from Basin C.

Basin C, 1.0 acres, (Q5=2.8cfs, Q100=5.9cfs), consists of the southeastern quarter of the proposed building, the east paved parking lot, landscaping, driveways as well as the north half of a 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 and a proposed 5' CDOT sump inlet located at **Design Point 3** (Q5=3.0cfs, Q100=6.6cfs). Runoff captured by the sump inlet is directed to the north underground via a proposed 24" RCP storm drain (**Pipe 1**). Flows conveyed within Pipe 1 combine with those in **Pipe 2** combine to create peak pipe flows of 6.4cfs and 13.7cfs in the 5 and 100 year events, respectively. The captured runoff continues north to the proposed FSD pond via a proposed 24" RCP storm drain (**Pipe 3**).

Basin D, 1.1 acres, (Q5=1.3fs, Q100=4.5cfs), consists of a portion of land which houses a proposed Full Spectrum Detention (FSD) pond. Runoff from **Design Points 1, 2**, & **3** contribute to the proposed FSD pond at **Design Point 4** at a combined peak flow rates of Q5=11.6cfs, Q100=38.0cfs. 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 1.35 acre feet of storage in the 100-year event and was limited to 21.0 cfs of discharge.

Several factors were evaluated in the design of the facility, which included site functionality and costs, but the primary being the relatively shallow depth of the proposed sanitary sewer line its effect on the allowable elevation of the outlet pipe and its subsequent proximity to sump inlet in the adjacent access road coupled with the consideration for future site development. (See future detailed drainage discussion). As configured the FSD pond in the proposed condition will have a 100-year volume of 1.53 ac-feet with a proposed discharge of 21.3 cfs. In the 100-year event it is estimated that the routed water surface will reach an elevation of approximately 6534.15. Based upon a starting 100-year WSE in FSD Pond 1, the hydraulic grade line in Pipe 3 will reach an elevation of 6534.54 at the proposed 5' sump inlet at DP3. This water surface elevation is basically equivalent to the planned flow line elevation of the curb at the inlet opening in the adjacent access roadway. A proposed single 30" RCP storm sewer will discharge the detained runoff to the historic drainage channel. A proposed riprap pad will be provided at the outfall to arrest erosion. The crest of the spillway is set above the 100-year water surface at 6535.30 which allows for positive drainage to the future curb line. The proposed embankment has been set at 6536.30. Should the pond outlet or box become clogged storm water would back up thru the inlet and would overtop the south embankment of the proposed access roadway to the historic channel. Should the inlet become clogged the runoff would discharge thru the proposed spillway section, where runoff would over top the south roadway embankment to the historic channel.

Basin OS-5, 22.9 acres, (Q5=7.6cfs, Q100=51.0cfs), 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, 26.4 acres, (Q5=5.8cfs, Q100=39.1cfs), 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.** A proposed a 20'bw 4:1 SS trapezoidal 2% grass lined swale is recommended to be constructed to direct proposed runoff of Q5=12.2cfs, Q100=82.0cfs around the southeast corner of the Timberline Storage Yard site.

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 temporary diversion channel and the FSD detention pond outlet pipe combines at **Design Point 6** for a 5 and 100-year peak flow rates of 10.5 cfs and 89.6 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.

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 21.7 acres by providing 0.234 acre-feet of storage for the water quality event 0.548 acre feet of storage at the EURV event storm and 1.53 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, 8.0 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 5.8 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, 7.7 acres, (Q5=8.7cfs, Q100=23.5cfs), 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=19.2cfs, Q100=46.3cfs). Runoff reaching DP-1 will be directed to an expanded Full Spectrum Detention Pond via a 6'bw 2:1 SS trapezoidal 25% rundown lined with D50=18" riprap (36" deep). A pair

of 4:1SS, 1' min. deep v-shaped earthen swales graded at 1% 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 o reach **Design Point 2**.

Basin B, 1.0 acres, (Q5=3.5cfs, Q100=7.0cfs), consists of a portion of the existing office/warehouse buildings, concrete aprons, and gravel and asphalted surfaces located along the western side of the existing development. Runoff from **Basin OS-3** combines with runoff generated in **Basin B** and is directed to via existing curb and gutter to an existing 5' CDOT sump inlet at **Design Point 2** (Q5=3.6cfs, Q100=7.6cfs). Flows captured by the sump inlet are directed to the east underground via an existing 18" RCP storm drain (**Pipe 2**).

Basin OS-4, 0.1 acres, (Q5=0.2cfs, Q100=0.6cfs), 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 existing access road. Runoff generated within this basin is directed westward via the existing curb and gutter to the combine flows from Basin C.

Basin C, 0.91 acres, (Q5=2.8cfs, Q100=5.9cfs), consists of portion of the existing building, the east paved parking lot, landscaping, driveways as well as the north half of a existing paved asphalt access roadway that runs east to west along the development. Runoff produced within **Basin C** is direct via curb and gutter to a low point and an existing 5' CDOT sump inlet located at **Design Point 3** (Q5=3.0cfs, Q100=6.6cfs). Runoff captured by the sump inlet is directed to the north underground via an existing 24" RCP storm drain (**Pipe 1**). Flows conveyed within Pipe 1 combine with those in **Pipe 2** combine to create peak pipe flows of 6.4cfs and 13.7cfs in the 5 and 100 year events, respectively. The captured runoff continues north to an expanded FSD pond via an existing 24" RCP storm drain (**Pipe 3**).

Basin D, 1.5 acres, (Q5=1.2cfs, Q100=5.1cfs), consists of a portion of land which houses an existing Full Spectrum Detention (FSD) pond that will require expansion as a result of the additional runoff and imperious area associated with the development of **Basin OS1**. Runoff from **Design Points 1, 2**, & **3** contribute to the FSD pond at **Design Point 4** at peak flow rates of Q5=23.8cfs, Q100=57.3cfs.

Based upon the contributing watershed size, characteristics and anticipated imperviousness the existing FSD pond would need to be expanded to provide a minimum of 2.17 acre-feet of storage in the 100-year event and limit discharge to approximately 26.0 cfs.

The goal within the expansion of the future FSD pond expansion would be to maintain a water surface elevation that closely mimics that which was established with the development of the Timberline Storage Yard site proposed condition analysis. This will allow for headwater relationships to be maintained thereby allowing for minimal alterations to the existing outlet structure and limit hydraulic grade line impacts to the existing storm sewer systems. Since the specific density and or type of development planned for **Basin**

OS1 is not know the goal of this analysis was to determine the approximate additional volume needed and equate that to a conceptual expansion footprint.
As illustrated on the Future Drainage Map, the expanded FSD pond in the future condition could be expanded to the north to provide additional volume. If this were to be done the expansion would require the removal of the existing riprap rundown and existing northeast concrete forebay. Based upon the calculations worksheets provided in the appendix minor modifications including the re-boring of a few holes on the existing orifice plate and some minor trimming to the existing restrictor plate would also be needed.

It should be noted that the removal and replacement of the rundown and concrete forebay was chosen over building an alternatively shaped proposed pond footprint and attempting to constructed of a larger future runoff based rundown and forebay for several reasons which include; the uncertainty of the exact type/size/density of the future development, the timing of said development, the potential to extend storm sewer to collect runoff with future development which could result in the elimination of a rundown, and the need to limit the access impacts to the warehouse that might otherwise be impacted by an alternatively shaped footprint.

Based upon the anticipated imperviousness and existing watershed characteristics the future expanded FSD pond would need to provide a minimum 100 year event storage volume of 2.22 ac-feet with a limited 100 year flow rate discharge of 25.1 cfs. As configured and illustrated on the future Drainage Map the routed 100 year water surface would reach an elevation of approximately 6534.25 which is within 0.1' of the proposed WSE of 6534.15. The WSE could easily be modified to meet a zero rise condition over the proposed once more information is available regarding the exact nature of the proposed development.

It is assumed in the future condition that the 26.6 acre offsite **Basin OS-5**, (Q5=59.6cfs, Q100=114.0cfs), 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 3**) located onsite, in this case at **Design Point 5** (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 could be allowed to discharge up to 34.6cfs to downstream facilities in the 100-year event. Conceptually a future 30" storm sewer system (**Pipe 5**) 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=78.4cfs, Q100=148.8cfs), would likely be developed for industrial use. Runoff generated by **Basin OS-5** could be conveyed to a future Full Spectrum Detention Pond (**Future FSD Pond 2**) located at the southwest corner of the basin at **Design Point 6** (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 4.3 acre-feet of storage. Per the UD Detention Worksheet, the future facility would be allowed to discharge approximately 25.4cfs to downstream facilities. Conceptually a future 24" storm sewer system (**Pipe 6**) 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 7) could be constructed to convey the combined drainage discharge from both ponds (Q5=3.5cfs, Q100=62.5cfs) 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 4 and Pipe 7 would combine at **Design Point 7** for a 5 and 100-year peak flow rates of 4.1 cfs and 89.3 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. .

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.	18" RCP	190	LF	$40	/LF	$7,600.00
2.	24" RCP	40	LF	$50	/LF	$2,000.00
3.	30" RCP	265	LF	$65	/LF	$17,225.00
4.	24" RCP FES	1	EA	$900	/EA	$900.00
5.	30" RCP FES	1	EA	$1,000	/EA	$1,000.00
6.	18" X 24" RCP WYE	1	EA	$850	/EA	$850.00
7.	5' CDOT Type R Inlet	2	EA	$4,000	/EA	$8,000.00
8.	12'x22'x3' 'H'Riprap Pad	30	CY	$100	/CY	$3,000.00
9.	Full Spectrum Det Pond	1	EA	$20,000	/EA	$20,000.00
10.	Modified Type D Outlet'	1	EA	$10,500	/EA	$10,500.00
					Total $	$71,075.00

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 drainageway 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".

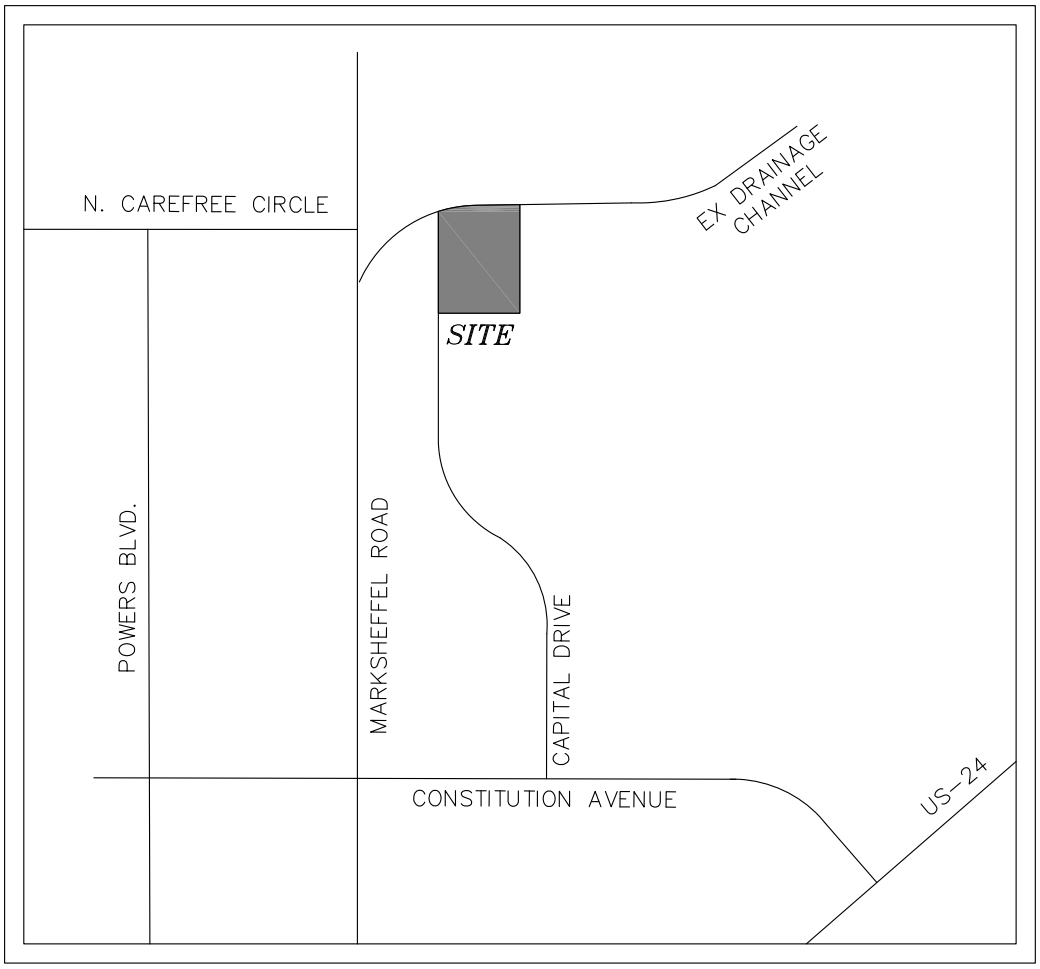
2.) "Urban Storm Drainage Criteria Manual"

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

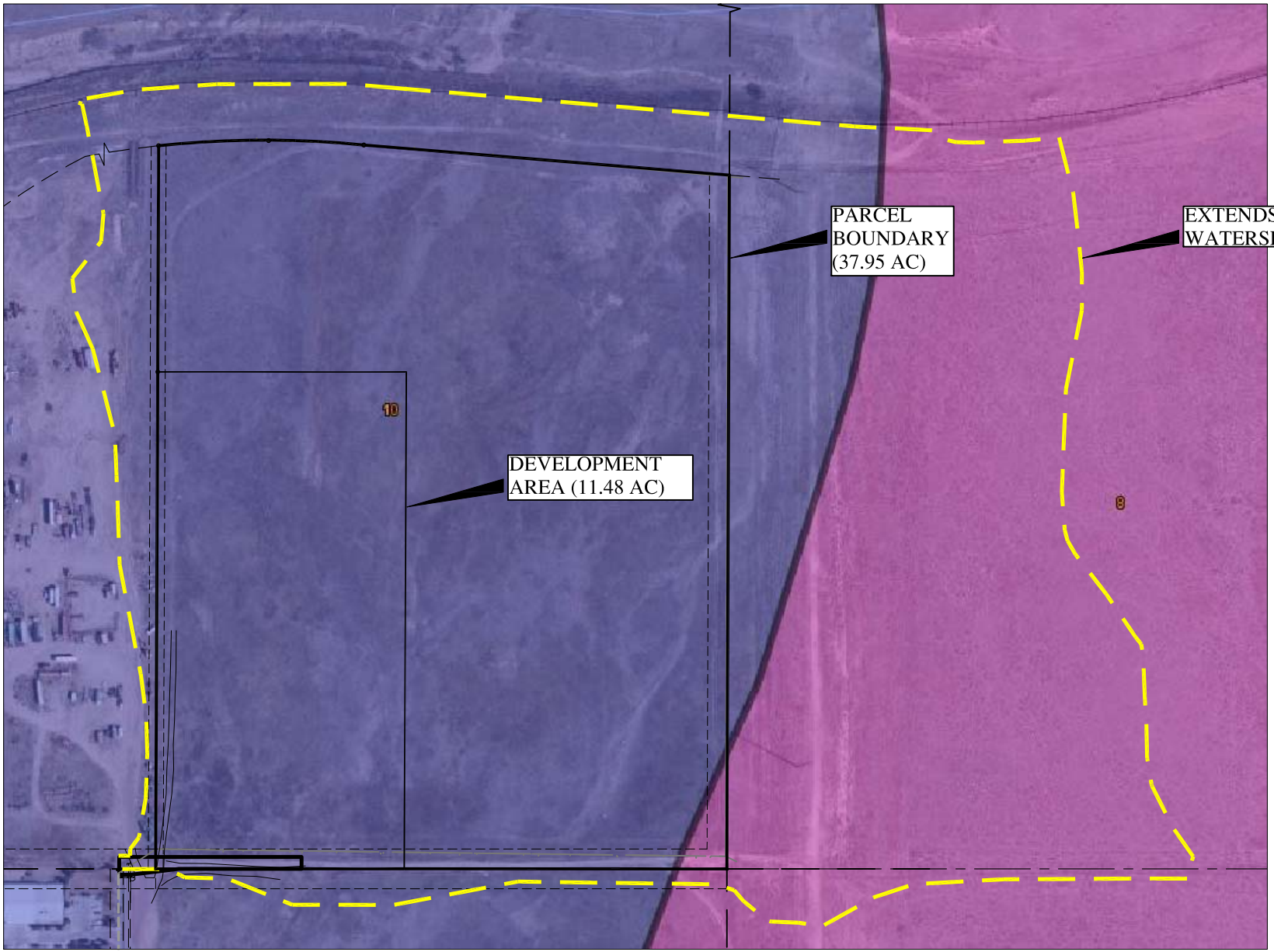


VICINITY MAP

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

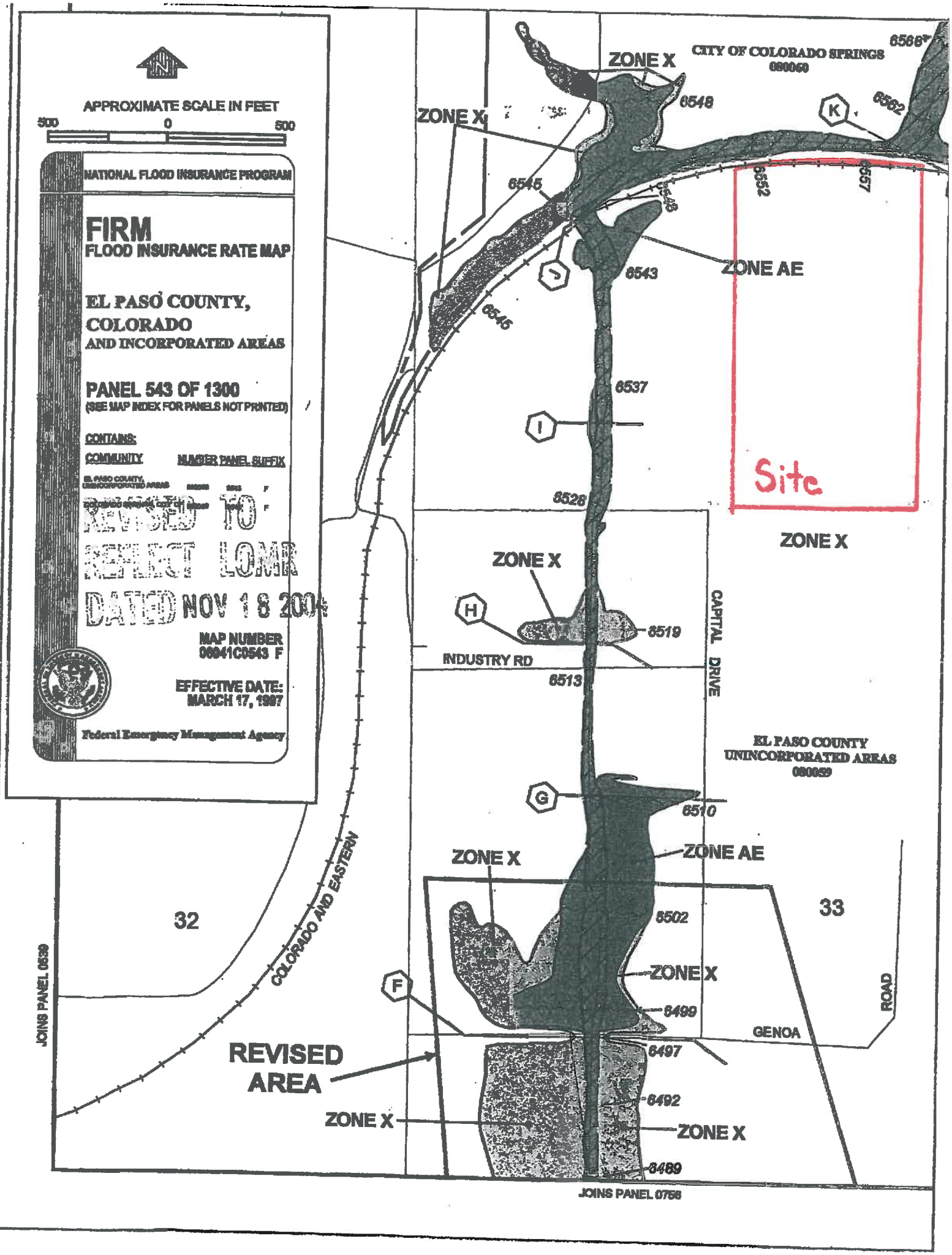
SITE BOUNDARY

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***

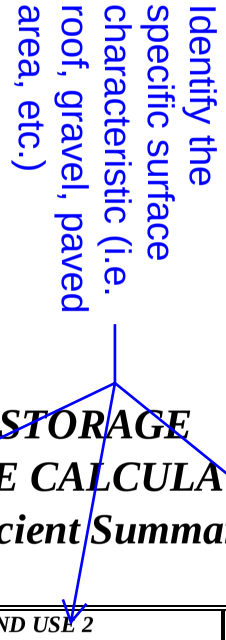
* Intensity equations assume a minimum travel time of 5 minutes.

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)

			LAND USE 1			*LAND USE 2*			*LAND USE 3*			*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	*346769.7*	**7.96**	0.19	0.73	0.81	7.67	0.30	0.50	0.10	0.90	0.96	***0.32***	***0.51***
B	*56610.3*	**1.30**	0.33	0.73	0.81	0.48	0.30	0.50	0.49	0.90	0.96	***0.64***	***0.75***
C	*44215.7*	**1.02**	0.07	0.73	0.81	0.48	0.16	0.41	0.47	0.90	0.96	***0.54***	***0.69***
D	*49284.2*	**1.13**	0.00	0.73	0.81	1.04	0.16	0.41	0.09	0.90	0.96	***0.22***	***0.46***
OS1	*388595.5*	**8.92**	0.00	0.81	0.88	0.00	0.30	0.50	8.92	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	*1151146.6*	**26.43**	0.00	0.81	0.88	0.00	0.30	0.50	26.43	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	7.96	0.32	0.51	0.32	95	2.0	10.8	920	1.4%	1.2	12.9	23.7	15.6	3.5	5.8	***8.7***	***23.7***
B	1.30	0.64	0.75	0.64	70	1.0	6.2	325	1.7%	2.0	2.8	9.0	12.2	4.3	7.2	***3.5***	***7.0***
C	1.02	0.54	0.69	0.54	25	0.5	4.0	200	1.3%	2.3	1.5	5.5	11.3	5.0	8.4	***2.8***	***5.9***
D	1.13	0.22	0.46	0.22	25	1.0	5.0					5.0	10.1	5.2	8.7	***1.3***	***4.5***
OS1	8.92	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	325	8.0%	2.8	1.9	13.5	12.4	3.7	6.2	***7.6***	***51.0***
OS6	26.43	0.09	0.36	0.09	100	8	9.2	1851	2.1%	1.4	21.5	30.7	20.8	2.4	4.1	***5.8***	***39.1***
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**	3.42	7.67	TAKEN FROM BASIN OS-1			20.2	1020	1.4%	1.2	14.5	34.7	2.3	3.8	***7.7***	***29.1***	DRAINAGE SWALE INTO FSD
2	**B, OS3**	0.85	1.05	TAKEN FROM BASIN B								9.0	4.3	7.2	***3.6***	***7.6***	SUMP INLET (PARKING LOT)
3	**OS4, C**	0.60	0.78	TAKEN FROM BASIN C								5.5	5.0	8.4	***3.0***	***6.6***	SUMP INLET (CAPITAL DRIVE)
4	**DP1**	3.42	7.67	TAKEN FROM BASIN DP1								34.7					
	PIPE 3	1.44	1.83														
	D	0.25	0.51														
		5.12	10.01									34.7	2.3	3.8	***11.6***	***38.0***	PROPOSED FSD POND
5	**OS5, OS6**	4.44	17.77	TAKEN FROM BASIN OS5			13.5	1300	1.5%	1.9	11.6	25.1	2.7	4.6	***12.2***	***82.0***	DIVERSION CHANNEL
6	**DP5**	4.44	17.77	TAKEN FROM DESIGN POINT 4								34.7					
	PIPE 4	0.15	5.60														
	OS7	0.06	0.24														
		4.65	23.61									34.7	2.3	3.8	***10.5***	***89.6***	TOTAL DISCHARGE DS

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	**DP2**	0.85	1.05	9.0	4.3	7.2	***3.6***	***7.6***	**PROP 18" RCP**
2	**DP3**	0.60	0.78	5.5	5.0	8.4	***3.0***	***6.6***	**PROP 24" RCP**
3	**PR1, PR2**	1.44	1.83	8.0	4.5	7.5	***6.4***	***13.7***	**PROP 24" RCP**
4	**POND 1 OUTLET (DP4)**	0.15	5.60	34.7	2.3	3.8	***0.3***	***21.3***	**PROP 30" 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)

			LAND USE 1			*LAND USE 2*			*LAND USE 3*			*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	*335552.3*	**7.70**	0.26	0.73	0.81	7.34	0.30	0.50	0.10	0.90	0.96	***0.32***	***0.52***
B	*56610.3*	**1.30**	0.33	0.73	0.81	0.48	0.30	0.50	0.49	0.90	0.96	***0.64***	***0.75***
C	*44215.7*	**1.02**	0.07	0.73	0.81	0.48	0.16	0.41	0.47	0.90	0.96	***0.54***	***0.69***
D	*63631.4*	**1.46**	0.00	0.73	0.81	1.46	0.16	0.41	0.00	0.90	0.96	***0.16***	***0.41***
OS1	*388595.5*	**8.92**	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	7.70	0.32	0.52	0.32	95	2.0	10.7	820	1.6%	1.3	10.9	21.6	15.1	3.5	5.9	***8.7***	***23.5***
B	1.30	0.64	0.75	0.64	70	1.0	6.2	325	1.7%	2.0	2.8	9.0	12.2	4.3	7.2	***3.5***	***7.0***
C	1.02	0.54	0.69	0.54	25	0.5	4.0	200	1.3%	2.3	1.5	5.5	11.3	5.0	8.4	***2.8***	***5.9***
D	1.46	0.16	0.41	0.16	25	1.0	5.4					5.4	10.1	5.1	8.5	***1.2***	***5.1***
OS1	8.92	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**	7.10	10.18	TAKEN FROM BASIN OS-1			11.3	1020	1.4%	1.2	14.5	25.8	2.7	4.5	***19.2***	***46.3***	DRAINAGE SWALE INTO SFB
2	**B, OS3**	0.85	1.05	TAKEN FROM BASIN B								9.0	4.3	7.2	***3.6***	***7.6***	SUMP INLET (PARKING LOT)
3	**OS4, C**	0.60	0.78	TAKEN FROM BASIN C								5.5	5.0	8.4	***3.0***	***6.6***	SUMP INLET (CAPITAL DRIVE)
4	**DP1**	7.10	10.18	TAKEN FROM BASIN DP1								25.8					
	PIPE 3	1.44	1.83														
	D	0.23	0.60														
		8.77	12.60									25.8	2.7	4.5	***23.8***	***57.3***	EXPANDED 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 (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
7	**OS7**			FLOW RATE COMPUTATION UTILIZES DIRECT ADDITION											***0.2***	***1.4***	
	PIPE 4														***0.4***	***25.4***	
	PIPE 7														***3.5***	***62.5***	
															4.1	***89.3***	

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	**DP2**	0.85	1.05	9.0	4.3	7.2	*3.6*	*7.6*	**18" RCP**
2	**DP3**	0.60	0.78	5.5	5.0	8.4	*3.0*	*6.6*	**18" RCP**
3	**PR1, PR2**	1.44	1.83	8.0	4.5	7.5	*6.4*	*13.7*	**24" RCP**
4	**EXPANDED POND 1 OUTLET (DP4)**	UD-DETENTION WORKSHEET					*0.4*	*25.4*	**30" RCP**
5	**OFFSITE POND 2 OUTLET (DP5)**						*1.6*	*25.4*	**24" RCP**
6	**FUTURE POND 3 OUTLET (DP6)**						*1.9*	*37.1*	**18" RCP**
7	**PIPE 5+PIPE 6**						*3.5*	*62.5*	**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 / SFB WQCV CALCULATIONS

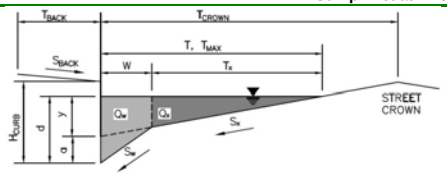
Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: Sump Inlet at DP3



Gutter Geometry (Enter data in the blue cells)

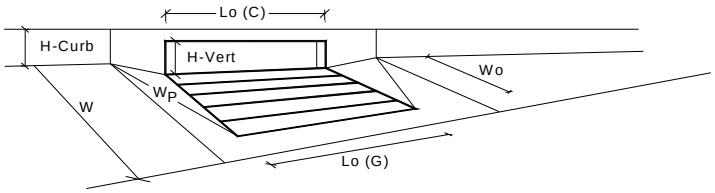
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	12.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.000	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	25.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	25.0	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	6.6	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.33	0.38	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.77	0.85	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**5.4**	**6.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	3.0	6.6	cfs

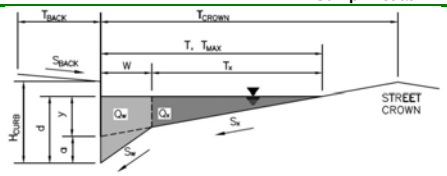
Version 4.05 Released March 2017

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

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

Project: Enter Your Project Name Here

Inlet ID: Sump Inlet at DP2



Gutter Geometry (Enter data in the blue cells)

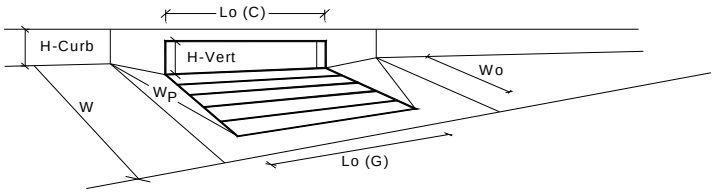
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.001	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	15.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.010	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	15.0	15.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

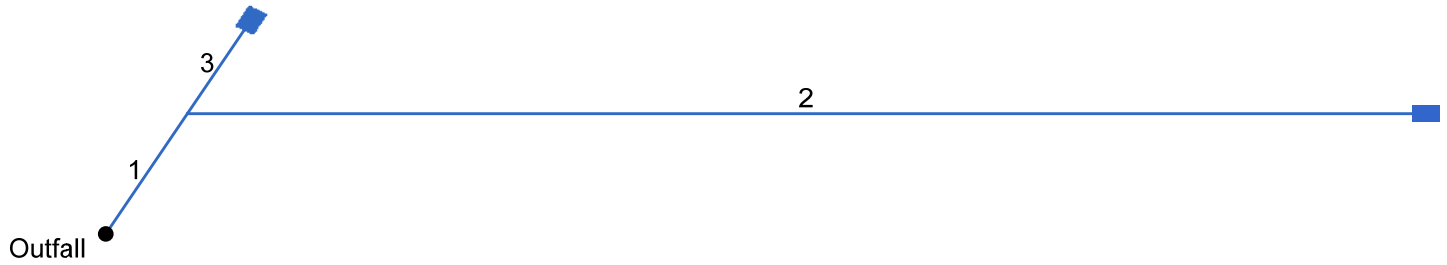
INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	7.1	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.33	0.43	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.77	0.91	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**5.4**	**7.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	3.6	7.6	cfs

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: Storm 1 - Proposed.stm	Number of lines: 3	Date: 6/12/2017

MyReport

Line No.	Area Dn (sqft)	Area Up (sqft)	Byp Ln No	Coeff C1 (C)	Coeff C2 (C)	Coeff C3 (C)	Capac Full (cfs)	Crit Depth (ft)	Cross Sl, Sw (ft/ft)	Cross Sl, Sx (ft/ft)	Curb Len (ft)	Defl Ang (Deg)	Depth Dn (ft)	Depth Up (ft)	DnStm Ln No	Drng Area (ac)	Easting X (ft)	EGL Dn (ft)	EGL Up (ft)	Energy Loss (ft)
1	3.14	3.14	n/a	0.20	0.50	0.90	16.30	1.33	....	....	....	-60.000	2.00	2.00	Outfall	0.00	220.86	6534.45	6534.54	0.092
2	1.77	1.77	Sag	0.20	0.50	0.90	10.48	1.07	0.050	0.020	13.16	60.000	1.50	1.50	1	0.00	410.46	6534.79	6535.79	0.993
3	3.14	3.14	Sag	0.20	0.50	0.90	15.34	0.83	0.050	0.020	9.70	0.000	2.00	2.00	1	0.00	230.62	6534.55	6534.57	0.012

Project File: Storm 1 - Proposed.stm | Number of lines: 3 | Date: 6/12/2017

NOTES: ** Critical depth

MyReport

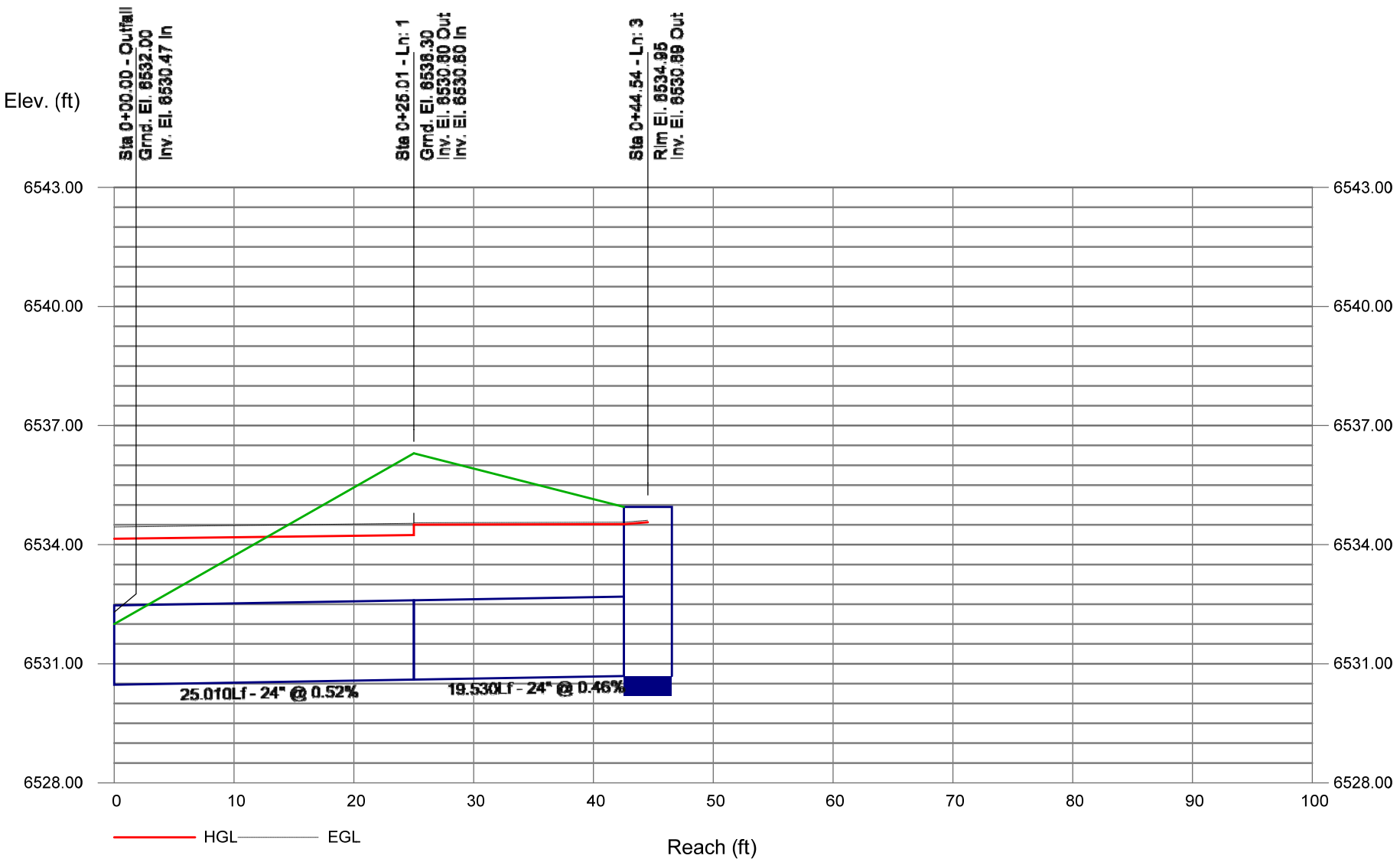
Flow Rate (cfs)	Sf Ave (ft/ft)	Sf Dn (ft/ft)	Grate Area (sqft)	Grate Len (ft)	Grate Width (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Gutter Depth (ft)	Gutter Slope (ft/ft)	Gutter Spread (ft)	Gutter Width (ft)	HGL Dn (ft)	HGL Up (ft)	HGL Jnct (ft)	HGL Jmp Dn (ft)	HGL Jmp Up (ft)	Incr CxA	Incr Q (cfs)	Inlet Depth (ft)	
13.70	0.367	0.367	....	....	....	6532.00	6536.30	....	....	....	....	6534.15	6534.24	6534.51	....	....	0.00	13.70	....	
7.60	0.524	0.524	....	....	....	6536.30	6538.18	0.33	Sag	13.66	2.00	6534.51	6535.50	6535.79	....	....	0.00	7.60	0.33	
5.60	0.061	0.061	....	....	....	6536.30	6534.95	0.33	Sag	13.66	2.00	6534.51	6534.52	6534.57	....	....	0.00	5.60	0.33	

Project File: Storm 1 - Proposed.stm | Number of lines: 3 | Date: 6/12/2017

NOTES: ** Critical depth

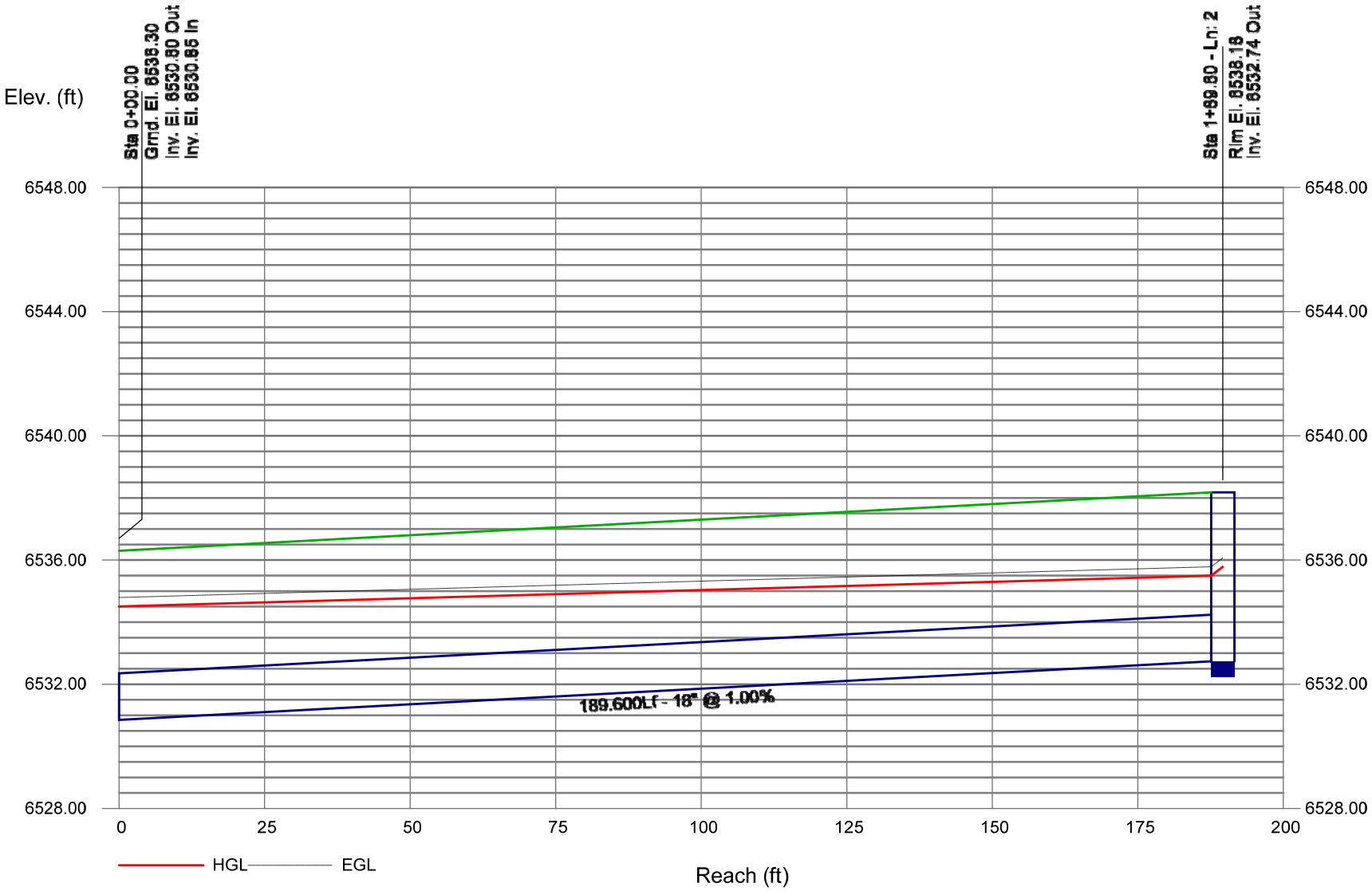
Storm Sewer Profile

Proj. file: Storm 1 - Proposed.stm

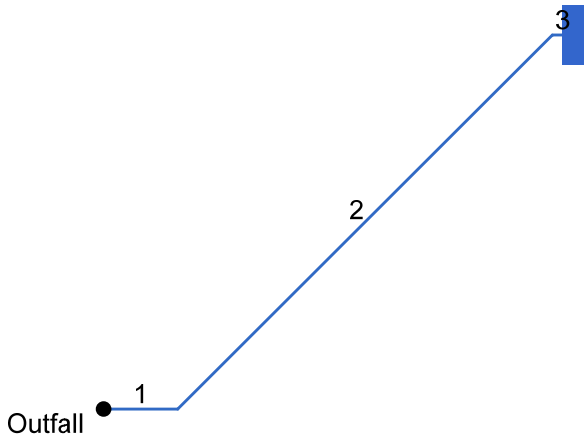


Storm Sewer Profile

Proj. file: Storm 1 - Proposed.stm



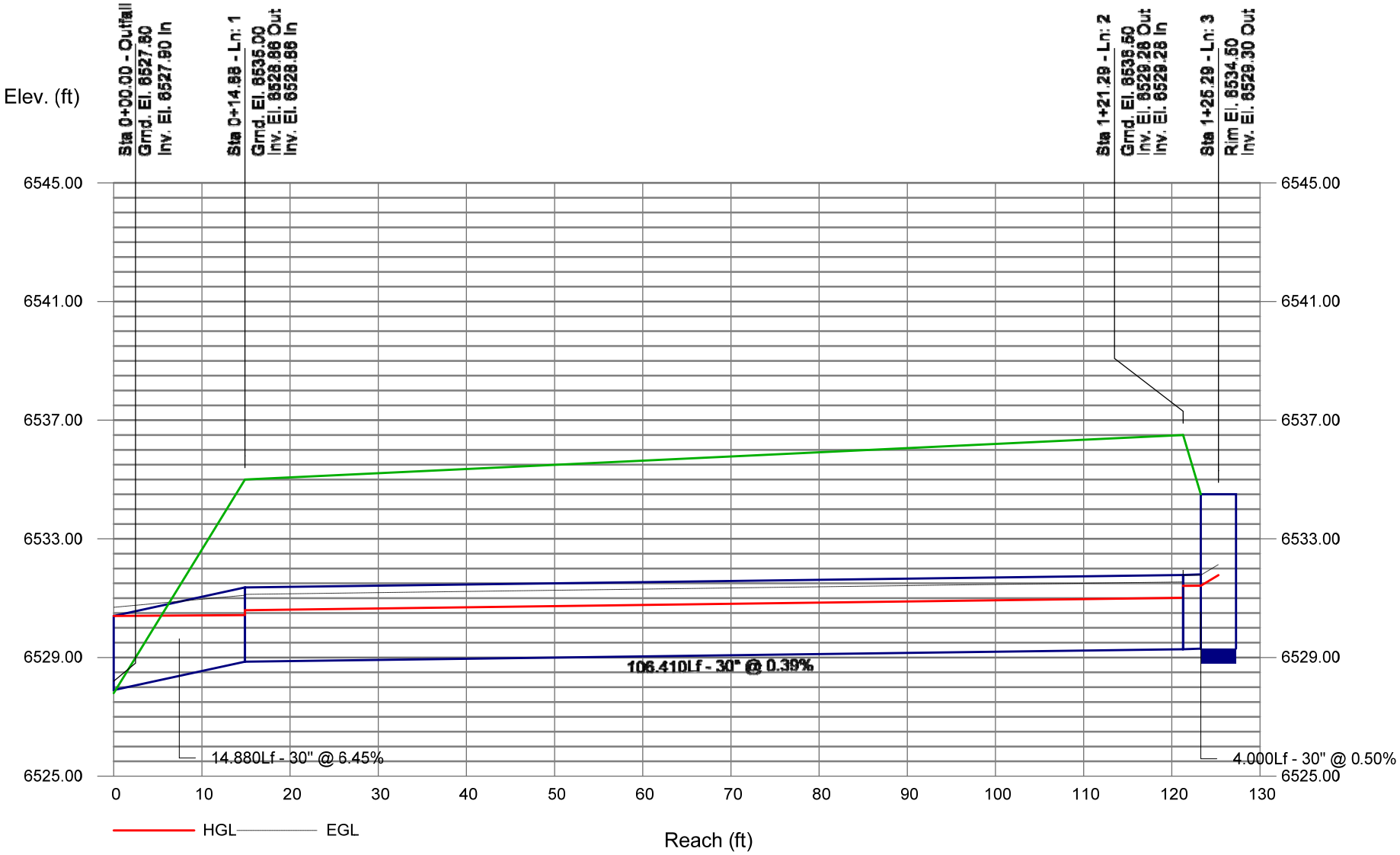
Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: Storm 2 - Proposed.stm	Number of lines: 3	Date: 6/13/2017

Storm Sewer Profile

Proj. file: Storm 2 - Proposed.stm



MyReport

Line No.	Area Dn (sqft)	Area Up (sqft)	Byp Ln No	Coeff C1 (C)	Coeff C2 (C)	Coeff C3 (C)	Capac Full (cfs)	Crit Depth (ft)	Cross Sl, Sw (ft/ft)	Cross Sl, Sx (ft/ft)	Curb Len (ft)	Defl Ang (Deg)	Depth Dn (ft)	Depth Up (ft)	DnStm Ln No	Drng Area (ac)	Easting X (ft)	EGL Dn (ft)	EGL Up (ft)	Energy Loss (ft)
1	3.24	3.24	n/a	0.20	0.50	0.90	104.17	1.57	....	....	....	0.000	2.50	1.57**	Outfall	0.00	229.68	6530.69	6531.10	0.059
2	3.63	3.63	n/a	0.20	0.50	0.90	25.76	1.57	....	....	....	-45.000	1.73	1.73	1	0.00	304.92	6531.13	6531.55	0.420
3	0.00	0.00	Sag	0.20	0.50	0.90	0.00	0.00	0.050	0.020	4.00	45.000	0.00	0.00**	2	0.00	308.92	6531.77	6531.78	0.000

Project File: Storm 2 - Proposed.stm | Number of lines: 3 | Date: 6/13/2017

NOTES: ** Critical depth

MyReport

Flow Rate (cfs)	Sf Ave (ft/ft)	Sf Dn (ft/ft)	Grate Area (sqft)	Grate Len (ft)	Grate Width (ft)	Gnd/Rim El Dn (ft)	Gnd/Rim El Up (ft)	Gutter Depth (ft)	Gutter Slope (ft/ft)	Gutter Spread (ft)	Gutter Width (ft)	HGL Dn (ft)	HGL Up (ft)	HGL Jnct (ft)	HGL Jmp Dn (ft)	HGL Jmp Up (ft)	Incr CxA	Incr Q (cfs)	Inlet Depth (ft)	
21.30	0.397	0.270	....	....	....	6527.80	6535.00	....	....	....	....	6530.40	6530.43	6530.43	....	....	0.00	21.30	....	
21.30	0.395	0.395	....	....	....	6535.00	6536.50	....	....	....	....	6530.59	6531.01	6531.41	....	....	0.00	21.30	....	
21.30	0.000	0.000	....	....	....	6536.50	6534.50	9.01	Sag	447.27	2.00	6531.41	6531.42	6531.78	....	....	0.00	21.30	9.01	

Project File: Storm 2 - Proposed.stm | Number of lines: 3 | Date: 6/13/2017

NOTES: ** 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	7.96	0.32	43	342.31
B	1.30	0.64	84	109.17
C	1.02	0.54	75	76.13
D	1.13	0.22	25	28.29
OS1	8.92	0.09	2	17.84
OS2	1.03	0.09	2	2.06
OS3	0.21	0.09	2	0.41
OS4	0.13	0.38	53	7.02
Totals	***21.70***			***583.23***
Imperviousness of WQ SFB	***26.9***			

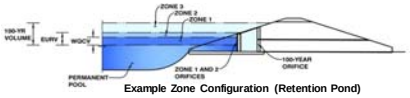
5.83 acres impervious

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 =	21.70	acres	
Watershed Length =	1,833	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) =	0.256	acre-feet	
Excess Urban Runoff Volume (EURV) =	0.594	acre-feet	
2-yr Runoff Volume (P1 = 1.19 in.) =	0.450	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.647	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.017	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	1.777	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	2.272	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.919	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet	inches
Approximate 2-yr Detention Volume =	0.420	acre-feet	
Approximate 5-yr Detention Volume =	0.607	acre-feet	
Approximate 10-yr Detention Volume =	0.907	acre-feet	
Approximate 25-yr Detention Volume =	1.070	acre-feet	
Approximate 50-yr Detention Volume =	1.128	acre-feet	
Approximate 100-yr Detention Volume =	1.349	acre-feet	

Optional User Override 1-hr Precipitation

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.256	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.338	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.755	acre-feet
Total Detention Basin Volume =	1.349	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

Depth Increment = ft

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	--	--	--	112	0.003	22	0.001
	--	0.50	--	--	--	597	0.014	49	0.001
	--	1.50	--	--	--	6,472	0.149	3,525	0.081
	--	2.50	--	--	--	20,631	0.474	17,141	0.393
	--	3.50	--	--	--	22,940	0.527	38,926	0.894
	--	4.50	--	--	--	25,358	0.582	63,075	1.448
	--	5.50	--	--	--	27,872	0.640	89,690	2.059
	--	6.50	--	--	--	29,130	0.669	118,191	2.713
	--	7.50	--	--	--	30,939	0.710	148,226	3.403

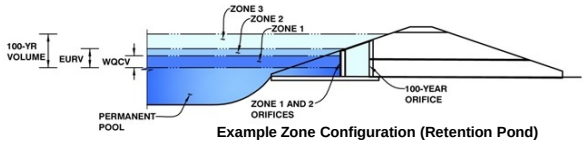
Identify the Pond to avoid mix up with the other detention pond designs. (Typical)

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project:

Basin ID:



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.18	0.256	Orifice Plate
Zone 2 (EURV)	2.92	0.338	Orifice Plate
Zone 3 (100-year)	4.33	0.755	Weir&Pipe (Restrict)
		1.349	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 =	3.75	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	1.25	2.50					
Orifice Area (sq. inches)	1.40	1.40	6.00					

	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			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 =	3.75	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.48	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 =	11.22	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 =	2.25	N/A	ft^2
Outlet Pipe Diameter =	30.00	N/A	inches	Outlet Orifice Centroid =	0.67	N/A	feet
Restrictor Plate Height Above Pipe Invert =	14.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.50	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.80	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.37	feet
Spillway Crest Length =	54.00	feet	Stage at Top of Freeboard =	6.67	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.68	acres
Freeboard above Max Water Surface =	0.50	feet			

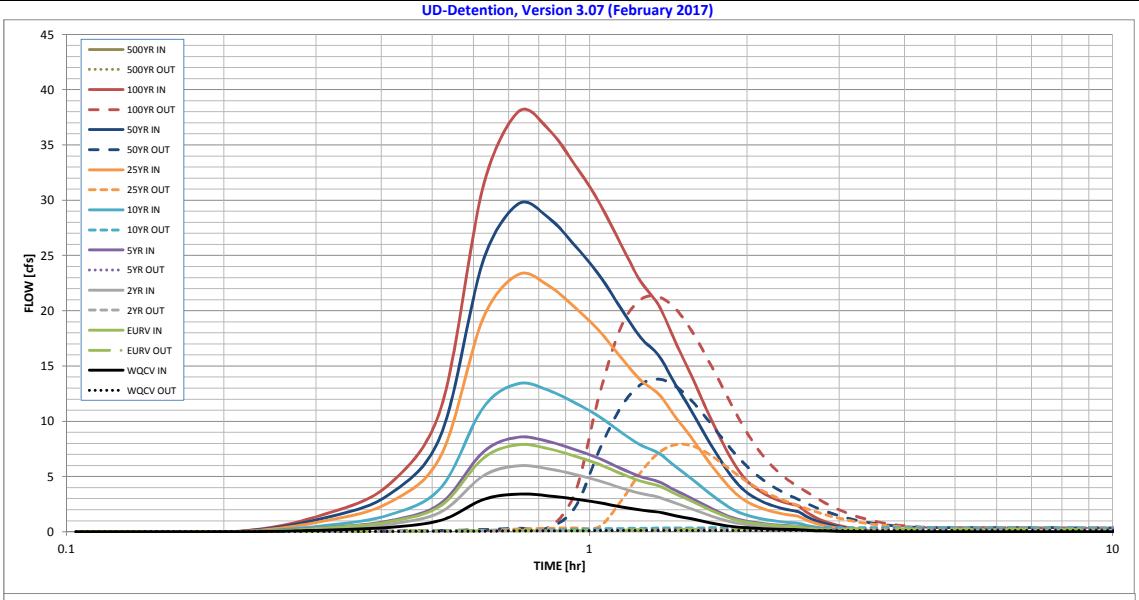
Calculated Parameters for Spillway

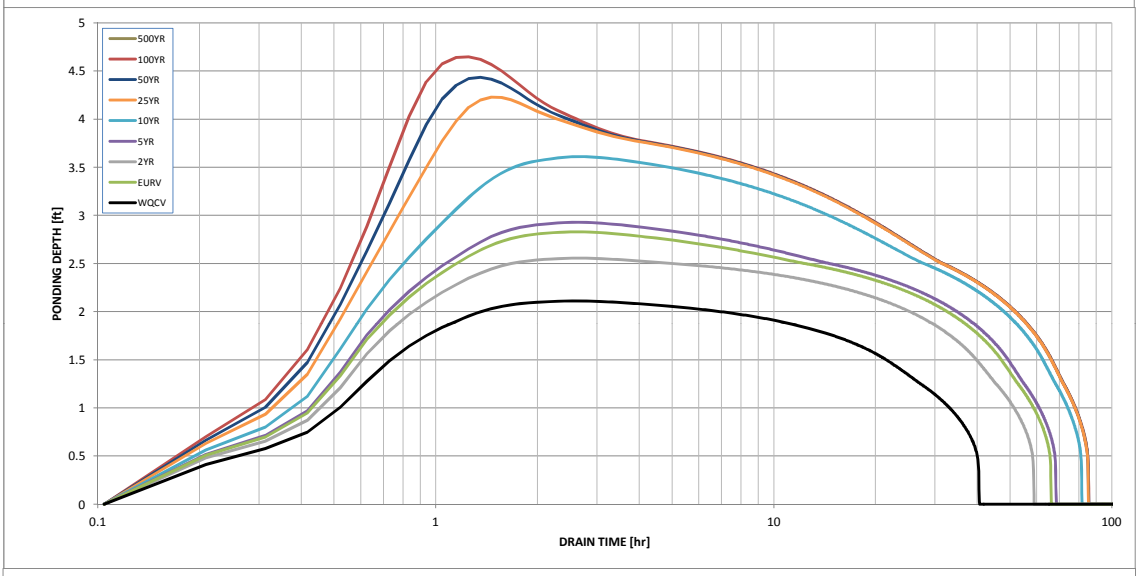
Routed Hydrograph Results

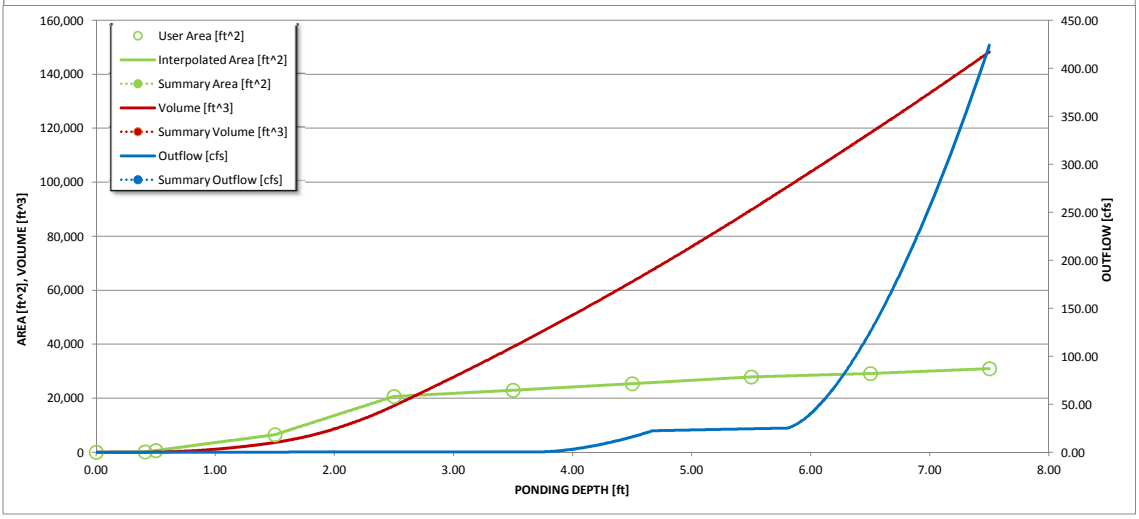
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.256	0.594	0.450	0.647	1.017	1.777	2.272	2.919	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.255	0.594	0.450	0.646	1.017	1.777	2.271	2.918	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.15	0.51	0.71	0.96	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.2	0.3	3.2	11.1	15.3	20.9	0.0
Peak Inflow Q (cfs) =	3.4	7.9	6.0	8.6	13.4	23.3	29.7	38.0	#N/A
Peak Outflow Q (cfs) =	0.1	0.3	0.2	0.3	0.4	7.9	13.8	21.3	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	0.1	0.7	0.9	1.0	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.3	0.5	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	61	55	63	73	71	69	66	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**40**	64	57	66	78	80	79	77	#N/A
Maximum Ponding Depth (ft) =	2.11	2.83	2.56	2.93	3.61	4.23	4.44	4.65	#N/A
Area at Maximum Ponding Depth (acres) =	0.35	0.49	0.48	0.50	0.53	0.57	0.58	0.59	#N/A
Maximum Volume Stored (acre-ft) =	0.234	0.548	0.417	0.597	0.952	1.287	1.407	1.530	#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 Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

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

Time Interval	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
6.26 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	0:06:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Hydrograph	0:12:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Constant	0:18:47	0.15	0.35	0.27	0.38	0.59	1.00	1.27	1.61	#N/A
0.799	0:25:02	0.41	0.94	0.72	1.02	1.59	2.74	3.48	4.43	#N/A
	0:31:18	1.06	2.42	1.84	2.63	4.09	7.04	8.92	11.37	#N/A
	0:37:34	2.92	6.65	5.07	7.22	11.23	19.32	24.49	31.20	#N/A
	0:43:49	3.42	7.88	5.99	8.57	13.41	23.28	29.66	37.98	#N/A
	0:50:05	3.26	7.52	5.71	8.18	12.82	22.29	28.42	36.42	#N/A
	0:56:20	2.96	6.85	5.20	7.44	11.67	20.29	25.86	33.15	#N/A
	1:02:36	2.63	6.11	4.63	6.65	10.45	18.21	23.24	29.82	#N/A
	1:08:52	2.26	5.27	3.99	5.74	9.04	15.81	20.23	26.01	#N/A
	1:15:07	1.97	4.60	3.48	5.00	7.87	13.74	17.59	22.66	#N/A
	1:21:23	1.79	4.16	3.15	4.53	7.13	12.46	15.94	20.50	#N/A
	1:27:38	1.46	3.43	2.59	3.74	5.91	10.38	13.30	17.13	#N/A
	1:33:54	1.18	2.80	2.11	3.05	4.85	8.55	10.98	14.17	#N/A
	1:40:10	0.90	2.16	1.61	2.35	3.76	6.69	8.62	11.17	#N/A
	1:46:25	0.66	1.60	1.20	1.75	2.82	5.09	6.59	8.57	#N/A
	1:52:41	0.48	1.16	0.87	1.27	2.04	3.73	4.86	6.36	#N/A
	1:58:56	0.38	0.90	0.68	0.98	1.57	2.84	3.68	4.80	#N/A
	2:05:12	0.31	0.74	0.56	0.81	1.29	2.31	2.99	3.88	#N/A
	2:11:28	0.26	0.63	0.47	0.69	1.09	1.95	2.52	3.27	#N/A
	2:17:43	0.23	0.55	0.42	0.60	0.96	1.71	2.20	2.85	#N/A
	2:23:59	0.21	0.50	0.37	0.54	0.86	1.53	1.97	2.55	#N/A
	2:30:14	0.19	0.46	0.35	0.50	0.79	1.41	1.81	2.34	#N/A
	2:36:30	0.14	0.34	0.25	0.37	0.58	1.04	1.34	1.73	#N/A
	2:42:46	0.10	0.25	0.19	0.27	0.43	0.76	0.97	1.26	#N/A
	2:49:01	0.08	0.18	0.14	0.20	0.31	0.56	0.72	0.93	#N/A
	2:55:17	0.06	0.13	0.10	0.15	0.23	0.41	0.53	0.69	#N/A
	3:01:32	0.04	0.10	0.07	0.10	0.17	0.30	0.39	0.50	#N/A
	3:07:48	0.03	0.07	0.05	0.07	0.12	0.21	0.28	0.36	#N/A
	3:14:04	0.02	0.05	0.04	0.05	0.08	0.15	0.20	0.26	#N/A
	3:20:19	0.01	0.03	0.02	0.03	0.06	0.11	0.14	0.18	#N/A
	3:26:35	0.01	0.02	0.01	0.02	0.03	0.07	0.09	0.12	#N/A
	3:32:50	0.00	0.01	0.01	0.01	0.02	0.04	0.05	0.06	#N/A
	3:39:06	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	#N/A
	3:45:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	#N/A
	3:51:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:57:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:04:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:10:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:16:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:22:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:29:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:35:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:41:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:47:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:54:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:00:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:06:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:13:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:19:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:25:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:31:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:38:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:44:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:50:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:56:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:03:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:09:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:15:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:21:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:28:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:34:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:40:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:46:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:53:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:59:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:05:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:11:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:18:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:24:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	7:30:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A

TIMBERLINE STORAGE (FUTURE CONDITIONS)

(Weighted Percent Imperviousness of Future FSD Pond 1)				
Contributing Basins	***Area (Acres)***	***C_5***	***Impervious % (I)***	***(Acres)*(I)***
A	7.70	0.32	43	331.24
B	1.30	0.64	84	109.17
C	1.02	0.54	75	76.13
D	1.46	0.16	14	20.45
OS1	8.92	0.51	72	642.31
OS2	1.03	0.09	2	2.06
OS3	0.21	0.09	2	0.41
OS4	0.13	0.38	53	7.02
Totals	***21.77***			***1188.79***
Imperviousness of WQ SFB	***54.6***			

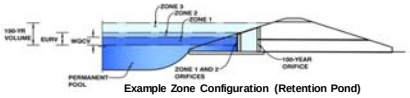
11.89 acres impervious

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Timberline Storage

Basin ID: Full Spectrum Detention Pond 1 (Future)



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB		
Watershed Area =	21.77	acres	
Watershed Length =	1,331	ft	
Watershed Slope =	0.015	ft/ft	
Watershed Imperviousness =	54.60%	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) =	0.398	acre-feet	Optional User Override 1-hr Precipitation
Excess Urban Runoff Volume (EURV) =	1.282	acre-feet	
2-yr Runoff Volume (P1 = 1.19 in.) =	1.040	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.409	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.870	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	2.532	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	3.001	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	3.615	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet	inches
Approximate 2-yr Detention Volume =	0.973	acre-feet	
Approximate 5-yr Detention Volume =	1.324	acre-feet	
Approximate 10-yr Detention Volume =	1.728	acre-feet	
Approximate 25-yr Detention Volume =	1.882	acre-feet	
Approximate 50-yr Detention Volume =	1.967	acre-feet	
Approximate 100-yr Detention Volume =	2.172	acre-feet	

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.398	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.884	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.891	acre-feet
Total Detention Basin Volume =	2.172	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = ft

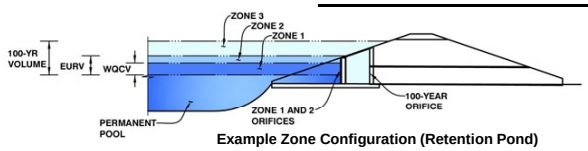
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	0	0.000		
	--	0.42	--	--	--	112	0.003	23	0.001
	--	0.50	--	--	--	462	0.011	43	0.001
	--	1.50	--	--	--	6,271	0.144	3,351	0.077
	--	2.50	--	--	--	26,447	0.607	19,772	0.454
	--	3.50	--	--	--	31,961	0.734	48,976	1.124
	--	4.50	--	--	--	34,901	0.801	82,407	1.892
	--	5.50	--	--	--	37,936	0.871	118,826	2.728
	--	6.50	--	--	--	41,086	0.943	158,337	3.635
	--	7.50	--	--	--	44,284	1.017	201,022	4.615

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project:

Basin ID:



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.38	0.398	Orifice Plate
Zone 2 (EURV)	3.62	0.884	Orifice Plate
Zone 3 (100-year)	4.69	0.891	Weir&Pipe (Restrict)
		2.172	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 =	3.75	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	1.25	2.50					
Orifice Area (sq. inches)	1.88	1.88	6.00					

	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			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 =	3.75	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.48	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 =	9.85	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 =	2.56	N/A	ft^2
Outlet Pipe Diameter =	30.00	N/A	inches	Outlet Orifice Centroid =	0.74	N/A	feet
Restrictor Plate Height Above Pipe Invert =	15.50		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.60	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.80	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.49	feet
Spillway Crest Length =	54.00	feet	Stage at Top of Freeboard =	6.79	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.03	acres
Freeboard above Max Water Surface =	0.50	feet			

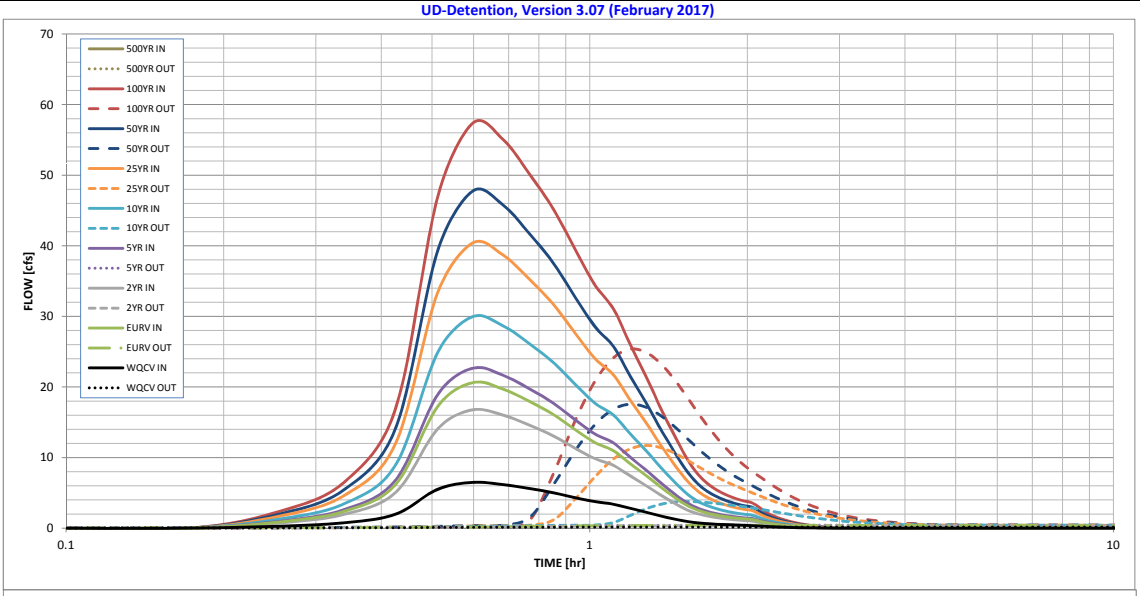
Calculated Parameters for Spillway

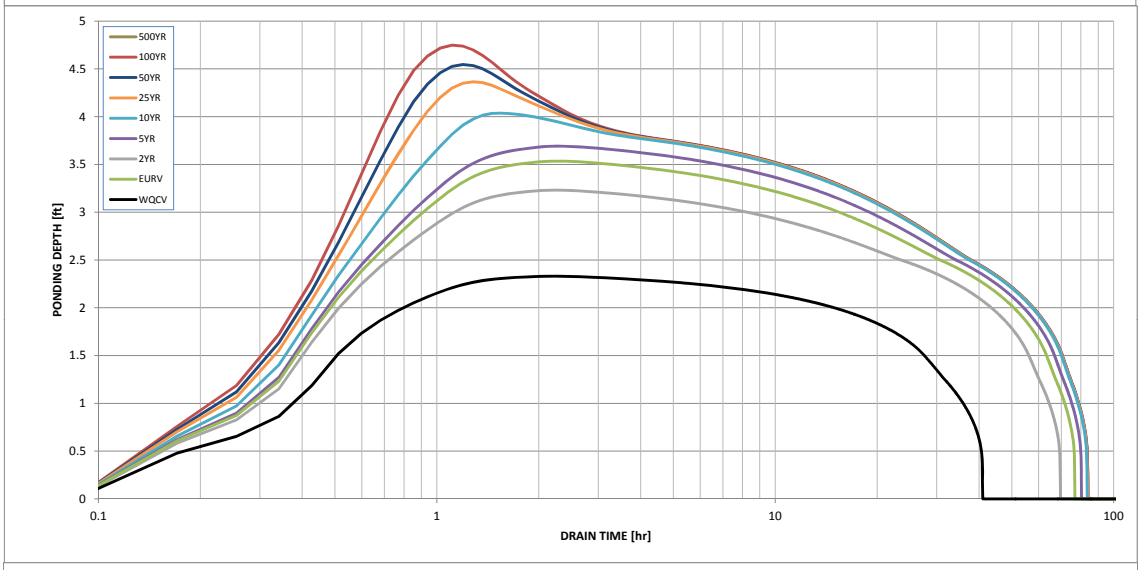
Routed Hydrograph Results

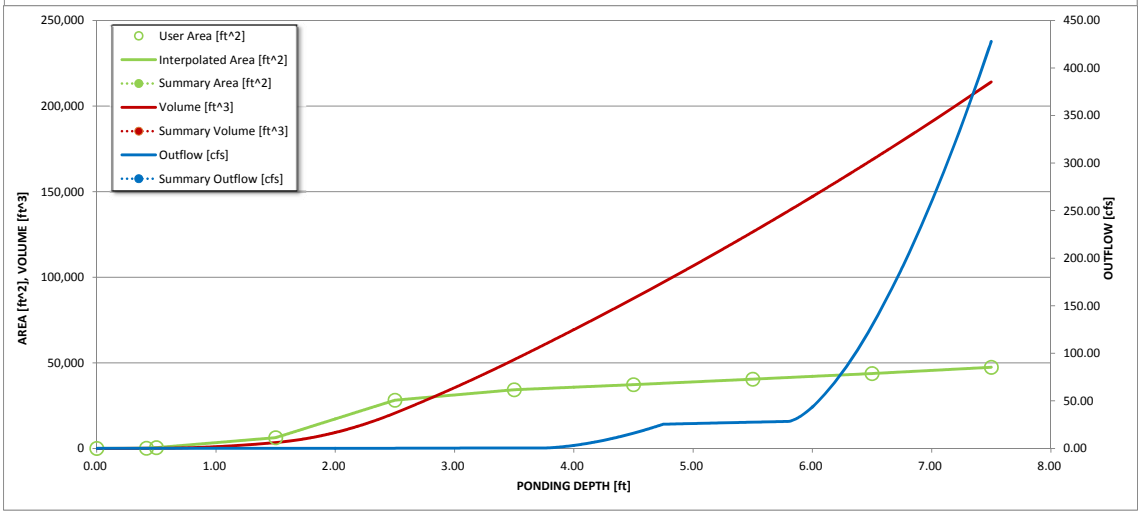
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.398	1.282	1.040	1.409	1.870	2.532	3.001	3.615	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.397	1.281	1.039	1.409	1.870	2.532	3.000	3.615	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.19	0.64	0.89	1.20	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.3	0.4	4.2	13.9	19.3	26.0	0.0
Peak Inflow Q (cfs) =	6.5	20.6	16.8	22.6	29.9	40.4	47.7	57.3	#N/A
Peak Outflow Q (cfs) =	0.2	0.4	0.4	0.4	3.8	11.7	17.6	25.4	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.0	0.9	0.8	0.9	1.0	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.1	0.4	0.7	1.0	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	38	69	63	72	73	71	69	67	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**40**	74	67	77	79	78	78	77	#N/A
Maximum Ponding Depth (ft) =	2.33	3.53	3.23	3.69	4.04	4.37	4.55	4.75	#N/A
Area at Maximum Ponding Depth (acres) =	0.56	0.79	0.75	0.80	0.82	0.85	0.86	0.87	#N/A
Maximum Volume Stored (acre-ft) =	0.371	1.214	0.983	1.341	1.617	1.892	2.045	2.218	#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 Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

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

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.12 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	0:05:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Hydrograph	0:10:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Constant	0:15:22	0.29	0.90	0.73	0.98	1.29	1.72	2.02	2.40	#N/A
0.977	0:20:29	0.78	2.44	1.99	2.67	3.52	4.72	5.56	6.65	#N/A
	0:25:36	2.00	6.26	5.11	6.87	9.04	12.13	14.29	17.07	#N/A
	0:30:43	5.50	17.19	14.03	18.86	24.82	33.28	39.19	46.82	#N/A
	0:35:50	6.48	20.61	16.76	22.64	29.95	40.38	47.73	57.34	#N/A
	0:40:58	6.18	19.70	16.02	21.66	28.67	38.70	45.78	55.08	#N/A
	0:46:05	5.62	17.94	14.58	19.71	26.10	35.23	41.67	50.12	#N/A
	0:51:12	5.01	16.07	13.05	17.67	23.42	31.67	37.49	45.14	#N/A
	0:56:19	4.31	13.94	11.30	15.33	20.35	27.59	32.70	39.45	#N/A
	1:01:26	3.76	12.12	9.84	13.33	17.68	24.01	28.50	34.41	#N/A
	1:06:34	3.41	10.99	8.92	12.08	16.03	21.74	25.78	31.09	#N/A
	1:11:41	2.80	9.13	7.39	10.05	13.36	18.15	21.55	26.03	#N/A
	1:16:48	2.27	7.50	6.06	8.26	11.02	15.00	17.82	21.55	#N/A
	1:21:55	1.74	5.84	4.70	6.44	8.63	11.80	14.05	17.04	#N/A
	1:27:02	1.28	4.41	3.53	4.87	6.57	9.03	10.80	13.13	#N/A
	1:32:10	0.93	3.21	2.56	3.56	4.82	6.68	8.01	9.78	#N/A
	1:37:17	0.73	2.46	1.97	2.72	3.66	5.05	6.04	7.35	#N/A
	1:42:24	0.60	2.01	1.62	2.22	2.98	4.09	4.88	5.93	#N/A
	1:47:31	0.51	1.70	1.37	1.88	2.52	3.45	4.11	4.99	#N/A
	1:52:38	0.45	1.49	1.20	1.64	2.20	3.01	3.59	4.35	#N/A
	1:57:46	0.40	1.34	1.08	1.48	1.98	2.70	3.21	3.89	#N/A
	2:02:53	0.37	1.23	0.99	1.36	1.82	2.48	2.94	3.56	#N/A
	2:08:00	0.27	0.91	0.73	1.00	1.34	1.83	2.18	2.65	#N/A
	2:13:07	0.20	0.66	0.53	0.73	0.98	1.33	1.58	1.92	#N/A
	2:18:14	0.15	0.49	0.39	0.54	0.72	0.98	1.17	1.42	#N/A
	2:23:22	0.11	0.36	0.29	0.40	0.53	0.73	0.87	1.05	#N/A
	2:28:29	0.08	0.26	0.21	0.29	0.39	0.53	0.63	0.77	#N/A
	2:33:36	0.05	0.18	0.15	0.20	0.27	0.38	0.45	0.55	#N/A
	2:38:43	0.04	0.13	0.11	0.15	0.20	0.28	0.33	0.40	#N/A
	2:43:50	0.02	0.09	0.07	0.10	0.14	0.19	0.23	0.28	#N/A
	2:48:58	0.01	0.05	0.04	0.06	0.09	0.12	0.15	0.18	#N/A
	2:54:05	0.01	0.03	0.02	0.03	0.05	0.07	0.08	0.10	#N/A
	2:59:12	0.00	0.01	0.01	0.01	0.02	0.03	0.04	0.05	#N/A
	3:04:19	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	#N/A
	3:09:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:14:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:19:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:24:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:29:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:35:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:40:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:45:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:50:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:55:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:00:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:05:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:10:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:16:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:21:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:26:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:31:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:36:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:41:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:46:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:51:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	4:56:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:02:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:07:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:12:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:17:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:22:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:27:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:32:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:37:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:43:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:48:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:53:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	5:58:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:03:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	6:08:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A

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)

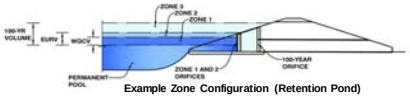
(Weighted Percent Imperviousness of Future Offsite FSD Pond 3)				
Contributing Basins	***Area (Acres)***	***C_5***	***Impervious % (I)***	***(Acres)*(I)***
Column1	**Column2**	**Column3**	**Column4**	**Column5**
OS-5	26.58	0.69	87	2312.32
Totals	***26.58***	0.00		***2312.32***
Imperviousness of WQ Pond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

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	Note: L / W Ratio < 1
Watershed Length =	760	ft	L / W Ratio = 0.5
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	Optional User Override 1-hr Precipitation
Excess Urban Runoff Volume (EURV) =	3.002	acre-feet	
2-yr Runoff Volume (P1 = 1.19 in.) =	2.169	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.816	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	3.396	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	4.000	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	4.539	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	5.214	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet	inches
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	

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	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

Depth Increment = ft

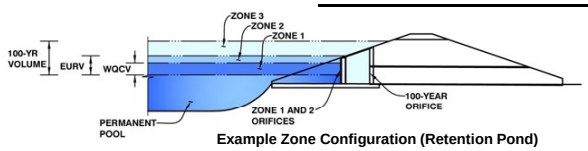
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	0	0.000		
	--	0.33	--	--	--	112	0.003	17	0.000
	--	0.50	--	--	--	462	0.011	63	0.001
	--	1.50	--	--	--	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

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 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 =	5.70	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	1.90	3.80					
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			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 =	5.70	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.43	N/A	feet
Overflow Weir Front Edge Length =	20.00	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 =	20.41	N/A	should be ≥ 4
Horiz. Length of Weir Sides =	2.91	N/A	feet	Overflow Grate Open Area w/o Debris =	41.99	N/A	ft^2
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	21.00	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 =	2.06	N/A	ft^2
Outlet Pipe Diameter =	24.00	N/A	inches	Outlet Orifice Centroid =	0.70	N/A	feet
Restrictor Plate Height Above Pipe Invert =	14.95		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.82	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.93	feet
Spillway Crest Length =	52.00	feet	Stage at Top of Freeboard =	8.43	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.01	acres
Freeboard above Max Water Surface =	0.00	feet			

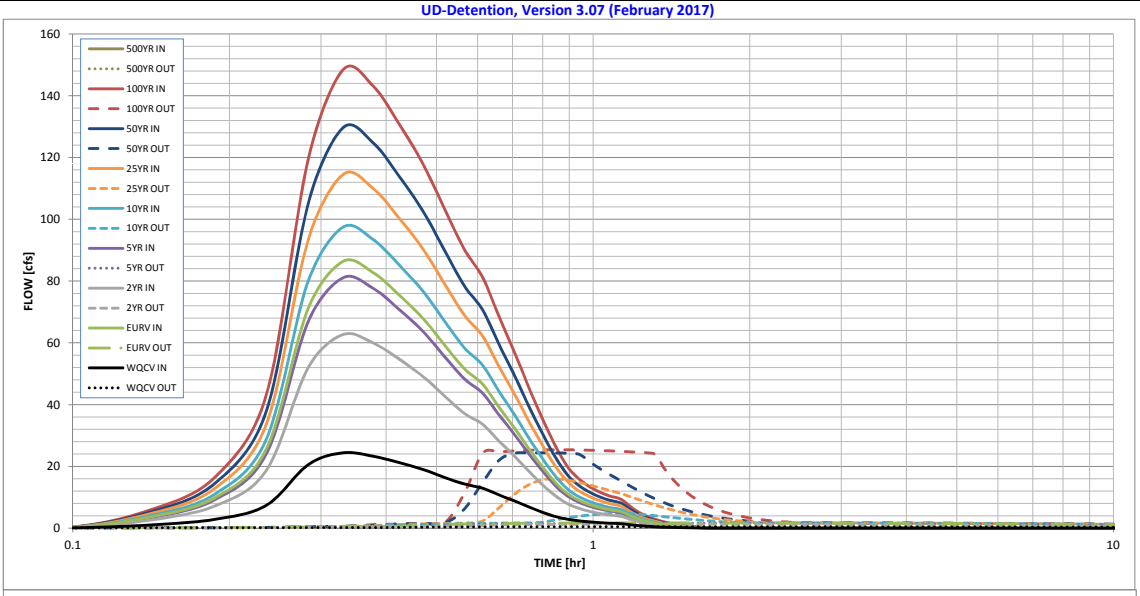
Calculated Parameters for Spillway

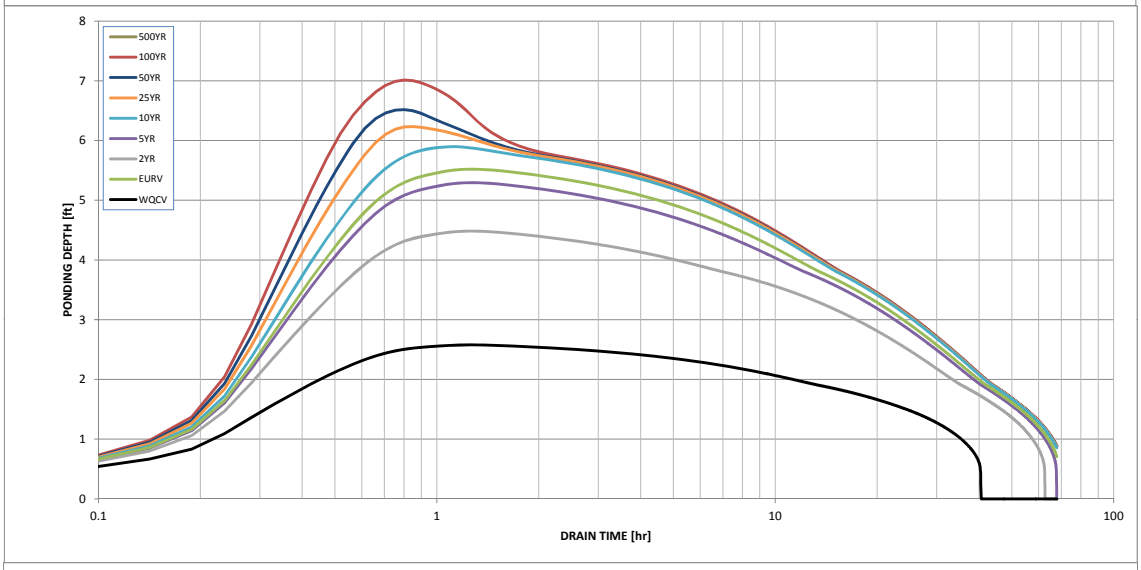
Routed Hydrograph Results

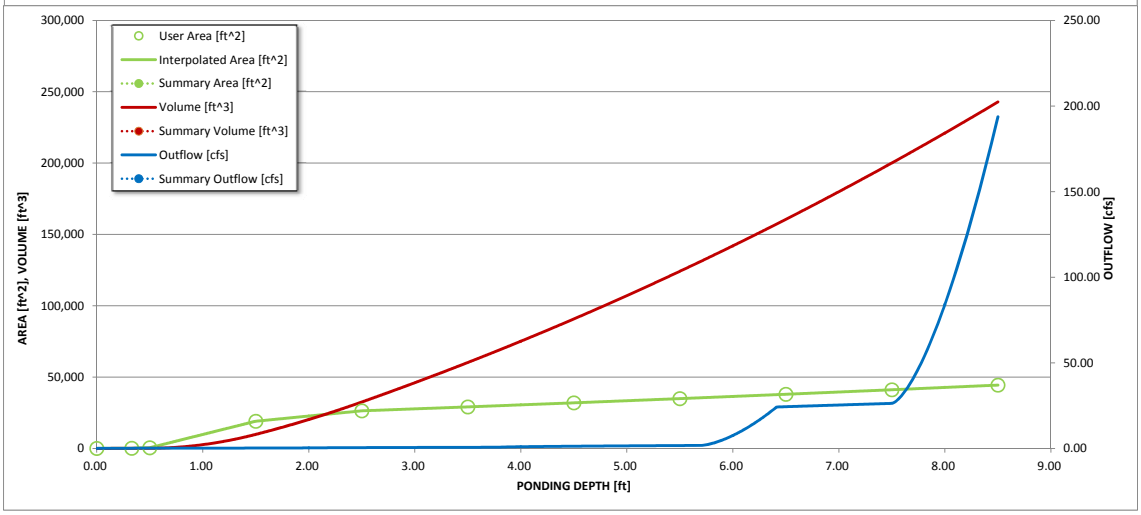
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.835	3.002	2.169	2.816	3.396	4.000	4.539	5.214	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.834	2.999	2.167	2.812	3.391	3.995	4.534	5.205	#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) =	24.4	86.3	62.6	81.0	97.4	114.4	129.5	148.3	#N/A
Peak Outflow Q (cfs) =	0.5	1.7	1.3	1.6	4.8	15.9	24.4	25.4	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	4.7	2.2	2.5	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**	67	61	65	68	68	67	67	#N/A
Maximum Ponding Depth (ft) =	2.58	5.52	4.48	5.29	5.90	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	3.453	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 Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

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

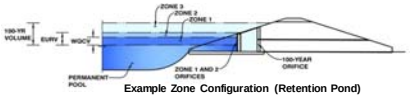
Time Interval	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
2.83 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	0:02:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Hydrograph	0:05:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Constant	0:08:29	1.07	3.66	2.68	3.44	4.10	4.76	5.34	6.02	#N/A
1.765	0:11:19	2.90	10.06	7.35	9.46	11.32	13.22	14.88	16.91	#N/A
	0:14:09	7.45	25.83	18.86	24.28	29.06	33.94	38.20	43.41	#N/A
	0:16:59	20.48	70.87	51.78	66.61	79.72	93.07	104.72	118.94	#N/A
	0:19:49	24.40	86.31	62.64	81.01	97.42	114.44	129.55	148.28	#N/A
	0:22:38	23.30	82.79	60.01	77.68	93.52	110.06	124.82	143.23	#N/A
	0:25:28	21.21	75.34	54.61	70.69	85.11	100.21	113.76	130.68	#N/A
	0:28:18	18.97	67.78	49.06	63.58	76.62	90.27	102.49	117.77	#N/A
	0:31:08	16.40	59.14	42.68	55.44	66.92	78.94	89.72	103.19	#N/A
	0:33:58	14.28	51.53	37.11	48.29	58.36	68.90	78.36	90.18	#N/A
	0:36:47	12.94	46.62	33.63	43.70	52.75	62.22	70.68	81.26	#N/A
	0:39:37	10.71	38.96	28.06	36.51	44.13	52.13	59.30	68.29	#N/A
	0:42:27	8.76	32.22	23.15	30.18	36.52	43.18	49.16	56.65	#N/A
	0:45:17	6.78	25.41	18.17	23.78	28.85	34.20	39.01	45.05	#N/A
	0:48:07	5.07	19.52	13.87	18.25	22.21	26.40	30.17	34.90	#N/A
	0:50:56	3.66	14.49	10.22	13.52	16.53	19.70	22.57	26.18	#N/A
	0:53:46	2.83	10.92	7.75	10.21	12.44	14.79	16.90	19.56	#N/A
	0:56:36	2.33	8.83	6.30	8.26	10.03	11.90	13.57	15.67	#N/A
	0:59:26	1.97	7.44	5.31	6.96	8.45	10.01	11.42	13.17	#N/A
	1:02:16	1.73	6.49	4.64	6.07	7.36	8.71	9.93	11.45	#N/A
	1:05:05	1.56	5.81	4.16	5.44	6.59	7.79	8.87	10.23	#N/A
	1:07:55	1.44	5.32	3.82	4.99	6.04	7.14	8.12	9.36	#N/A
	1:10:45	1.05	3.95	2.82	3.69	4.48	5.32	6.07	7.02	#N/A
	1:13:35	0.77	2.86	2.05	2.68	3.25	3.85	4.39	5.07	#N/A
	1:16:25	0.57	2.11	1.51	1.98	2.40	2.85	3.25	3.76	#N/A
	1:19:14	0.42	1.57	1.12	1.47	1.79	2.12	2.42	2.79	#N/A
	1:22:04	0.30	1.15	0.81	1.07	1.30	1.55	1.77	2.05	#N/A
	1:24:54	0.21	0.82	0.58	0.77	0.93	1.11	1.27	1.48	#N/A
	1:27:44	0.15	0.60	0.42	0.56	0.68	0.81	0.92	1.07	#N/A
	1:30:34	0.10	0.41	0.29	0.38	0.47	0.56	0.65	0.75	#N/A
	1:33:23	0.06	0.26	0.18	0.24	0.30	0.36	0.42	0.49	#N/A
	1:36:13	0.03	0.15	0.10	0.14	0.17	0.21	0.24	0.28	#N/A
	1:39:03	0.01	0.06	0.04	0.06	0.08	0.09	0.11	0.13	#N/A
	1:41:53	0.00	0.02	0.01	0.01	0.02	0.03	0.03	0.04	#N/A
	1:44:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	1:47:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	1:50:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	1:53:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	1:56:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	1:58:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:01:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:04:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:07:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:10:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:13:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:15:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:18:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:21:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:24:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:27:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:29:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:32:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:35:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:38:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:41:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:44:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:46:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:49:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:52:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:55:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:58:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:01:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:03:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:06:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:09:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:12:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:15:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:18:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:20:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:23:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A

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	Note: L / W Ratio < 1
Watershed Length =	755	ft	L / W Ratio = 0.6
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		
Water Quality Capture Volume (WQCV) =	0.716	acre-feet	Optional User Override 1-hr Precipitation
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	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

Depth Increment = ft

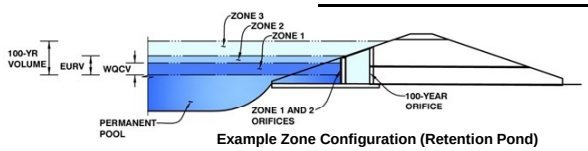
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	0	0.000		
	--	0.33	--	--	--	112	0.003	17	0.000
	--	0.50	--	--	--	462	0.011	63	0.001
	--	1.50	--	--	--	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

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 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 =	2.903E-02	ft^2
Depth at top of Zone using Orifice Plate =	4.70	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 =	4.18	sq. inches (use rectangular openings)	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	1.57	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			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 =	4.70	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.43	N/A	feet
Overflow Weir Front Edge Length =	10.00	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 =	4.99	N/A	should be ≥ 4
Horiz. Length of Weir Sides =	2.91	N/A	feet	Overflow Grate Open Area w/o Debris =	21.00	N/A	ft^2
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	10.50	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 =	4.21	N/A	ft^2
Outlet Pipe Diameter =	30.00	N/A	inches	Outlet Orifice Centroid =	1.09	N/A	feet
Restrictor Plate Height Above Pipe Invert =	24.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.21	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.25	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.78	feet
Spillway Crest Length =	52.00	feet	Stage at Top of Freeboard =	8.03	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.98	acres
Freeboard above Max Water Surface =	1.00	feet			

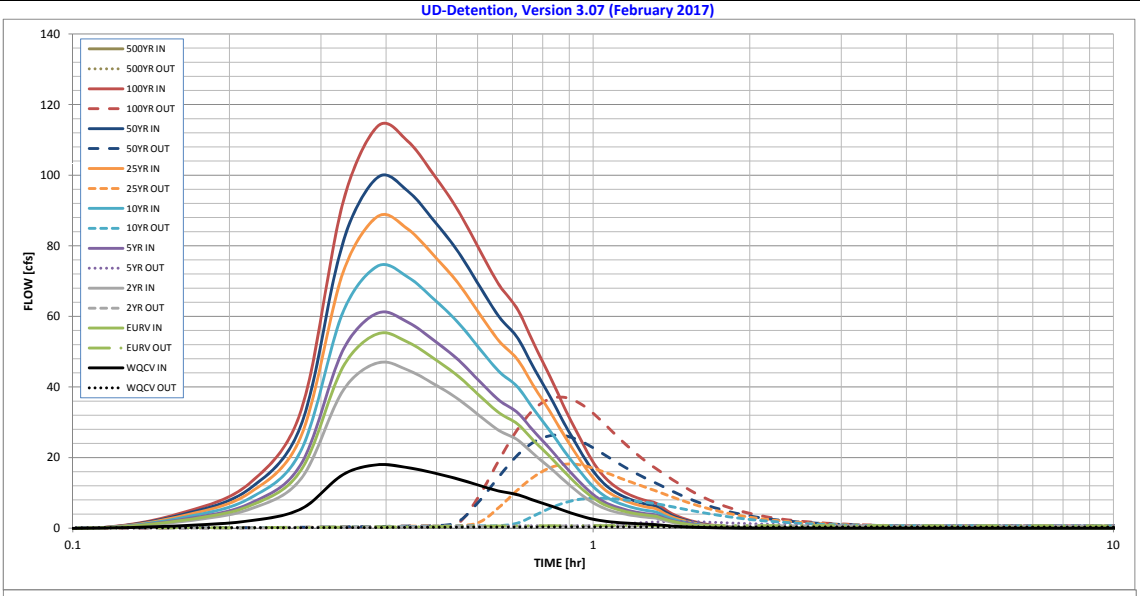
Calculated Parameters for Spillway

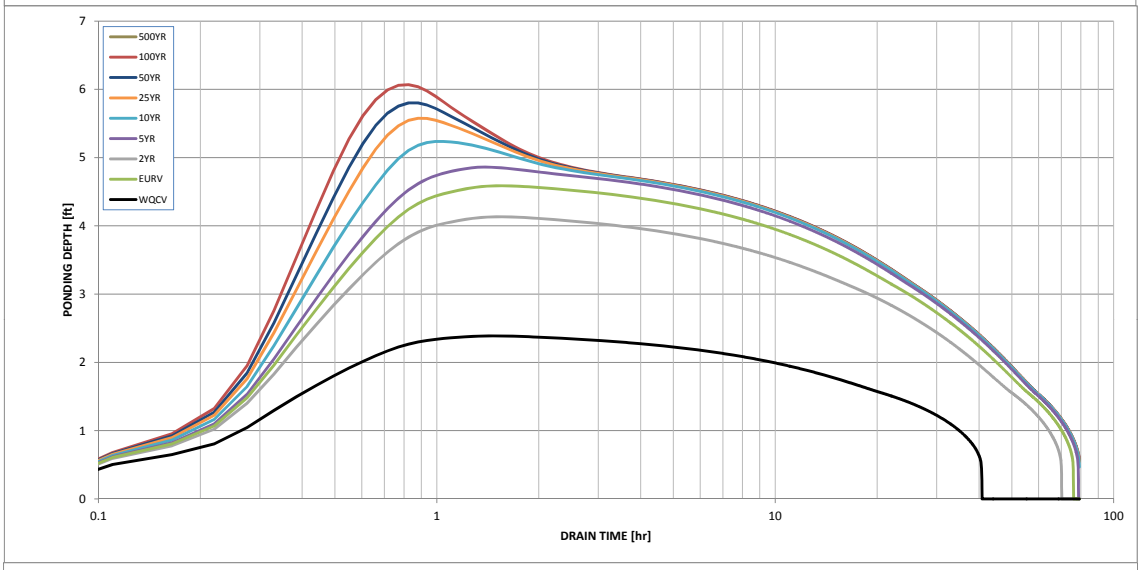
Routed Hydrograph Results

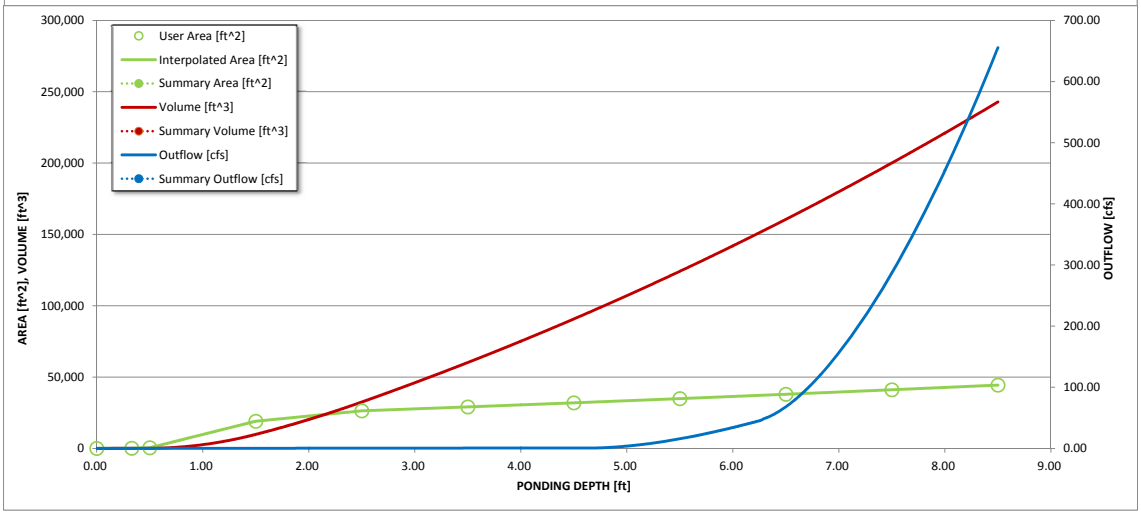
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	0.00
Calculated Runoff Volume (acre-ft) =	0.716	2.222	1.886	2.462	3.007	3.587	4.045	4.647	0.000
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.715	2.221	1.885	2.462	3.006	3.586	4.044	4.646	#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	55.0	46.8	60.9	74.2	88.3	99.3	113.8	#N/A
Peak Outflow Q (cfs) =	0.3	0.7	0.6	1.9	8.4	18.1	26.2	37.1	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.9	1.3	0.9	0.9	1.0	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 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) =	39	70	65	72	71	70	69	67	#N/A
Time to Drain 99% of Inflow Volume (hours) =	**40**	74	68	76	76	76	76	75	#N/A
Maximum Ponding Depth (ft) =	2.39	4.59	4.13	4.86	5.24	5.58	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	2.142	1.816	2.351	2.636	2.906	3.093	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			

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

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

	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	#N/A
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
3.30 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	0:03:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Hydrograph	0:06:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
Constant	0:09:54	0.79	2.36	2.02	2.60	3.14	3.70	4.13	4.68	#N/A
1.515	0:13:12	2.14	6.45	5.50	7.13	8.65	10.24	11.47	13.05	#N/A
	0:16:30	5.50	16.57	14.13	18.31	22.20	26.29	29.44	33.51	#N/A
	0:19:48	15.12	45.47	38.80	50.24	60.91	72.09	80.74	91.86	#N/A
	0:23:06	17.97	55.04	46.82	60.93	74.19	88.27	99.33	113.78	#N/A
	0:26:24	17.15	52.73	44.83	58.39	71.16	84.78	95.54	109.67	#N/A
	0:29:42	15.62	47.99	40.80	53.14	64.76	77.15	86.99	99.97	#N/A
	0:33:00	13.95	43.11	36.63	47.77	58.26	69.48	78.36	90.07	#N/A
	0:36:18	12.05	37.52	31.83	41.60	50.83	60.71	68.54	78.86	#N/A
	0:39:36	10.50	32.63	27.64	36.21	44.30	52.96	59.83	68.88	#N/A
	0:42:54	9.52	29.56	25.07	32.79	40.07	47.85	54.02	62.13	#N/A
	0:46:12	7.86	24.67	20.90	27.37	33.49	40.05	45.26	52.13	#N/A
	0:49:30	6.43	20.36	17.23	22.61	27.70	33.16	37.50	43.23	#N/A
	0:52:48	4.96	15.99	13.50	17.78	21.84	26.22	29.70	34.31	#N/A
	0:56:06	3.70	12.21	10.27	13.61	16.78	20.20	22.93	26.54	#N/A
	0:59:24	2.67	9.00	7.55	10.06	12.45	15.05	17.12	19.87	#N/A
	1:02:42	2.07	6.82	5.73	7.60	9.39	11.31	12.84	14.87	#N/A
	1:06:00	1.70	5.54	4.67	6.17	7.59	9.12	10.33	11.94	#N/A
	1:09:18	1.44	4.67	3.94	5.20	6.40	7.68	8.70	10.04	#N/A
	1:12:36	1.27	4.08	3.45	4.54	5.58	6.69	7.57	8.73	#N/A
	1:15:54	1.14	3.66	3.09	4.07	4.99	5.98	6.77	7.80	#N/A
	1:19:12	1.05	3.36	2.84	3.73	4.58	5.48	6.20	7.14	#N/A
	1:22:30	0.77	2.48	2.09	2.76	3.39	4.07	4.62	5.34	#N/A
	1:25:48	0.57	1.81	1.53	2.01	2.46	2.95	3.34	3.86	#N/A
	1:29:06	0.42	1.33	1.12	1.48	1.82	2.18	2.47	2.86	#N/A
	1:32:24	0.31	0.99	0.83	1.10	1.35	1.62	1.84	2.13	#N/A
	1:35:42	0.22	0.72	0.60	0.80	0.98	1.19	1.35	1.56	#N/A
	1:39:00	0.16	0.51	0.43	0.57	0.70	0.85	0.97	1.12	#N/A
	1:42:18	0.11	0.37	0.31	0.41	0.51	0.62	0.70	0.81	#N/A
	1:45:36	0.07	0.25	0.21	0.29	0.35	0.43	0.49	0.57	#N/A
	1:48:54	0.04	0.16	0.13	0.18	0.23	0.28	0.32	0.37	#N/A
	1:52:12	0.02	0.09	0.07	0.10	0.13	0.16	0.18	0.21	#N/A
	1:55:30	0.01	0.04	0.03	0.04	0.06	0.07	0.08	0.10	#N/A
	1:58:48	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.03	#N/A
	2:02:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:05:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:08:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:12:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:15:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:18:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:21:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:25:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:28:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:31:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:35:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:38:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:41:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:48:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:51:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:54:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	2:58:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:01:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:04:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:08:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:11:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:14:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:18:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:21:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:24:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:27:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:31:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:34:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:37:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:41:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:44:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:47:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:51:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:54:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A
	3:57:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	#N/A

CIVIL CONSULTANTS, INC.

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

PROJECT: Timberline Storage

DATE: 6/7/17

Initial
Surcharge Volume (Pond 1) (ISV)

Based Upon Proposed Conditions (P)

0.3% WQCV (Per UDFCD T5 EDB-4)

$WQCV_P = 0.256$

$ISV = 0.003 \times 0.256 \text{ AC-FT} = 0.00768 \text{ AC-FT} \times \frac{43560 \text{ AC-FT}}{\text{FT}}$

$= 33.45 \text{ CF}$

@ 4" DEEP $= 33.45 \text{ CF} / 0.333 \text{ FT} =$ 100.4 SQ FT REQ'D →

Based Upon Future Conditions (F) (Assumes Dev. of OS-1)

0.3% WQCV

$WQCV_F = 0.398$

$ISV = 0.003 \times 0.398 \text{ AC-FT} = 0.01194 \text{ AC-FT} \times \frac{43560 \text{ AC-FT}}{\text{FT}}$

$= 52.01 \text{ CF}$

@ 4" DEEP $= 52.01 / 0.333 \text{ FT} =$ 156.2 SQ FT REQ'D →

@ 5" DEEP $= 52.01 / 0.417 \text{ FT} =$ 124.8 SQ FT REQ'D →

Use 5" to reduce Structure Size. →

Size for Future Conditions

CIVIL CONSULTANTS, INC.

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

PROJECT: Timberline Storage

DATE: 6/1/2017

PROPOSED CONDITION (POND 1)

FOREBAY VOLUMES REQ'D FOR POND

SIZE OF CONTRIBUTING AREA = 21.77 AC

MIN FOREBAY VOLUME = 3% of WQCV (UDFCD T5 EDB-12)

WQCV POND 1 = 0.255 AC-FT (UD-Det v3.07)

TOTAL VOLUME REQUIRED = $0.03(0.255)\frac{43560 \text{ sq ft}}{1 \text{ acre}}$

= 333.3 cf

TOTAL # OF FOREBAYS = 2

DIVIDE VOLUME BASED UPON CONTRIBUTING FLOWS TO EACH FOREBAY

Q_{100} @ POND = 13.7 + 29.1 = 42.8 (Not Routed)

SW = 13.7/42.8 = 0.32 = 32%

NE = 29.1/42.8 = 0.68 = 68%

5.83 IMPERVIOUS ACRES

REQ'D VOLUME @ FOREBAYS

SW = 32% of 333.3 cf = 107 cf/ . = 106 cu ft =

NE = 68% of 333.3 cf = 200 cf/

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(719) 955-5485

PROJECT: Timberline Storage

DATE: 6/8/17

Size notch for SW Forebay

2% of Undetained 100-yr Flow Reaching Forebay

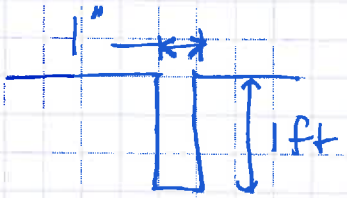
Q_{100} = 13.7 cfs

Q_{LF} = 13.7 cfs x 0.02 = 0.26 cfs

Size notch using Weir Eqn. (Retangular Weir)

$$Q = \frac{3.247\, L \cdot H^{1.48} - 0.566\, L^{1.9} \cdot H^{1.9}}{1 + 2L^{1.87}}$$

Solve for L = 1" Q = 0.26 cfs



Size notch for NE Forebay

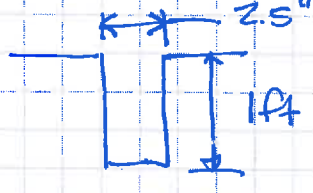
Q_{100} = 29.1 cfs

Q_{LF} = 29.1 cfs x 0.02 = 0.58 cfs

Using Rect. Formula

Solve For 2" Q = 0.52 cfs

Solve For 2.5" Q = 0.59 cfs ← Use 2.5"



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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 = 13.7 x 0.02 = 0.26 cfs

NE Forebay (Future) 46.3 x 0.02 = 0.93 cfs

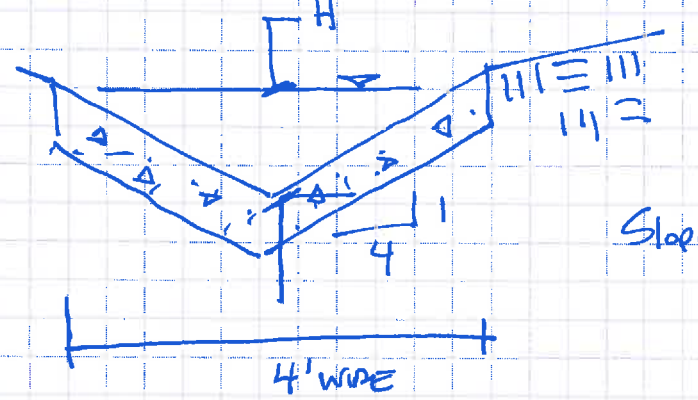
Peak Combined (2% of Contributing 100yr)

= 0.26

+ 0.93

1.19 cfs

Solved in Flowmaster

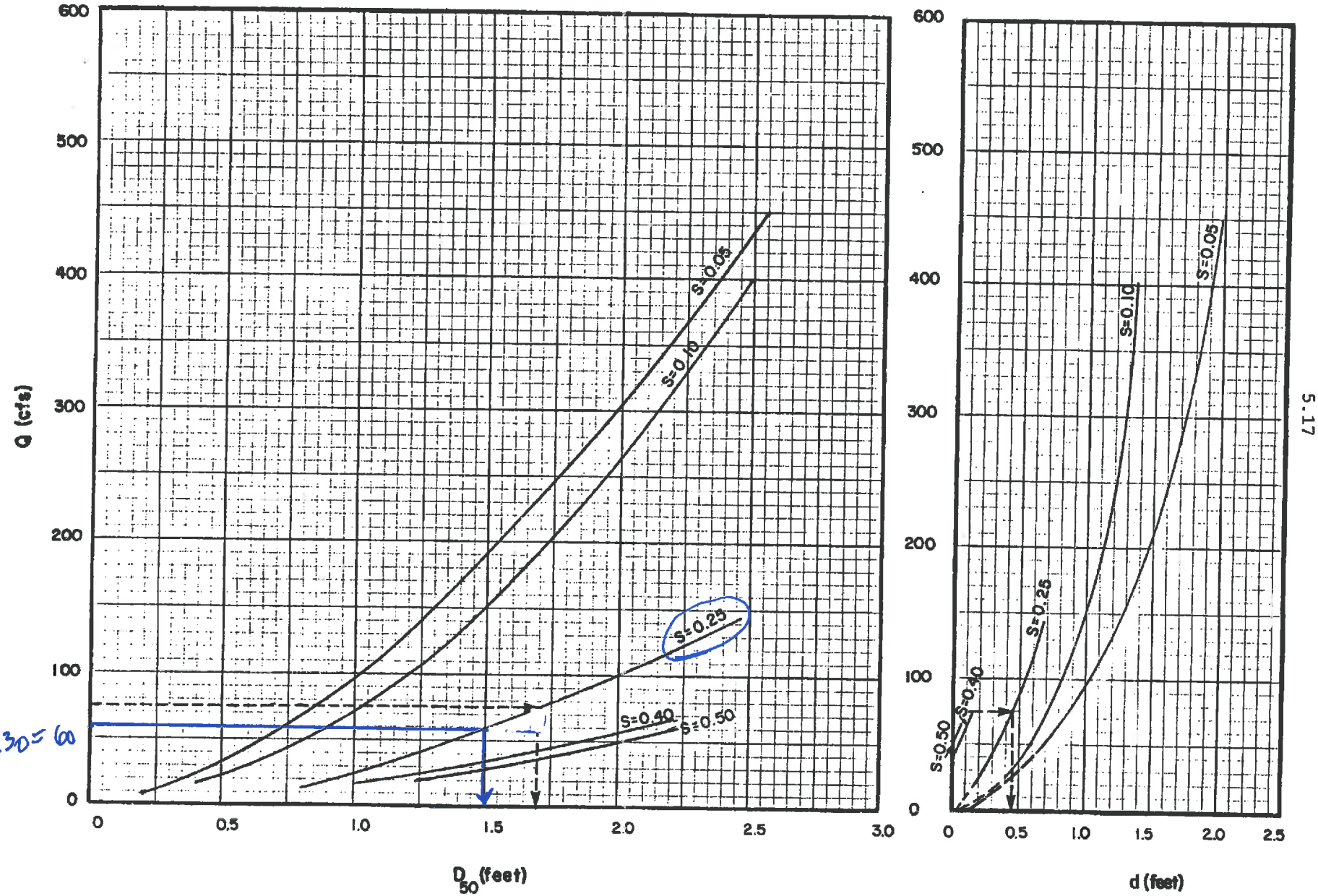


H = 0.5'

Slope = 0.5%

Q capacity = 3.14 cfs > 1.19 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 for 6ft wide evaluation

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

CIVIL CONSULTANTS, INC.

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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%

Offsite Diversion Swale - 82.0 cfs

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.02200	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	20.00	ft
Discharge	82.00	ft^3/s

Results

Normal Depth	0.68	ft
Flow Area	15.57	ft^2
Wetted Perimeter	25.65	ft
Hydraulic Radius	0.61	ft
Top Width	25.48	ft
Critical Depth	0.76	ft
Critical Slope	0.01510	ft/ft
Velocity	5.27	ft/s
Velocity Head	0.43	ft
Specific Energy	1.12	ft
Froude Number	1.19	
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	0.68	ft
Critical Depth	0.76	ft
Channel Slope	0.02200	ft/ft

Top of Proposed Rundown

Project Description

Solve For	Headwater Elevation

Input Data

Discharge		29.10	ft³/s
Crest Elevation		0.00	ft
Tailwater Elevation		0.00	ft
Crest Surface Type	Gravel		
Crest Breadth		6.00	ft
Crest Length		4.00	ft

Results

Headwater Elevation	1.78	ft
Headwater Height Above Crest	1.78	ft
Tailwater Height Above Crest	0.00	ft
Weir Coefficient	3.07	US
Submergence Factor	1.00	
Adjusted Weir Coefficient	3.07	US
Flow Area	7.10	ft²
Velocity	4.10	ft/s
Wetted Perimeter	7.55	ft
Top Width	4.00	ft

Proposed Rundown Swale - 29.1 cfs

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.055	
Channel Slope	0.25000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	29.10	ft^3/s

Results

Normal Depth	0.74	ft
Flow Area	3.31	ft^2
Wetted Perimeter	6.31	ft
Hydraulic Radius	0.53	ft
Top Width	5.96	ft
Critical Depth	1.11	ft
Critical Slope	0.05244	ft/ft
Velocity	8.79	ft/s
Velocity Head	1.20	ft
Specific Energy	1.94	ft
Froude Number	2.08	
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	0.74	ft
Critical Depth	1.11	ft
Channel Slope	0.25000	ft/ft

Future Swale Upstream of Rundown - 46.3 cfs

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.032	
Channel Slope	0.05000	ft/ft
Left Side Slope	40.00	ft/ft (H:V)
Right Side Slope	25.00	ft/ft (H:V)
Discharge	46.30	ft^3/s

Results

Normal Depth	0.56	ft
Flow Area	10.36	ft^2
Wetted Perimeter	36.72	ft
Hydraulic Radius	0.28	ft
Top Width	36.71	ft
Critical Depth	0.66	ft
Critical Slope	0.02159	ft/ft
Velocity	4.47	ft/s
Velocity Head	0.31	ft
Specific Energy	0.87	ft
Froude Number	1.48	
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	0.56	ft
Critical Depth	0.66	ft
Channel Slope	0.05000	ft/ft
Critical Slope	0.02159	ft/ft

Future Rundown Swale - 46.3 cfs

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.055	
Channel Slope	0.25000	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	8.00	ft
Discharge	46.30	ft^3/s

Results

Normal Depth	0.59	ft
Flow Area	5.39	ft^2
Wetted Perimeter	10.63	ft
Hydraulic Radius	0.51	ft
Top Width	10.35	ft
Critical Depth	0.93	ft
Critical Slope	0.05019	ft/ft
Velocity	8.59	ft/s
Velocity Head	1.15	ft
Specific Energy	1.73	ft
Froude Number	2.10	
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	0.59	ft
Critical Depth	0.93	ft
Channel Slope	0.25000	ft/ft

Forebay short rundown

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.055	
Channel Slope	0.25000	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	18.00	ft
Discharge	13.70	ft^3/s

Results

Normal Depth	0.18	ft
Flow Area	3.30	ft^2
Wetted Perimeter	19.46	ft
Hydraulic Radius	0.17	ft
Top Width	19.41	ft
Critical Depth	0.26	ft
Critical Slope	0.07085	ft/ft
Velocity	4.15	ft/s
Velocity Head	0.27	ft
Specific Energy	0.44	ft
Froude Number	1.77	
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	0.18	ft
Critical Depth	0.26	ft
Channel Slope	0.25000	ft/ft

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

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.

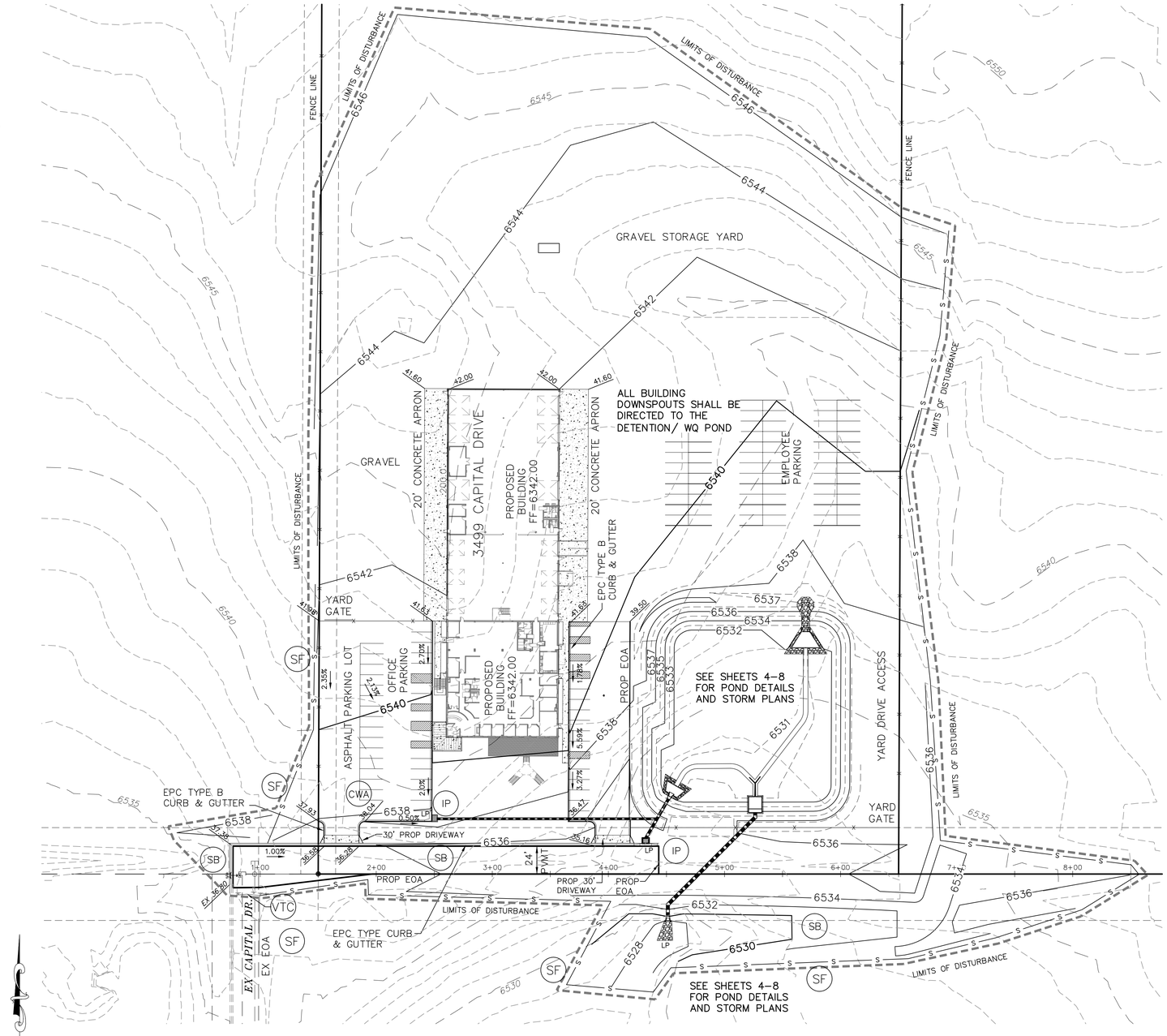
24. PRIOR TO ACTUAL CONSTRUCTION THE PERMITEE SHALL VERIFY THE LOCATION OF EXISTING UTILITIES.

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



DESIGN ENGINEER'S STATEMENT

THIS GRADING AND EROSION CONTROL PLAN WAS PREPARED UNDER MY DIRECTION AND SUPERVISION AND IS CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF. SAID PLAN HAS BEEN PREPARED ACCORDING TO THE CRITERIA ESTABLISHED BY THE COUNTY FOR GRADING AND EROSION CONTROL PLANS. I ACCEPT RESPONSIBILITY FOR ANY LIABILITY CAUSED BY NEGLIGENT ACTS, ERRORS OR OMISSIONS ON MY PART IN PREPARING THIS PLAN.

VIRGIL A. SANCHEZ, COLORADO P.E. #37160 DATE
FOR AND ON BEHALF OF M & S CIVIL CONSULTANTS, INC.

OWNER/DEVELOPER'S STATEMENT:

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

NAME: DATE

BUSINESS NAME:

ADDRESS:

EL PASO COUNTY:

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

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

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

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

GRADING AND EROSION CONTROL PLAN
TIMBERLINE STORAGE YARD
JOB NO. 43-095
DATE PREPARED: JUNE 13, 2017
DATE REVISED:

EL PASO COUNTY FILE NO. PPR 17-018

M&S CIVIL CONSULTANTS, INC.
20 BOULDER CRESCENT STE. 110
COLORADO SPRINGS,
COLORADO 80903
719.955.5485

PROPOSED/EXISTING DRAINAGE MAP

TIMBERLINE STORAGE YARD

COUNTY OF EL PASO, STATE OF COLORADO

EXISTING DRAINAGE MAP

JUNE 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

EX1 22.9 0.09 0.36

EX2 23.6 0.09 0.36

EX3 24.7 0.09 0.36

15' RAILROAD SPUR EASEMENT

15' RAILROAD SPUR EASEMENT

SITE OF FUTURE DEVELOPMENT

EXISTING CAPITAL DRIVE

EXISTING DIRT TRAVELWAY

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: 6/9/2017	
DESIGNED BY: CMN		SHEET 1 OF 1	EDM
DRAWN BY: CMN			
CHECKED BY: VAS			

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TIMBERLINE STORAGE YARD

COUNTY OF EL PASO, STATE OF COLORADO

PROPOSED DRAINAGE MAP

JUNE 2017

EXISTING SUBTRIBUTARY OF EAST FORK SAND CREEK

EXISTING RAILROAD EMBANKMENT/TRACK

PROPERTY BOUNDARY

DEVELOPMENT BOUNDARY

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

15' RAILROAD SPUR EASEMENT

TIMBERLINE STORAGE YARD

UNPLATTED

OS1 8.9 | 0.09 | 0.36

OS2 1.0 | 0.09 | 0.36

OS3 0.2 | 0.09 | 0.36

OS4 0.1 | 0.38 | 0.57

OS5 22.9 | 0.09 | 0.36

OS6 26.4 | 0.09 | 0.36

OS7 0.7 | 0.09 | 0.36

A 8.0 | 0.32 | 0.51

B 1.30 | 0.64 | 0.75

C 1.0 | 0.54 | 0.69

D 1.1 | 0.22 | 0.46

PROPOSED BUILDING

GRAVEL

CONCRETE APRON

PROP RIPRAP RUNDOWN AND CONCRETE OREBAY

PROPOSED CONCRETE LOW FLOW CHANNEL

PROP ASPHALT CURB

ASPHALT PARKING

PROP 1.5 AC-FT FULL SPECTRUM DETENTION POND

POND 1

MODIFIED CDOT TYPE D INLET BOX

PROP 24" RCP

FUTURE FSD OUTFALL STRUCTURE

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

LANDSCAPED AREA

CAPITAL DR.

PROP 5' CDOT TYPE R SUMP INLET W/18" RCP

PROP 18" RCP

PROP 5' CDOT TYPE R SUMP INLET W/24" RCP

PROP D_{50}=18" 36" THICK RIPRAP PAD

PROP 30" RCP OUTFALL

TEMP 20'W x 2'D TRAP DIVERSION SWALE

FUTURE OUTFALL PIPE

FUTURE COLLECTION SYSTEM TO BE SIZED WITH FUTURE DEVELOPMENT

FUTURE CURB & GUTTER

H.P.

L.P.

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

1" = 80'

0 40 80 160

Scale in Feet

BASIN SUMMARY

BASIN	AREA (ACRES)	Q_5	Q_{100}
A	7.96	8.7	23.7
B	1.30	3.5	7.0
C	1.02	2.8	5.9
D	1.13	1.3	4.5
OS1	8.92	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	51.0
OS6	26.43	5.8	39.1
OS7	0.68	0.2	1.4

DESIGN POINT SUMMARY

DESIGN POINT	Q_5	Q_{100}	BASIN	STRUCTURE
1	7.7	29.1	OS1, OS2, A	RIP RAP RUNDOWN INTO FULL-SPECTRUM DETENTION POND
2	3.6	7.6	B, OS3	5' SUMP INLET
3	3.0	6.6	OS4, C	5' SUMP INLET
4	11.6	38.0	DP1, PIPE 3, D	PROPOSED FULL-SPECTRUM DETENTION POND
5	12.2	82.0	OS5, OS6	
6	10.5	89.6	DP5, PIPE 4, OS7	

STORM SEWER SUMMARY

PIPE RUN	Q_5	Q_{100}	PIPE SIZE	CONTRIBUTING STRUCTURES
1	3.6	7.6	18" RCP	5' SUMP INLET
2	3.0	6.6	24" RCP	5' SUMP INLET
3	6.4	13.7	24" RCP	PR1, PR2
4	0.3	21.3	30" RCP	POND OUTFALL

POND 1 FULL SPECTRUM DETENTION BASIN DATA

WQ WATER SURFACE EL=7031.61
WQ VOLUME=0.234 AC-FT.
EURV WATER SURFACE EL=6532.33
EURV VOLUME=0.548 AC-FT
100-YR WATER SURFACE EL=6534.15
SPILLWAY CREST EL=6535.3
TOP OF EMBANKMENT EL=6536.3
100-YR VOLUME=1.530 AC-FT
100-YR INFLOW=38.0 CFS
100-YR RELEASE=21.3 CFS

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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: 6/9/2017	
DESIGNED BY: CMN		SHEET 1 OF 1	PDM
DRAWN BY: CMN			
CHECKED BY: VAS			

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TIMBERLINE STORAGE YARD

COUNTY OF EL PASO, STATE OF COLORADO

FUTURE DRAINAGE MAP

JUNE 2017

EXISTING SUBTRIBUTARY OF EAST FORK SAND CREEK

EXISTING RAILROAD EMBANKMENT/TRACK

PROPERTY BOUNDARY

FUTURE INDUSTRIAL DEVELOPMENT

DEVELOPMENT BOUNDARY

OS1 8.9 | 0.60 | 0.72

OS2 1.0 | 0.09 | 0.36

OS6 22.8 | 0.67 | 0.78

OS5 26.6 | 0.73 | 0.83

A 7.7 | 0.32 | 0.52

B 1.3 | 0.64 | 0.75

C 1.0 | 0.54 | 0.69

D 1.5 | 0.16 | 0.41

OS3 0.2 | 0.09 | 0.36

OS4 0.1 | 0.34 | 0.88

OS7 0.7 | 0.09 | 0.36

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

15' RAILROAD SPUR EASEMENT

EXISTING TIMBERLINE STORAGE YARD

UNPLATTED

EXISTING GRAVEL LOT

EXISTING BUILDING

EXISTING OFFICE PARKING

EXISTING GRAVEL STORAGE YARD

FUTURE FSD EXPANSION FOR BASIN OS3

REMOVE AND REPLACE EXISITNG RUNDOWN AND FOREBAY EXTEND LOW FLOW CHANNEL

FUTURE FULL SPECTRUM DETENTION POND 1

FUTURE FULL SPECTRUM DETENTION POND 2

FUTURE FULL SPECTRUM DETENTION POND 3

FUTURE FSD OUTFALL STRUCTURE W/30" RCP OUTFALL

FUTURE 24" RCP OUTLET PIPE

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

MODIFY ORIFICE AND RESTRICTOR PLATE ON EXISTING FSD OUTFALL STRUCTURE

EX 24" RCP W/FOREBAY

EX 5' CDOT TYPE R SUMP INLET W/18" RCP

EX 5' CDOT TYPE R SUMP INLET W/24" RCP

EX. 30" RCP OUTFALL

FUTURE 42" RCP OUTFALL

EXPAND EXISTING RIPRAP PAD

FUTURE COLLECTION SYSTEM TO BE SIZED WITH FUTURE DEVELOPMENT

FUTURE 24" OUTFALL PIPE

FUTURE CURB & GUTTER

CAPITAL DR.

L.P. LOW POINT

H.P. HIGH POINT

6546 6544 6542 6540 6538 6532

1" = 80'

0 40 80 160

Scale in Feet

LEGEND

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

4 — PIPE RUN (PR) REFERENCE LABEL

6 — 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	7.70	8.7	23.5
B	1.30	3.5	7.0
C	1.02	2.8	5.9
D	1.46	1.2	5.1
OS1	8.92	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	19.2	46.3	OS1, OS2, A	RIP RAP RUNDOWN INTO SFB
2	3.6	7.6	B, OS3	EX 5' SUMP INLET
3	3.0	6.6	OS4, C	EX 5' SUMP INLET
4	23.8	57.3	DP1, PIPE 3, D	EXPANDED FSD POND
5	78.4	148.8	OS5	FUTURE FSD POND 3
6	59.6	114.0	OS6	FUTURE FSD POND 2
7	4.1	89.3	OS7,PIPE4, PIPE 7	HISTORIC CHANNEL

STORM SEWER SUMMARY

PIPE RUN	Q_5	Q_{100}	PIPE SIZE	CONTRIBUTING STRUCTURES
1	3.6	7.6	18" RCP	SUMP INLET
2	3.0	6.6	18" RCP	SUMP INLET
3	6.4	13.7	24" RCP	PR1, PR2
4	0.4	25.4	(2) 30" RCP	PR3, DP4
5	1.6	25.4	24" RCP	DP5
6	1.9	37.1	30" RCP	DP6
7	3.5	62.5	42" RCP	PR5, PR6

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PHONE: 719.955.5485

TIMBERLINE STORAGE YARD

FUTURE DRAINAGE MAP

PROJECT NO. 43-095
DESIGNED BY: CMN
DRAWN BY: CMN
CHECKED BY: VAS
SCALE: HORIZONTAL: 1"=80' VERTICAL: N/A
DATE: 6/12/2017
SHEET 1 OF 1
FDM

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