PRELIMINARY DRAINAGE REPORT
FOR
CLOVERLEAF SUBDIVISION PRELIMINARY PLAN

PCD File No. SP202

Prepared For:

PT Cloverleaf, LLC.
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September 9, 2020
Project No. 25158.01

Prepared By:

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719-593-2593

PRELIMINARY DRAINAGE REPORT FOR
CLOVERLEAF SUBDIVISION PRELIMINARY PLAN

ENGINEER'S STATEMENT:

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

_____

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

DEVELOPER'S STATEMENT:

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

Business Name: PT Cloverleaf, LLC.

By: _____

Title: _____

Address: 1864 Woodmoor Drive, Suite 100
Monument, CO 80920

El Paso County:

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

_____ _____

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

Conditions:

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APPENDIX

PURPOSE

This document is the Preliminary Drainage Report for Cloverleaf Subdivision Preliminary Plan. The purpose of this report is to identify on-site and off-site drainage patterns, storm sewer, culvert and inlet locations, areas tributary to the site, and to safely route developed storm water to adequate outfall facilities.

GENERAL SITE DESCRIPTION

GENERAL LOCATION

The proposed Cloverleaf Subdivision Preliminary Plan, known as "Cloverleaf" from herein, is a parcel of land located in Section 23 and 24, Township 11 South, Range 67 West of the 6th Principal Meridian in El Paso County, Colorado. The subdivision will replat portions of Tract H of Woodmoor Greens, Tract F of Woodmoor Greens vacation L496-500 and a Portion of Tract B of Woodmoor Placer. Cloverleaf is a 38.75 acre, single family-development and is comprised of 150 lots and associated infrastructure. Cloverleaf will be split into two distinct uses; Lot 1 – Lot 141 will be an urban subdivision proposed for RS-5000 zoning; Lots 148, 149 and 150 will be suburban lots consistent with the existing RS-20000 zoning. The site is bounded by Walters Commons Townhomes and Country Ridge Condos to the south, Bowstring Road to the west, Woodmoor Greens and Woodmoor Place subdivision to the north and Cloverleaf Road to the east. A vicinity map of the area is presented in Appendix A.

No major drainageways or irrigation wells exist on the site.

DESCRIPTION OF PROPERTY

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

Per an NRCS web soil survey of the area, Cloverleaf is made up of Type B soils. This Type B soil is a Tomah-Crowfoot loamy sand. This soil type has a moderate infiltration rate when thoroughly wet. It also consists of moderately deep or deep, moderately well drained or well-drained soil. A soil survey map has been presented in Appendix A.

There are no major drainageways on the site.

There are no known irrigation facilities located on the project site. Woodmoor Water and Sanitation District does have various easements for both sanitary and water lines run parallel to existing property lines or cross the site as shown on the drainage map in Appendix F.

FLOODPLAIN STATEMENT

Based on the FEMA Firm Map Number 08041CO278G, revised December 7, 2018, the entire development is located within Zone X, or areas area outside the Special Flood Hazard Area (SFHA) and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. The FEMA map containing the site has been presented in Appendix A.

EXISTING DRAINAGE CONDITIONS

MAJOR BASIN DESCRIPTIONS

Cloverleaf lies within the upper reaches of the Teachout Creek watershed basin. Although no DBPS currently exists for Teachout Creek, basin fees have been listed in the Interim Basin Section of the 2020 El Paso County Drainage Basin Fee list. Existing vegetation on the proposed site consists primarily of native grasses. The terrain is sloped generally from northeast to southwest and ranges from 3% to 15%. Drainage from the site currently discharges both west through existing culverts to Lewis Palmer High School and south under Higby Road through existing culverts.

EXISTING SUB-BASIN DRAINAGE

Existing basin drainage patterns are generally from northeast to southwest by way of sheet flow. Woodmoor Placer and Woodmoor Greens subdivisions were platted in the 1970's with half acre or larger lots served by asphalt roads with roadside ditches and culverts. Woodmoor Placer and Woodmoor Greens also had a large somewhat connected series of open space tracts that were envisioned as a golf course. Any excess drainage flows generated by Woodmoor Greens or Woodmoor Place were not detained except in natural depressions within the open space.

The upper Woodmoor drainage flows above Caribou Drive have been collected in the roadside ditches and historically discharged through the lower lots via side lot swales and into the open space where the flow dispersed as sheet flow. The open space flows drain to lower Woodmoor developments; Leggins Way, County Ridge Condos, and Walters Commons Townhomes. Leggins Way accepts the upstream flows via gentle side lot swales that drain to Leggins Way roadside swales discharge through a 28"x42" culvert under Bowstring Road and continue into the Lewis-Palmer High School drainage system. Upstream flows onto Country Ridge pass through the condos and exit into Magic Lamp Way which discharges as gutter flow at the high point of Bowstring Road with half the flows entering the high school at Leggins Way and half the flows entering the Higby Road storm sewer system. Leggins Way and Country Ridge do not provide detention. Walters Commons Townhomes was developed in the 2000's also accepts some of the Woodmoor Place and Woodmoor Greens upstream developed flows but it does provide for stormwater detention which discharges to the Higby Road storm sewer system.

A meeting was held with the school district in January 2020 and the district reported no periodic flooding or drainage concerns.

CUHP/SWMM EXISTING SUB-BASIN DRAINAGE

The Cloverleaf Subdivision Site contains 4 separate areas. The main area, totaling approximately 37.24 acres will contain lots 1 – lot 147. Three additional parcels are also being developed with this project, which total 1.51 acres. The main site area has approximately 136 tributary acres upstream of it, and the three separate lots are part of two additional basins SX-6 and SX-7, which total an additional 93.7 acres. Due to the total analysis area being over 200 acres, the historic, existing, and proposed conditions hydrology were analyzed using CUHP/SWMM.

As seen in the "Existing Conditions CUHP/SWMM Basins & Routing Map" drainage map, the offsite and on-site areas can be broken into eight sub-basins, TX-1, TX-2, SX-3, SX-4, SX-5, SX-6, and SX-7.

Existing Basin TX-1 is approximately 108.7 acres and consists of prairie grasses, public streets and single family lots. Flow from this basin (Q_5=46.8 cfs, Q_{100} =124.8 cfs) flows through an existing side yard swale and enters the open space at Node/DP-1 (Q_5=46.8 cfs, Q_{100} =124.8 cfs), eventually reaching the Cloverleaf site as sheet flow at Node/DP-3.

Existing Basin TX-2 is approximately 27.2 acres and consists of prairie grasses, public streets and single family lots. Flow from this basin (Q_5=10.9 cfs, Q_{100} =31.4 cfs) flows through an existing side yard swale and enters the open space at Node/DP-2 (Q_5=10.9 cfs, Q_{100} =31.4 cfs), eventually reaching the Cloverleaf site as sheet flow into Basin SX-4.

Existing Basin SX-3 is approximately 27.6 acres and consists of prairie grasses. Flow from this basin (Q_5 =9.1 cfs, Q_{100} =33.0 cfs) combines with flows from Basins TX-1 and TX-2 at Node/DP-3 and flows ultimately to the roadside swale along the east side of Leggins Way at DP-9. The areas included in existing SWMM basin SX-3 were included in the Walters Commons FDR as portions of basins OS-5(32.05 ac) and OS-4 (5.68 ac).

Existing Basin SX-4 is approximately 5.2 acres and consists of prairie grasses and a portion of Walters Point (an existing private road access to Walters Commons. Flow from this basin (Q_5=1.7 cfs, Q_{100} =5.6 cfs) sheet flows south into Walters Commons at Node/DP-4. This flow continues to the southwest through the Walters Commons F1 site until it reaches the existing 1.83 ac-ft detention pond part of the Walters Commons development. This pond was sized for the offsite tributary areas that are now part of the Cloverleaf development site and included a total of 9.31 tributary acres to the existing 1.83 ac-ft detention from the Cloverleaf site in basins OS-9, OS-10, and OS-11.

The existing Walters Commons detention pond limits flows to historic rates, and ultimately discharges to the existing 2.3' diameter CMP culvert pipe that outfalls to the ditch on the south side of Higby Road.

Existing Basin SX-5 is approximately 4.3 acres and consists of prairie grasses and a portion of Walters Point. Flow from this basin (Q_5=1.7 cfs, Q_{100} =5.8 cfs) sheet flows to the south and enters the roadside ditch for Cloverleaf Road at Node/DP-5. Flows in the roadside ditch are collected at a Type C area inlet and enter the Walters Commons Storm Sewer System at Node/DP-11 and are then piped to the exisintg 1.83 ac-ft detention pond part of the Walters Commons development. This pond was sized for the offsite tributary areas that are now part of the Cloverleaf development site and included a total of 9.31 tributary acres to the existing 1.83 ac-ft detention from the Cloverleaf site in basins OS-9, OS-10, and OS-11.

The existing Walters Commons detention pond limits flows to historic rates, and ultimately discharges to the existing 2.3' diameter CMP culvert pipe that outfalls to the ditch on the south side of Higby Road.

Basins OS-9, OS-10, and OS-11 form the Walters Commons FDR are reasonably consistent in area, flow patterns and runoff quantities with existing basins SX-4 and SX-5 detailed in this report.

Existing Basin SX-6 is approximately 49.1 acres and consists of prairie grasses, Leggins Way, and single family lots. Flow from this basin (Q_5=22.3 cfs, Q_{100} =63.1 cfs) sheet flows to the roadside swales along Bowstring Road at DP-6 and continue in the roadside swale to the southeast until they reach the EX-28"X42" CMP culvert at outfall 10.

Existing Basin SX-7 is approximately 44.6 acres and consists of prairie grasses, Caribou Drive West, and single family lots. Flow from this basin (Q_5=12.4 cfs, Q_{100} =33.9 cfs) sheet flows to the roadside swale along Bowstring Road at DP-7. The roadside swale routes the flow to an existing 24" CMP culvert under Bowstring Road at DP-12.

CUHP/SWMM HISTORIC SUB-BASIN DRAINAGE

Two basins were analyzed for historic flows. The first basins H1, consists of 163.4 acres of open space/fields (2% impervious). This basin roughly encompasses the same area as the proposed basins TX-1, TX-2, and S-3 from the CUHP/SWMM proposed conditions model. The intent of the historical flow analysis was to quantify pre-development flow rates for the area congruent with Pond P2's tributary area (Proposed basins TX-1, TX-2, and S-3) to determine allowable release rates for the proposed pond. This pond needed to be modeled in SWMM as it is in series with the proposed volume attenuation pond P1. Historic Basin H1 generates runoff rates of Q5 = 32.6 cfs and Q100 = 124.8 cfs.

Historic Basin H2 was provided for informational purposes only and was not used to determine allowable release rates to any pond. Basin H2 consists of 9.62 acres in the southeast corner of the proposed development site. Basin H2 generates runoff rates of Q5 = 2.8 cfs and Q100 = 31.4 cfs. Proposed Pond P3 lies within the historic basin H2, but was sized and designed using the UDFCD UD-detention workbook as its tributary is very small, and in our opinion best modeled through methods other than SWMM and CUHP.

PROPOSED DRAINAGE CONDITIONS

PROPOSED SUB-BASIN DRAINAGE (RATIONAL METHOD)

The proposed site was broken into 19 sub-basins: Basins A through O, and OS-1 through OS-4. The proposed and sub-basin delineation is shown on the drainage basin map in Appendix F. Four ponds are proposed as part of this development. Pond P1 is a private volume attenuation pond that receives all flow from offsite basins that are tributary to the project site, as well as Basin OS-1. Pond P2 is a private full spectrum detention extended detention basin that receives flow from Basins A through K, which make up the majority of the project site. Pond P3 is a private full spectrum detention extended detention basin that receives flow from Basin L in the southeast side of the project site. Pond P4 is a private water quality pond that receives flow from Basins M, N, and O on the western side of the project site.

The proposed Cloverleaf basin delineation is described below. Refer to the basin and design point summary tables at the end of this section for basin and design point flows.

Proposed Basin A is approximately 4.39 acres in area and includes portions of 23 proposed single family residential lots, proposed open space, and proposed roadway. Runoff from Basin A (Q_5=7.9 cfs, Q_{100} =17.5 cfs) sheet flows to the proposed roads and is routed via proposed El Paso County Type C curb and gutter to a proposed public 15’ Type R on-grade inlet at DP-1. This inlet was sized to capture all flow in the 5 and 100-year events. Once in the inlet, the captured flow is piped via proposed public storm sewer to a proposed public manhole at DP-4.1, where it combines with the flow from Basin D.

Proposed Basin B is approximately 3.14 acres in area and includes portions of 25 proposed single family residential lots. Runoff from Basin B (Q_5=4.6 cfs, Q_{100} =11.3 cfs) sheet flows to the back of the proposed lots and is routed via a proposed swale to a proposed private Type C area inlet at DP-2. The proposed swale will be within a drainage easement, which will restrict the installation of fencing, structures, or storage of materials within the easement. Once in the inlet, the captured flow is piped via proposed private storm sewer to a proposed public manhole at DP-4.2, where it combines with the flow from DP-4.1. In the event that the inlet at DP-2 becomes clogged, the flow will be routed directly into the proposed private water quality pond P4 at DP-15 via a proposed swale. The

proposed routing reduces the runoff to the adjacent site and instead routes the flow to the proposed pond P2, which releases flow at or below the historic rates.

Proposed Basin C is approximately 1.67 acres in area and includes portions of 19 proposed single family residential lots and proposed roadway. Runoff from Basin C (Q_5=4.1 cfs, Q_{100} =8.4 cfs) sheet flows to the proposed road and is routed via proposed El Paso County Type C curb and gutter to a proposed public 10' Type R on-grade inlet at DP-3. This inlet was sized to capture all flow in the 5 and 100-year events. The captured flow is piped via proposed private storm sewer to DP-4.3, where it combines with flow from DP-4.2.

Proposed Basin D is approximately 3.46 acres in area and includes portions of 21 proposed single family residential lots, proposed open space, and proposed roadway. Runoff from Basin D (Q_5=6.3 cfs, Q_{100} =13.9 cfs) sheet flows to the proposed road and is routed via proposed El Paso County Type C curb and gutter to a proposed public 15' Type R on-grade inlet at DP-4. This inlet was sized to capture all flow in the 5 and 100-year events. Once in the inlet, the captured flow is piped via proposed public storm sewer to a proposed public manhole at DP-4.1, where it combines with the flow from Basin A.

All flow at DP-4.1 (Q_5=14.2 cfs, Q_{100} =31.4 cfs) is piped via proposed public storm sewer to DP-4.2.

All flow at DP-4.2 (Q_5=22.2 cfs, Q_{100} =42.5 cfs) is piped via proposed public storm sewer to DP-4.3.

All flow at DP-4.3 (Q_5=25.7 cfs, Q_{100} =49.8 cfs) is piped via proposed public storm sewer to DP-5.1.

Proposed Basin E is approximately 0.30 acres in area and includes portions of four proposed single family residential lots and proposed roadway. Runoff from Basin E (Q_5=1.0 cfs, Q_{100} =2.0 cfs) sheet flows to the proposed road and is routed via proposed El Paso County Type C curb and gutter to a proposed public 5' Type R on-grade inlet at DP-5. This inlet was sized to capture all flow in the 5 and 100-year events. Once in the inlet, the captured flow combines with flow from DP-4.3 at DP-5.1.

All flow at DP-5.1 (Q_5=26.5 cfs, Q_{100} =51.3 cfs) is piped via proposed private storm sewer to proposed private Pond P2, where it combines with flow from Basin K and DP-10.1 at DP-11.

Proposed Basin F is approximately 1.19 acres in area and includes portions of eight proposed single family residential lots and proposed roadway. Runoff from Basin F (Q_5=3.1 cfs, Q_{100} =6.4 cfs) sheet flows to the proposed roads and is routed via proposed El Paso County Type C curb and gutter to a proposed public 5' Type R on-grade inlet at DP-6. This inlet was sized to capture all flow in the 5 and 100-year events. Once in the inlet, the captured flow is piped via proposed public storm sewer to a proposed public manhole at DP-6.1, where it combines with the flow from tributary basins routed through Pond P1 (DP-TB).

All flow from tributary basins is routed through Pond P1 and throttled in a proposed private outlet structure at DP-TB to release into the proposed storm system at rates of Q_5=34 cfs, Q_{100} =85 cfs. This flow is routed via proposed private storm sewer to DP-6.1, where it combines with flow from Basin F. In the event that the proposed private outlet structure becomes clogged, flow will overtop the proposed pond embankment and travel down through proposed open space to the proposed public 15' Type R sump inlet at DP-8.

All flow at DP-6.1 (Q_5=34.3 cfs, Q_{100} =85.5 cfs) is piped via proposed public storm sewer to a proposed public manhole at DP-8.2, where it combines with flow from DP-8.1.

Proposed Basin G is approximately 0.90 acres in area and includes portions of seven proposed single family residential lots, proposed open space, and proposed roadway. Runoff from Basin G (Q_5=2.4 cfs, Q_{100} =5.1 cfs) sheet flows to the proposed roads and is routed via proposed El Paso County Type C curb and gutter to a proposed public 5' Type R sump inlet at DP-7. This inlet was sized to capture all flow in the 5 and 100-year events. Once in the inlet, the captured flow is piped via proposed public storm sewer to a proposed public 15' Type R inlet at DP-8.1, where it combines with the flow from Basin H. In the event that the proposed public sump inlet becomes clogged, flow will overtop the local depression in the road and travel in the proposed curb and gutter along the northwest side of Crimson Clover Drive in Basin J to the proposed public 5' Type R sump inlet at DP-10.

Proposed Basin H is approximately 4.39 acres in area and includes portions of 21 proposed single family residential lots, proposed Pond P1, proposed open space, and proposed roadway. Runoff from Basin H (Q_5=7.4 cfs, Q_{100} =16.4 cfs) sheet flows to the proposed roads and is routed via proposed El Paso County Type C curb and gutter to a proposed public 15' Type R sump inlet at DP-8. This inlet was sized to capture all flow in the 5 and 100-year events. Once in the inlet, the captured flow combines with the flow from Basin G at DP-8.1. In the event that the proposed public sump inlet becomes clogged, flow will overtop the local depression in the road and travel in the proposed curb and gutter along the northwest side of Crimson Clover Drive in Basin J to the proposed public 5' Type R sump inlet at DP-10.

All flow at DP-8.1 (Q_5=9.3 cfs, Q_{100} =20.2 cfs) is piped via proposed public storm sewer to DP-8.2, where it combines with flow from DP-6.1.

All flow at DP-8.2 (Q_5=35.3 cfs, Q_{100} =87.7 cfs) is piped via proposed public storm sewer to DP-9.1, where it combines with flow from Basin I.

Proposed Basin I is approximately 4.39 acres in area and includes portions of 28 proposed single family residential lots and proposed roadway. Runoff from Basin I (Q_5=10.2 cfs, Q_{100} =21.5 cfs) sheet flows to the proposed roads and is routed via proposed El Paso County Type C curb and gutter to a proposed public 15' Type R sump inlet at DP-9. This inlet was sized to capture all flow in the 5 and 100-year events. Once in the inlet, the captured flow combines with flow from DP-8.2 at DP-9.1.

In the event that the proposed public sump inlet becomes clogged, flow will overtop the crown in the road and enter the proposed public 5' Type R sump inlet at DP-10.

All flow at DP-9.1 (Q_5=36.2 cfs, Q_{100} =89.6 cfs) is piped via proposed public storm sewer to DP-10.1, where it combines with flow from Basin J.

Proposed Basin J is approximately 1.39 acres in area and includes portions of 17 proposed single family residential lots and proposed roadway. Runoff from Basin J (Q_5=3.5 cfs, Q_{100} =7.2 cfs) sheet flows to the proposed roads and is routed via proposed El Paso County Type C curb and gutter to a proposed public 5' Type R sump inlet at DP-10. This inlet was sized to capture all flow in the 5 and 100-year events. Once in the inlet, the captured flow combines with flow from DP-9.1 at DP-10.1. In the event that the proposed public sump inlet becomes clogged, flow will overtop the proposed curb and travel down the proposed open space into Pond P2 at DP-11.

All flow at DP-10.1 (Q_5=36.5 cfs, Q_{100} =90.3 cfs) is piped via proposed private storm sewer to Pond P2, where it combines with flow from Basin K and DP-5.1 at DP-11.

Proposed Basin K is approximately 5.29 acres in area and includes portions of 26 proposed single-family residential lots, proposed private full spectrum extended detention Pond P2, and proposed open space. Runoff from Basin K (Q_5=5.2 cfs, Q_{100} =15.0 cfs) sheet flows to the back of the proposed lots and is routed via a proposed swale to the proposed Pond P2, where it combines with flow from DP-5.1 and DP-10.1. A proposed swale along the western property line ensures that all flow from Basin K is routed to Pond P2 at DP-11. The proposed swale will be within a tract, which will restrict the installation of fencing, structures, or storage of materials within the tract. The flow from DP-11 is routed via proposed private storm sewer to DP-15.1, where it combines with the flow from DP-15 (Pond P4).

Proposed Basin L is approximately 1.90 acres in area and includes portions of six proposed single family residential lots, proposed private full spectrum extended detention Pond P3, proposed open space, and existing roadway (Walters Point). Runoff from Basin L (Q_5=2.5 cfs, Q_{100} =6.7 cfs) sheet flows to the back of the proposed lots and into Pond P3 at DP-12. Proposed swales ensure that the runoff will be routed to the pond. The proposed swales will be within tracts, which will restrict the installation of fencing, structures, or storage of materials within the tracts.

Proposed Basin M is approximately 0.54 acres in area and includes portions of two proposed single family residential lots, proposed open space, and proposed roadway. Runoff from Basin M (Q_5=1.5 cfs, Q_{100} =3.1 cfs) sheet flows to the proposed road and is routed via proposed El Paso County Type C curb and gutter to a proposed public 5' Type R on-grade inlet at DP-13. This inlet was sized to capture all flow in the 5 and 100-year events. Once in the inlet, the captured flow is piped via proposed public storm sewer to a proposed public 5' Type R on-grade inlet at DP-14.1, where it combines with the flow from Basin N.

Proposed Basin N is approximately 0.63 acres in area and includes portions of eight proposed single family residential lots and proposed roadway. Runoff from Basin N (Q_5=1.8 cfs, Q_{100} =3.6 cfs) sheet flows to the proposed road and is routed via proposed El Paso County Type C curb and gutter to a proposed public 5' Type R on-grade inlet at DP-14. This inlet was sized to capture all flow in the 5 and 100-year events. Once in the inlet, the captured flow is piped to DP-14.1, where it combines with the flow from Basin M.

- If the exclusion can be met, then update the narrative to explain why the basin is excluded from WQ (w/ reference to the pertinent section)

Unresolved. At the end of the paragraph identify that Basin OS-2 meets the criteria to exclude WQCV for up to 20% of the applicable site, not to exceed 1 acre per ECM Appendix I Section I.7.1.C.1.a

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installation of fencing, structures, or storage of materials within the easement. The flow from DP-15 is routed via proposed private storm sewer to DP-15.1, where it combines with the flow from DP-11 (Pond P2).

All flow at DP-15.1 (Q_5=46.4 cfs, Q_{100} =103.9 cfs) is piped via proposed private storm sewer to the outfall on the northeast corner of Bowstring Road and Leggins Way.

Proposed Basin OS-1 is approximately 0.41 acres in area and includes portions of three proposed single family residential lots and proposed open space. Runoff from Basin OS-1 (Q_5=0.8 cfs, Q_{100} =1.9 cfs) sheet flows to the back of the proposed lots and into Pond P1 at DP-16. The flow continues through the pond and combines with the flow from tributary basins at DP-TB.

Proposed Basin OS-2 is approximately 0.79 acres in area and includes proposed open space and proposed roadway. Runoff from Basin OS-2 (Q_5=1.2 cfs, Q_{100} =3.6 cfs) sheet flows to the proposed road and is routed via proposed El Paso County Type C curb and gutter to DP-17, where the flow exits the site at Leggins Way. Due to the low existing grade along Leggins Way, the runoff from Basin OS-2 could not be feasibly routed to a proposed pond.

Proposed Basin OS-3 is approximately 0.31 acres in area and includes proposed open space and existing roadway (Walters Point). Runoff from Basin OS-3 (Q_5=0.6 cfs, Q_{100} =1.6 cfs) sheet flows to the existing road and is routed via existing curb and gutter to DP-18, where the flow exits the site along Walters Point. The runoff from Basin OS-3 is received by the existing 1.83-acre foot detention pond to the southwest in the adjacent Walters Commons development, per the approved *Final Drainage Report for Walters Commons*, dated 2005. Flows tributary to the Walters Commons F1

subdivision from the proposed Cloverleaf development are consistent with the approved *Final Drainage Report for Walters Commons*, dated 2005.

The Walters Commons FDR delineates a basin (OS-9) that discharges to the same point as Basin OS-3 in this report. The runoff from Basin OS-9 (Q_5=2 cfs, Q_{100} =4 cfs) is greater than the runoff expected from the proposed Basin OS-3. Therefore, the existing adjacent Walters Commons development has accounted for the runoff from Basin OS-3 in its existing 1.83-acre foot detention pond and stormwater infrastructure.

Proposed Basin OS-4 is approximately 1.20 acres in area and includes the back portion of four proposed lots, proposed open space, and existing roadway (Walters Point). The back of the proposed lots is assumed to consist mainly of undeveloped and landscaped areas. Runoff from Basin OS-4 (Q_5=2.7 cfs, Q_{100} =6.2 cfs) sheet flows to the proposed roadside swale along Cloverleaf Road and is routed south via the proposed swale to DP-19, where the flow exits the site and enters the existing culvert underneath Walters Point immediately west of Cloverleaf Road. From the existing culvert, the flow continues south along an existing roadside swale along Cloverleaf Road to the existing Type C inlet on the northwest corner of Higby Road and Cloverleaf Road. The flow is then routed via the existing stormwater system to the existing 1.83-acre foot detention pond in the Walters Commons development. The Walters Commons FDR delineates a basin (OS-10) that discharges to the same point as Basin OS-4 in this report. The runoff from Walters Commons F1 FDR Basin OS-10 (Q_5=2 cfs, Q_{100} =5 cfs) is reasonably consistent with the runoff expected from the proposed Basin OS-4. Therefore, the existing adjacent Walters Commons development has accounted for the runoff from Basin OS-4 in its existing 1.83-acre foot detention pond and stormwater infrastructure.

The site is anticipated to send runoff (Q_5=3.3 cfs, Q_{100} =9.5 cfs) to the existing 1.83-acre foot Walters Commons detention pond from Basin OS-3, Basin OS-4, and proposed pond P3. Flows tributary to the Walters Commons F1 subdivision from the proposed Cloverleaf development are consistent with the approved *Final Drainage Report for Walters Commons*, dated 2005. Per the approved Walters Commons FDR, the 1.83-acre foot detention pond was designed to accommodate more flow (Q_5=7 cfs, Q_{100} =17 cfs) than the proposed site is anticipated to send to the pond. See the table below for a comparison in the flows proposed in this report and the flows in the Walters Commons FDR.

Walters Commons 1.83-Acre Foot Detention Pond Flow Comparison								
	Basin OS-3 / OS-9		Basin OS-4 / OS-10		Pond P3 / Basin OS-11		Sum	
	Q5 [cfs]	Q100 [cfs]	Q5 [cfs]	Q100 [cfs]	Q5 [cfs]	Q100 [cfs]	Q5 [cfs]	Q100 [cfs]
This Report	0.6	1.6	2.7	6.2	0.05	1.7	3.3	9.5
Final Drainage Report for Walters Commons	2	4	2	5	3	8	7	17

update sentence to clarify if the detention pond also provided water quality capture volume. If the existing pond was only designed for flood control then permanent BMP for WQCV is required for OS-4

DESIGN POINT SUMMARY TABLE		
DP	Q5	Q100
1	7.9	17.5
2	4.6	11.3
3	4.1	8.4
4	6.3	13.9
4.1	14.2	31.4
4.2	22.2	42.5
4.3	25.7	49.8
5	1.0	2.0
5.1	26.5	51.3
6	3.1	6.4
TB	34.0	85.0
6.1	34.3	85.5
7	2.4	5.1
8	7.4	16.4
8.1	9.3	20.2
8.2	35.3	87.7
9	10.2	21.5
9.1	36.2	89.6
10	3.5	7.2
10.1	36.5	90.3
11	46.0	103.0
12	2.5	6.7
13	1.5	3.1
14	1.8	3.6
14.1	3.2	6.8
15	4.3	9.6
15.1	46.4	103.9
16	0.8	1.9
17	1.2	3.6
18	0.6	1.6
19	2.7	6.2

BASIN SUMMARY TABLE							
Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A	4.39	61%	0.47	0.62	11.9	7.9	17.5
B	3.14	52%	0.37	0.54	11.4	4.6	11.3
C	1.67	72%	0.55	0.67	8.3	4.1	8.4
D	3.46	64%	0.47	0.61	11.8	6.3	13.9
E	0.30	80%	0.65	0.76	5.0	1.0	2.0
F	1.19	71%	0.54	0.66	6.3	3.1	6.4
G	0.90	71%	0.57	0.70	6.5	2.4	5.1
H	4.39	63%	0.46	0.61	13.9	7.4	16.4
I	4.39	69%	0.51	0.64	7.6	10.2	21.5
J	1.39	71%	0.54	0.67	7.1	3.5	7.2
K	5.29	36%	0.28	0.49	15.7	5.2	15.0
L	1.90	41%	0.32	0.52	10.7	2.5	6.7
M	0.54	71%	0.54	0.66	5.0	1.5	3.1
N	0.63	71%	0.55	0.67	5.0	1.8	3.6
O	0.95	47%	0.35	0.53	8.0	1.5	3.7
OS-1	0.41	38%	0.43	0.58	6.9	0.8	1.9
OS-2	0.79	28%	0.30	0.52	5.0	1.2	3.6
OS-3	0.31	37%	0.37	0.57	5.0	0.6	1.6
OS-4	1.20	32%	0.44	0.59	5.0	2.7	6.2

PROPOSED SUB-BASIN DRAINAGE (CUHP/SWMM METHOD)

The areas tributary to proposed ponds P1 and P2 were analyzed for the proposed conditions utilizing CUHP/SWMM. Due to the large tributary areas to the ponds and the ponds being in series (P1 drains to P2) a CUHP/SWMM analysis was required.

Pond P3 and its tributary area (quantified as proposed rational basin L) were not included in the CUHP/SWMM proposed conditions analysis, as the ponds tributary areas is only 1.9 acres and it was analyzed and designed using the rational method and UDFCD's UD-Detention workbook. Flows from pond P3 are limited to historic rates through the full spectrum design outlet structure and outfall

to Walters Commons Filing 1, along with proposed rational basins OS-3 & OS-4. The flows generated from these three basins are consistent with the Walters Commons Filing 1 FDR. See the proposed conditions rational method section above for more detail.

Proposed Pond P4's tributary area was included in proposed SWMM basin S-6 in order to quantify the total flows at the existing 28" by 42" CMP pipe at the intersection of Leggins Way and Bowstring Road. However, Pond P4 is proposed to provide water quality only for its tributary area, and therefore, a controlled release was not modeled in SWMM. Pond P4 was analyzed/designed using the rational method and UDFCD's UD-Detention workbook.

Proposed Basin TX-1 is approximately 108.7 acres and consists of prairie grasses, public streets and single family lots. Flow from this basin (Node 1, Q_5=46.8 cfs, Q_{100} =124.8 cfs) flow through an existing side yard swale and enter proposed volume attenuation Pond P1 at Storage Unit/Node P1 where they combine with flows from proposed basin TX-2.

Proposed Basin TX-2 is approximately 27.2 acres and consists of prairie grasses, public streets and single family lots (2/3 acre+). Flow from this basin (Node 2, Q_5=10.9 cfs, Q_{100} =31.4 cfs) flows through an existing side yard swale and enters the proposed volume attenuation Pond P1 at Storage Unit/Node P1 where they combine with flows from proposed basin TX-1. The total flow tributary to Storage Unit/Node P1 is Q5 = 57.6 cfs, Q100 = 155.8 cfs.

Storage Unit P1 was designed to limit the release rates to Q5 = 34 cfs and Q100 = 85 cfs. Storage Unit P1 will outfall through a 36" RCP pipe (link 1) and is connected to the on-site storm sewer system which collects all onsite flows from basin S-3 and transports them directly to Pond P2, a full spectrum extended detention basin.

Proposed Basin S-3 consists of 30.5 acres of single family residential lots, roadways and walks, and open space. It's area and composite percent imperviousness is consistent with rational basins A-K. Basin S-3 generates runoff rates of Q5 = 40 cfs and Q100 = 79 cfs. Runoff from basin S-3 is collected via the proposed Type C curb and gutter system, and proposed on-site storm sewer system and transported to the proposed full spectrum extended detention basin, Pond P2. See the proposed rational basin descriptions for on-site routing. The total flow tributary to Storage Unit P2 is Q5 = 55 cfs and Q100 = 122 cfs.

Pond/Storage Unit P2 will release through a full-spectrum outlet structure into a 42" RCP outfall pipe (link 2, Q5 = 46 cfs, Q100 = 103 cfs). The proposed outfall pipe will transport flow to the existing roadside swale on the northeast corner of Leggins Way and Bowstring Road where flows will combine with proposed Basin S-6 runoff.

Proposed Basin S-6 is approximately 49.1 acres and consists of prairie grasses, Leggins Way, portions of 10 proposed residential lots (9 lots are approximately 6000 s.f. each and one is 21,780

s.f.) and existing single family lots (2/3 acre+). Lot 148 will have a sand filter sized to provide water quality for the entire lot area. Flow from this basin (Q_5 = 23.9 cfs, Q_{100} = 69.7 cfs) sheet flows to the roadside swales along Bowstring Road at DP-6 and continue in the roadside swale to the southeast until they reach the Ex. 28" x 42" CMP culvert at outfall 10 where flows combine with the controlled release of Pond/Storage Unit P2, and the existing Walters Commons Flows (Q5 = 12 cfs, Q100 = 26cfs) for a total flow of Q5 = 82.1 cfs, Q100 = 202.0 cfs.

As part of determining whether the proposed outfall are suitable locations, update the narrative to analyze/describe whether or not the stormwater outfall to the existing man-made structures are hydraulically adequate.

Unresolved. Expand on the narrative. Identify the resulting depth of the 5yr and 100yr overtopping and whether or not it meets the allowable cross flow criteria per EPC DCM Table 6-1.

If the culvert does not meet criteria upgrade the culvert or submit a deviation request from ECM Section 3.2.4 for the ECM Administrators consideration.

Proposed Basin S-7 consists of undeveloped land covered in native grasses, Caribou Drive West, two proposed single family residential lots totaling 1.01 acres, and existing single family lots (2/3 acre+). Flow from this basin (Q_5=12.6 cfs, Q_{100}=34.2 cfs) sheet flows to the roadside swale along Bowstring Road at DP-7. The roadside swale routes the flow to an existing 24" CMP culvert under Bowstring Road at DP-12. The two proposed single family residential lots 149 and 150 will each have a sand filter sized to provide water quality for their entire lot areas.

Due to the large offsite developed areas that currently have no detention facilities that are tributary to the proposed full-spectrum extended detention basin Pond P2, it was not feasible to limit the pond's release rate to the historic flows for the entire basin. Therefore, the design goals for the site were to provide water quality for all new development part of this project, to provide detention for all new developed areas part of the project, and to provide as much additional detention for the offsite areas as practical to limit the flows downstream of the project site to as close to historic levels as possible. Flows from the three CUHP/SWMM models were compared at different design points. The first comparison shown below is for the areas tributary to the proposed full-spectrum extended detention basin Pond P2. This tributary area includes Basin H-1 in the historic conditions model, Basins TX-1, TX-2, and SX-3 in the existing conditions model, and Basins TX-1, TX-2, and S-3 in the proposed conditions model.

The next flow comparison shown compares the existing present day conditions to the proposed conditions for the flow tributary to the existing 18 inch CMP pipe at the intersection of Leggins Way and Bowstring Road. The proposed swale at the back of lots 1-72 captures flows on-site and limits flows tributary to the neighboring Walters Commons development as shown in the table below.

The third flow comparison is for the flow tributary to the existing 28" by 42" CMP pipe located at the intersection of Leggins Way and Bowstring Road. This pipe contains all flows from Ponds P2 and P4, including the offsite tributary areas described above, and proposed basin S-6's flows. Refer to the appendix for a HY-8 analysis of this culvert. The results indicate that, despite the decrease in flow from existing to proposed, Bowstring Road will be overtopped in the 5 and 100-year storms. Proposed basin S-6 includes a single 0.5 acre lot that will be developed for a single family residence. As shown in the table below, the proposed detention facilities limit the proposed release rates to below existing conditions, and thus provide detention for all proposed development, and some additional detention for the existing offsite developed tributary areas.

The next flow comparison provided in the table below is to show the effects of the two proposed 0.5 acre lots proposed to be developed part of proposed basin S-7 and existing basin SX-7 at outfall 12.

Pond 3 outfalls to Walters Commons F1 at or below historic rates as shown in the table below.

The last row in the table compares the existing and proposed conditions flows tributary to the existing 1.83 ac-ft detention pond part of the Walter Commons F1 development. The existing flows shown are per the Walters Commons F1 FDR and are further explained in the proposed rational method section above. The proposed flows are per the proposed rational analysis and the proposed Pond 3 release rates.

CUHP OUTFALL/DESIGN POINT COMPARISON TABLE						
Outfall/Design Point	Historic		Existing		Proposed	
	Q5 (cfs)	Q100 (cfs)	Q5 (cfs)	Q100 (cfs)	Q5 (cfs)	Q100 (cfs)
01, 9, P2_OUT	33	125	67	188	46	103
EX18CMP	n/a	n/a	14	32	12	26
EX28X42			102	282	71	165
12			12	34	13	34
Pond 3*	0	1.9	N/A	N/A	0	1.8
Areas tributary to Walters Commons F1 1.83-ac-ft pond	N/A	N/A	7	17	3.3	9.5
* Flows per UD-Detention Basin and Outlet Worksheets, see Appendix D						
From rational calculations, prior reports, and UD-Detention worksheets						

DRAINAGE DESIGN CRITERIA

DEVELOPMENT CRITERIA REFERENCE

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

HYDROLOGIC CRITERIA

All hydrologic data was obtained from the "*El Paso Drainage Criteria Manual*" Volumes 1 and 2, and the "*Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual*"

Volumes 1, 2, and 3. Onsite drainage improvements were designed based on the 5 year (minor) storm event and the 100-year (major) storm event. Existing Basin Runoff (offsite and on-site) were calculated with Colorado Urban Hydrograph Program (CUHP) due to basin size and Stormwater Management Model (SWMM) was used routing the flows through the offsite pond and the larger on-site pond. On-site developed condition runoff was calculated using the Rational Method, and rainfall intensities for the 5-year and the 100-year storm return frequencies were obtained from Table 6-2 of the CSDCM. One hour point rainfall data for the storm events is identified in the chart below. Runoff coefficients were determined based on proposed land use and from data in Table 6-6 from the CSDCM. Time of concentrations were developed using equations from CSDCM. All runoff calculations and applicable charts and graphs are included in the Appendices.

Table 2 - 1-hr Point Rainfall Data

Storm	Rainfall (in.)
5-year	1.50
100-year	2.52

HYDRAULIC CRITERIA

The Rational Method and USDCM's SF-2 and SF-3 forms were used to determine the runoff from the minor and major storms on the site, and the UDFCD UD-Detention v3.07 spreadsheet was utilized for evaluating proposed detention and water quality Pond P3 (Full spectrum extended detention basin). UDFCD-Detention v3.07 was used to calculate the required WQCV and EURV for on-site Pond P2 (Full spectrum extended detention basin), however the pond was modeled utilizing EPA SWMM 5.1. Sump and on-grade inlets were sized using UDFCD UD-Inlet v2.07. Manning's equation was used to size the proposed pipes in this report and StormCAD will be used to model the proposed storm sewer system and to analyze the proposed HGL calculations for Construction Drawings. StormCAD and other hydraulic analyses will be provided with the final drainage report.

DRAINAGE FACILITY DESIGN

FOUR STEP PROCESS TO MINIMIZE ADVERSE IMPACTS OF URBANIZATION

In accordance with the El Paso County Drainage Criteria Manual Volume 2, this site has implemented the four step process to minimize adverse impacts of urbanization. The four step process includes reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainage ways, and implementing long-term source controls.

Step 1 – Reducing Runoff Volumes: The Cloverleaf Subdivision development project consists of 150 single family lots with open spaces and lawn areas interspersed within the development which helps disconnect impervious areas and reduce runoff volumes. Roof drains from the structures will discharge to lawn areas, where feasible, to allow for infiltration and runoff volume reduction. The

site also uses grass lined swales to transport runoff to the proposed storm sewer system and detention ponds which allows for additional infiltration and runoff reduction above pipe conveyance systems.

Step 2 – Stabilize Drainageways: The site lies within the Teachout Creek Drainage Basin. Basin and bridge fees will be paid at time of platting. These funds will be used on future projects within the basin to stabilize drainageways. The site does not discharge directly into the open drainageway of Teachout Creek, therefore no downstream stabilization will be accomplished with this project.

Step 3 – Treat the WQCV: Water Quality treatment for this site is provided in two proposed full spectrum extended detention basins: Pond P2 and Pond P3, proposed water-quality pond P4, and three sand filters located on lots 148-150 (owned and maintained by the property owners). The runoff from this site will be collected within inlets and conveyed to the proposed ponds via storm sewer. Upon entrance to the ponds, flows will be captured in a forebay designed to promote settlement of suspended solids. A trickle channel is also incorporated into the ponds to minimize the amount of standing water. The outlet structure has been designed to detain the water quality capture volume (WQCV) for 40 hours, and the extended urban runoff volume (EURV) for 72 hours.

Step 4 – Consider Need for Industrial and Commercial BMPs: BMPs will be utilized to minimize off-site contaminants and to protect the downstream receiving waters. Site specific temporary source control BMPs that will be implemented include, but are not limited to, silt fencing placed around downstream areas of disturbance, construction vehicle tracking pads at the entrances, designated concrete truck washout basin, designated vehicle fueling areas, covered storage areas, spill containment and control, etc. The permanent erosion control BMPs include asphalt streets, storm inlets and storm pipe, two full spectrum water quality and detention ponds, and permanent vegetation.

WATER QUALITY/DETENTION

The site is split by a natural ridge, therefore; a full spectrum water quality and detention pond is provided on both sides. Basins A through K, located north of the natural ridge, will discharge to the pond at DP-11 (Pond P2). Basins M, N, and O, also located north of the natural ridge, will discharge to the pond at DP-15 (Pond P4). Basin L, south of the natural ridge, will discharge to the pond at DP-12 (Pond P3). Both ponds have been designed per Section 13.3.2.1 of Resolution 15-042 of the El Paso County Drainage Criteria Manual.

As previously discussed, two large off-site basins (TX-1 and TX-2) are tributary to the site and currently have no engineered detention or water quality features. Due to space constraints on-site, detention for the off-site basins TX-1 and TX-2 was not feasible on-site. Therefore, a volume attenuation pond, Pond P1, is proposed upstream of the site along the site's northeastern border to reduce the peak flows tributary to the site. Pond P1 is intended to provide volume attenuation only,

and is connected to proposed on-site Pond P2 (ponds in series). Both ponds were modeled using SWMM version 5.1.

As shown in the attached CUHP/SWMM models(existing & proposed), basins TX-1 and TX-2 produce a total tributary flow to proposed Pond/node P1 of Q5 = 58 cfs, & Q100 = 156 cfs. The proposed peak outflow of Pond P1 (link 1), is Q5 = 34 cfs & Q100 = 85 cfs and is piped directly to Pond P2 via proposed 36 inch reinforced concrete pipe (RCP).

Pond P2 receives flows from the controlled release of Pond P1, via the storm sewer system described above, and from on-site tributary basins (rational basins A-K, and CUHP/SWMM basin S-3/Node 3). Basin S3/Node 3 produces a peak flow of Q5 = 40 cfs, & Q100 = 79 cfs which combines with the controlled release from Pond P1 for a total peak flow into Pond P2 of Q5 = 55 cfs, and Q100 = 122 cfs. The proposed full-spectrum outlet structure will limit Pond P2's release to a maximum of Q5 = 46 cfs, and Q100 = 103 cfs.

For comparison purposes, a Historic CUHP/SWMM model was created to quantify the pre-development flows from the entire area tributary to Pond P2. Basin H1 in the Historic Model encompasses 163.4 acres, in roughly the same area as basins TX-1, TX-2, and S-3/SX-3. This model assumed all area to be undeveloped open space with a composite percent impervious value of 2%. Basin H1 produced peak flows of Q5 = 33 cfs, and Q100 = 125 cfs. As shown above, Pond P2's maximum release rate is approximately equal to the historic peak flow for the 100 year storm, and slightly more than the historic peak flow for the 5 year storm. A flow comparison table is provided below, and more fully discussed in the "Proposed Sub-Basin Drainage (CUHP/SWMM)" section above.

CUHP OUTFALL/DESIGN POINT COMPARISON TABLE

Outfall/Design Point	Historic		Existing		Proposed	
	Q5 (cfs)	Q100 (cfs)	Q5 (cfs)	Q100 (cfs)	Q5 (cfs)	Q100 (cfs)
01, 9, P2_OUT	33	125	67	188	46	103
EX18CMP	n/a	n/a	14	32	12	26
EX28X42			102	282	71	165
12			12	34	13	34
Pond 3*	0	1.9	N/A	N/A	0	1.8
Areas tributary to Walters Commons F1 1.83-ac-ft pond	N/A	N/A	7	17	3.3	9.5

* Flows per UD-Detention Basin and Outlet Worksheets, see Appendix D

From rational calculations, prior reports, and UD-Detention worksheets

Pond P2's required WQCV and EURV was calculated using UDFCD UD-Detention workbook for the on-site tributary basins A-K, totaling 30.5 acres.

- Required WQCV: 0.594 ac-ft
- Required EURV: 1.279 ac-ft

The pond was designed for a 40-hour WQCV drain time and a 72-hour EURV drain time (see appendix D for supporting calculations). As described above, Pond P2 was also sized to provide detention for both the on-site and off-site tributary areas and has a total volume of 3.5 ac-ft. The pond totally drains in less than 96 hours.

Both Ponds P1 and P2 will include an emergency overflow spillway sized for the undetained peak 100 year flow rate tributary to each pond. Both spillways will consist of buried soil riprap w/ a grade control concrete weir installed in the crest of the spillway. Both spillways will provide a minimum of one foot of freeboard from the design water surface elevation to the top of embankment.

Pond P1's emergency overflow spillway will be centered on the open space tract between lots 107 and 108 where a trapezoidal channel will be graded in to direct flows westward into the proposed street. Flows will then follow the overflow routing described in the rational basins G and J description above.

Pond P2's spillway will direct water from the southwestern corner of the pond where the outlet structure is proposed to the adjacent proposed street to the south. Flows will then travel down the proposed street to the west to the existing Leggins Way, and ultimately to the existing 28"x42" CMP beneath Bowstring Road.

Pond P3 receives flows from proposed Basin L. The proposed full-spectrum outlet structure will limit Pond P3's release rate to below predevelopment peaks. The Pond P3 design includes a forebay, trickle channel, and a full spectrum detention outlet structure.

Pond P3's required WQCV and EURV was calculated using UDFCD UD-Detention workbook for the on-site tributary Basin L, totaling 1.9 acres.

- Required WQCV: 0.029 ac-ft
- Required EURV: 0.054 ac-ft

The pond was designed for a 40-hour WQCV drain time and a 68-hour EURV drain time (see appendix D for supporting calculations). Pond P3 was also sized to provide detention for the 100-yr storm and below and has a total volume of 0.312 ac-ft. The pond totally drains in 120 hours.

During preliminary design of Pond P3, the area provided for the pond and the topography made it difficult to attain required pond volume per the UD-Detention spreadsheet. Additional retaining wall

heights and slopes up to 3:1 are required to attain required volume. Details in the pond design will be finalized in the construction document process.

Pond P3 will include an emergency overflow spillway sized for the undetained peak 100 year flow rate tributary to the pond. The spillway will consist of buried soil riprap. The spillway will provide a minimum of one foot of freeboard from the design water surface elevation to the top of embankment.

The overflow path for the stormwater that crests the spillway extends from the Pond P3 spillway southeast to the existing roadside swale along the west side of Cloverleaf Road. The flow will then enter the existing Type C inlet at the northwest corner of Cloverleaf Road and Higby Road.

Pond P4 receives flows from proposed Basins M, N, and O. The proposed outlet structure will limit Pond P4's water quality capture volume to release in 40 hours. The Pond P4 design includes a forebay, trickle channel, and an outlet structure.

Pond P4's required WQCV was calculated using UDFCD UD-Detention workbook for the on-site tributary Basins M, N, and O, totaling 2.1 acres.

- Required WQCV: 0.042 ac-ft

The pond was designed for a 40-hour WQCV drain time (see appendix D for supporting calculations.

The Pond P4 emergency spillway will be routed to the existing swale in Walters Commons Filing 1 to the southwest of the pond's outlet structure, consistent with existing drainage patterns. The flow will travel to the existing roadside ditch along Bowstring Road, which will route the flow northwest to the existing 18" RCP culvert under Leggins Way. The proposed spillway outfall point onto Walters Commons Filing 1 is consistent with the Basin OS-4 discharge included in the approved *Final Drainage Report for Walters Commons.* The proposed peak 100-year spillway discharge from Pond P4 (7.5 cfs) is less than the anticipated flow from the aforementioned Basin OS-4 (per Walters Commons FDR) (9 cfs).

Three isolated lots are included as part of this project. Refer to the appendix for the vicinity map showing the location of these lots (148-150). Each isolated lot will be graded to direct runoff to a proposed sand filter. The proposed sand filters will provide water quality for the lot in which they lie. The sand filters have been sized for the total lot areas.

EROSION CONTROL PLAN

We respectfully request that the Erosion Control Plan and Cost Estimate be submitted in conjunction with the grading and erosion control plan and construction assurances posted prior to obtaining a grading permit. The PUDSP plan set includes a preliminary grading plan.

OPERATION & MAINTENANCE

In order to ensure the function and effectiveness of the stormwater infrastructure, maintenance activities such as inspection, routine maintenance, restorative maintenance, rehabilitation and repair, are required. The property owner shall be responsible for the inspection, maintenance, rehabilitation and repair of stormwater and erosion control facilities located on the property unless another party accepts such responsibility in writing and responsibility is properly assigned through legal documentation. Access is provided from onsite facilities and easements for proposed infrastructure located offsite. Access to Pond P3 is provided through the existing access easements centered around Walters Point.

DRAINAGE AND BRIDGE FEES

The site lies within the Teachout Creek Drainage Basin. Anticipated drainage and bridge fees are presented below and will be paid at time of platting (depending on date of plat submittal):

2020 DRAINAGE AND BRIDGE FEES – CLOVERLEAF SUBDIVISION				
Impervious Acres (ac)	Drainage Fee (Per Imp. Acre)	Bridge Fee (Per Imp. Acre)	Cloverleaf Drainage Fee	Cloverleaf Bridge Fee
22.02	$5,245	$788	$115,495	$17,352

SUMMARY

The proposed Cloverleaf Subdivision development drainage improvements, including storm sewer and two full spectrum water quality and detention ponds were designed to meet or exceed the El Paso County Drainage Criteria. The proposed development will not adversely affect the offsite drainageways or surrounding development. This report is in conformance and meets the latest El Paso County Storm Drainage Criteria requirements for this site.

REFERENCES

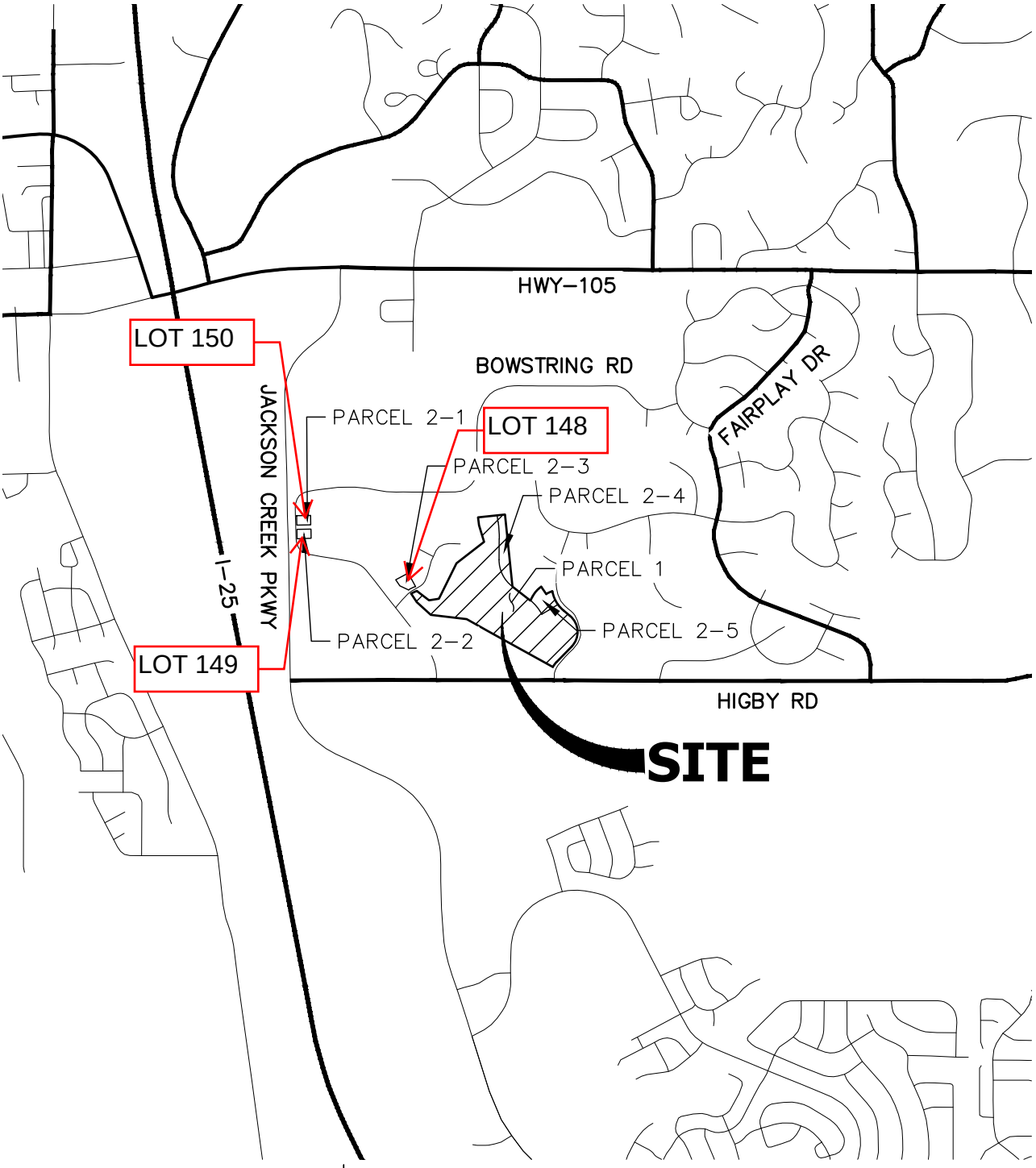
1. El Paso County Drainage Criteria Manual Volume 1, El Paso County, CO, 1994.

2. Urban Storm Drainage Criteria Manual (Volumes 1, 2, and 3), Urban Drainage and Flood Control District, June 2001.

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

4. Walters Commons Final Drainage Report, prepared by JR Engineering, 2005.

Appendix A
Vicinity Map, Soil Descriptions, FEMA Floodplain Map



2000 1000 0 2000

ORIGINAL SCALE: 1" = 2000'

VICINITY MAP
CLOVERLEAF
JOB NO. 25158.01
04/23/2020
SHEET 1 OF 1

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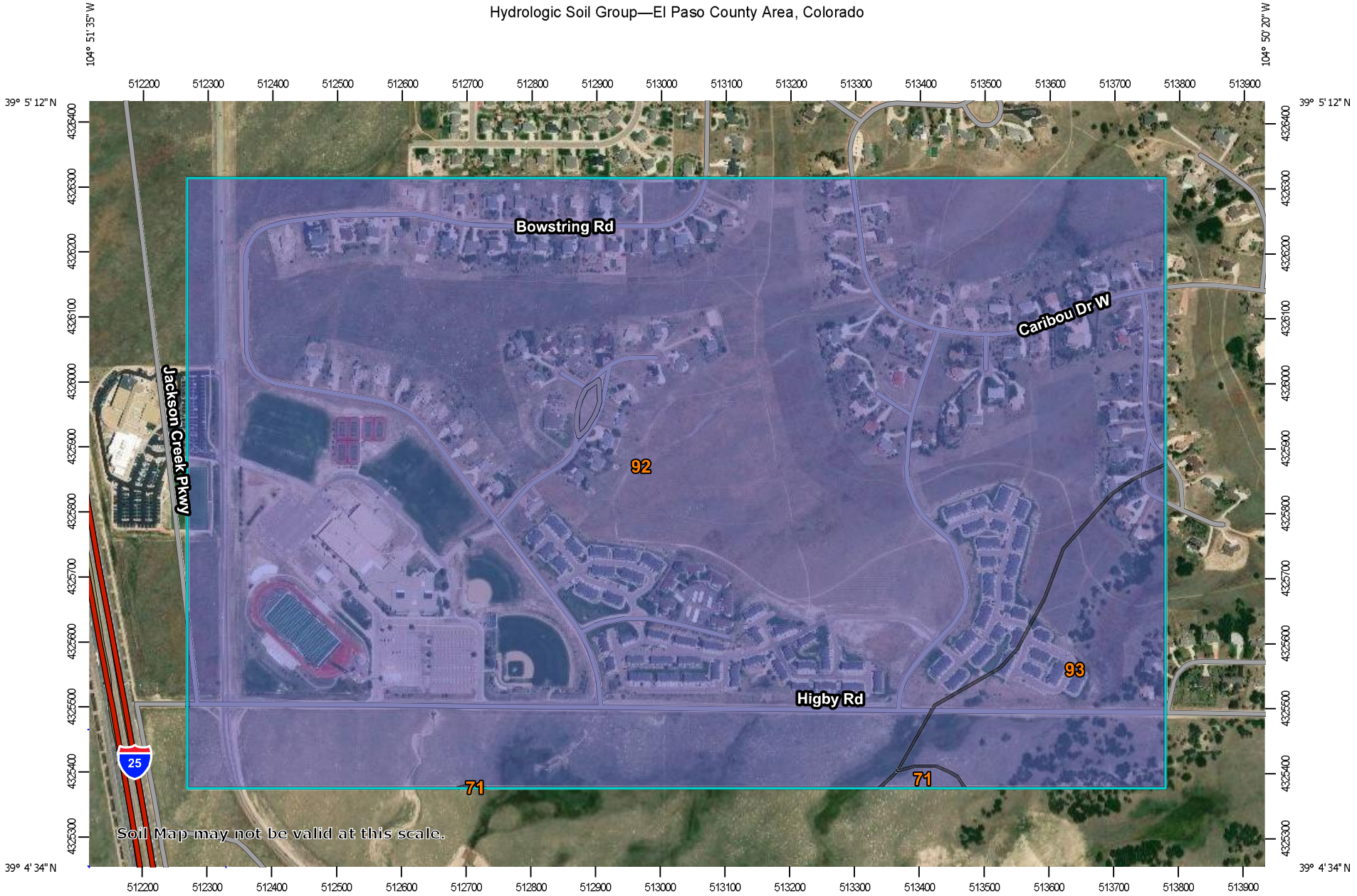
Fort Collins 970–491–9888 • www.jrengineering.com



Map Scale: 1:8,300 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 400 800 1600 2400

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 16, Sep 10, 2018

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

Date(s) aerial images were photographed: Jul 4, 2010—Oct 16, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	0.8	0.2%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	B	323.0	91.8%
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	B	28.1	8.0%
Totals for Area of Interest			**352.0**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

National Flood Hazard Layer FIRMette

FEMA

Legend

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

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

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

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

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

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

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

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 4/4/2020 at 4:42:39 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

Appendix B
Hydrologic Calculations (Rational)

COMPOSITE % IMPERVIOUS & COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Cloverleaf Subdivision
Location: Colorado Springs

Project Name: Cloverleaf Subdivision - Proposed
Project No.: 2000-5158.01
Calculated By: RPD
Checked By:
Date: 9/8/20

Basin ID	Total Area (ac)	Paved Streets (100% Imp.)				Residential (6k SF min) (62% Imp.)				Parks (7% Imp.)				Basins Total Weighted C Values		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
A	4.39	0.90	0.96	0.69	15.8%	0.43	0.58	3.13	44%	0.12	0.39	0.57	0.9%	0.47	0.62	61.2%
B	3.14	0.90	0.96	0.00	0.0%	0.43	0.58	2.54	51%	0.12	0.39	0.60	1.3%	0.37	0.54	51.9%
C	1.67	0.90	0.96	0.41	24.7%	0.43	0.58	1.26	47%	0.12	0.39	0.00	0.0%	0.55	0.67	71.7%
D	3.46	0.90	0.96	0.39	11.4%	0.43	0.58	2.90	52%	0.12	0.39	0.17	0.3%	0.47	0.61	64.0%
E	0.30	0.90	0.96	0.14	46.5%	0.43	0.58	0.16	33%	0.12	0.39	0.00	0.0%	0.65	0.76	79.9%
F	1.19	0.90	0.96	0.26	21.8%	0.43	0.58	0.93	49%	0.12	0.39	0.00	0.0%	0.54	0.66	70.6%
G	0.90	0.90	0.96	0.31	35.2%	0.43	0.58	0.51	36%	0.12	0.39	0.07	0.6%	0.57	0.70	71.3%
H	4.39	0.90	0.96	0.49	11.1%	0.43	0.58	3.60	51%	0.12	0.39	0.30	0.5%	0.46	0.61	62.8%
I	4.39	0.90	0.96	0.71	16.2%	0.43	0.58	3.68	52%	0.12	0.39	0.00	0.0%	0.51	0.64	68.5%
J	1.39	0.90	0.96	0.33	23.5%	0.43	0.58	1.07	48%	0.12	0.39	0.00	0.0%	0.54	0.67	71.3%
K	5.29	0.90	0.96	0.00	0.0%	0.43	0.58	2.75	32%	0.12	0.39	2.54	3.4%	0.28	0.49	35.8%
Pond 2 Subtotal	30.5															59.3%
L	1.90	0.90	0.96	0.07	3.9%	0.43	0.58	1.05	35%	0.12	0.39	0.77	2.8%	0.32	0.52	41.4%
Pond 3 Subtotal	1.90															41.4%
M	0.54	0.90	0.96	0.12	21.8%	0.43	0.58	0.42	49%	0.12	0.39	0.00	0.0%	0.54	0.66	70.6%
N	0.63	0.90	0.96	0.15	23.9%	0.43	0.58	0.48	48%	0.12	0.39	0.00	0.0%	0.55	0.67	71.4%
O	0.95	0.90	0.96	0.00	0.0%	0.43	0.58	0.69	45%	0.12	0.39	0.26	1.9%	0.35	0.53	47.2%
Pond 4 Subtotal	2.12															60.3%
OS-1	0.41	0.90	0.96	0.00	0.0%	0.43	0.58	0.41	38%	0.12	0.39	0.00	0.0%	0.43	0.58	37.5%
OS-2	0.79	0.90	0.96	0.18	22.5%	0.43	0.58	0.00	0%	0.12	0.39	0.61	5.4%	0.30	0.52	28.0%
OS-3	0.31	0.90	0.96	0.10	32.1%	0.43	0.58	0.00	0%	0.12	0.39	0.21	4.8%	0.37	0.57	36.8%
OS-4	1.20	0.90	0.96	0.08	6.3%	0.43	0.58	1.05	25%	0.12	0.39	0.07	0.4%	0.44	0.59	32.1%
TOTAL	37.2															56.5%

STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Cloverleaf Subdivision
Location: Colorado Springs

Project Name: Cloverleaf Subdivision - Proposed
Project No.: 2000-5158.01
Calculated By: RPD
Checked By:
Date: 9/8/20

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	K	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
A	4.4	B	61%	0.47	0.62	100	2.4%	8.6	720	3.2%	20.0	3.6	3.4	11.9	820.0	19.4	11.9
B	3.1	B	52%	0.37	0.54	100	8.6%	6.4	830	3.5%	15.0	2.8	4.9	11.4	930.0	21.7	11.4
C	1.7	B	72%	0.55	0.67	50	5.9%	3.9	980	3.4%	20.0	3.7	4.4	8.3	1030.0	18.5	8.3
D	3.5	B	64%	0.47	0.61	100	3.4%	7.6	860	2.9%	20.0	3.4	4.2	11.8	960.0	19.8	11.8
E	0.3	B	80%	0.65	0.76	30	1.6%	3.8	300	4.4%	20.0	4.2	1.2	5.0	330.0	13.6	5.0
F	1.2	B	71%	0.54	0.66	60	7.2%	4.1	460	3.1%	20.0	3.5	2.2	6.3	520.0	16.3	6.3
G	0.9	B	71%	0.57	0.70	60	9.9%	3.5	530	2.1%	20.0	2.9	3.0	6.5	590.0	17.1	6.5
H	4.4	B	63%	0.46	0.61	100	2.7%	8.3	770	1.3%	20.0	2.3	5.6	13.9	870.0	21.7	13.9
I	4.4	B	69%	0.51	0.64	0	1.0%	0.0	1400	2.4%	20.0	3.1	7.6	7.6	1400.0	22.5	7.6
J	1.4	B	71%	0.54	0.67	70	3.6%	5.5	405	4.3%	20.0	4.2	1.6	7.1	475.0	15.6	7.1
K	5.3	B	36%	0.28	0.49	100	6.6%	7.9	1255	3.2%	15.0	2.7	7.8	15.7	1355.0	28.3	15.7
L	1.9	B	41%	0.32	0.52	100	7.1%	7.3	560	3.4%	15.0	2.8	3.4	10.7	660.0	22.4	10.7
M	0.5	B	71%	0.54	0.66	60	6.9%	4.2	250	5.6%	20.0	4.7	0.9	5.0	310.0	14.9	5.0
N	0.6	B	71%	0.55	0.67	60	6.9%	4.1	250	5.6%	20.0	4.7	0.9	5.0	310.0	14.8	5.0
O	1.0	B	47%	0.35	0.53	97	15.0%	5.5	470	4.3%	15.0	3.1	2.5	8.0	567.0	20.4	8.0
OS-1	0.4	B	38%	0.43	0.58	100	5.4%	6.9	0	1.0%	20.0	2.0	0.0	6.9	100.0	19.6	6.9
OS-2	0.8	B	28%	0.30	0.52	0	0.0%	0.0	205	4.7%	20.0	4.3	0.8	0.8	205.0	22.5	5.0
OS-3	0.3	B	37%	0.37	0.57	48	9.1%	4.4	134	8.0%	20.0	5.7	0.4	4.8	182.0	20.3	5.0
OS-4	1.2	B	32%	0.44	0.59	71	11.8%	4.4	215	8.9%	21.0	6.3	0.6	5.0	286.0	21.4	5.0

NOTES:

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

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

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

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
K = travel time velocity (ft/sec) = $K\sqrt{S}$

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

Where:

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

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

Where:

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
L_t = length of channelized flow path (ft)

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Cloverleaf Subdivision
Location: Colorado Springs
Design Storm: 5-Year

Project Name: Cloverleaf Subdivision - Proposed
Project No.: 2000-5158.01
Calculated By: RPD
Checked By:
Date: 9/8/20

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	1	A	4.39	0.47	11.9	2.05	3.87	7.9															Runoff from Basin A, collected by public 15' Type R on-grade inlet @ DP-1, piped to DP-4.1.
	2	B	3.14	0.37	11.4	1.18	3.94	4.6															Runoff from Basin B, collected by private Type C inlet @ DP-2, piped to DP-4.2.
	3	C	1.67	0.55	8.3	0.92	4.40	4.1															Runoff from Basin C, collected by public 10' Type R on-grade inlet @ DP-3, piped to DP-4.3.
	4	D	3.46	0.47	11.8	1.63	3.88	6.3															Runoff from Basin D, collected by public 15' Type R on-grade inlet @ DP-4, piped to DP-4.1.
	4.1								11.9	3.68	3.87	14.2											Combined flow in storm pipe @ DP-4.1, piped to DP-4.2.
	4.2								11.9	5.73	3.87	22.2											Combined flow in storm pipe @ DP-4.2, piped to DP-4.3.
	4.3								11.9	6.65	3.87	25.7											Combined flow in storm pipe @ DP-4.3, piped to DP-5.1.
	5	E	0.30	0.65	5.0	0.19	5.17	1.0															Runoff from Basin E, collected by public 5' Type R on-grade inlet @ DP-5, piped to DP-5.1.
	5.1								11.9	6.84	3.87	26.5											Combined flow in storm pipe @ DP-5.1, piped to private FSD EDB P2 @ DP-11.
	6	F	1.19	0.54	6.3	0.64	4.82	3.1															Runoff from Basin F, collected by public 5' Type R on-grade inlet @ DP-6, piped to DP-6.1.
	TB				120.0	84.63	0.40	34.0															Flow from tributary basins, routed through offsite detention pond, piped to DP-6.1.
	6.1								120.0	85.27	0.40	34.3											Combined flow (including off-site flow) in storm pipe @ DP-6.1, piped to DP-8.2.
	7	G	0.90	0.57	6.5	0.51	4.77	2.4															Runoff from Basin G, collected by public 5' Type R sump inlet @ DP-7, piped to DP-8.1.
	8	H	4.39	0.46	13.9	2.04	3.64	7.4															Runoff from Basin H, collected by public 15' Type R sump inlet @ DP-8, piped to DP-8.1.
	8.1								13.9	2.55	3.64	9.3											Combined flow in storm pipe @ DP-8.1, piped to DP-8.2.
	8.2								120.0	87.82	0.40	35.3											Combined flow in storm pipe @ DP-8.2, piped to DP-9.1.
	9	I	4.39	0.51	7.6	2.24	4.54	10.2															Runoff from Basin I, collected by public 15' Type R sump inlet @ DP-9, piped to DP-9.1.
	9.1								120.0	90.06	0.40	36.2											Combined flow in storm pipe @ DP-9.1, piped to DP-10.1.
	10	J	1.39	0.54	7.1	0.76	4.63	3.5															Runoff from Basin J, collected by public 5' Type R sump inlet @ DP-10, piped to DP-10.1.
	10.1								120.0	90.82	0.40	36.5											Combined flow in storm pipe @ DP-10.1, piped to private FSD EDB P2 @ DP-11.
	11	K	5.29	0.28	15.7	1.50	3.45	5.2	120.0	114.50	0.40	46.0											Runoff from Basin K, routed via swale into private FSD EDB P2 @ DP-11. Combines with flow from DP-10.1 and DP-5.1. Piped to DP-15.1.
	12	L	1.90	0.32	10.7	0.62	4.03	2.5															Runoff from Basin L, routed via swale to private FSD EDB P3 @ DP-12.
	13	M	0.54	0.54	5.0	0.29	5.15	1.5															Runoff from Basin M, collected by public 5' Type R on-grade inlet @ DP-13, piped to DP-14.1.
	14	N	0.63	0.55	5.0	0.34	5.17	1.8															Runoff from Basin N, collected by public 5' Type R on-grade inlet @ DP-14, piped to DP-14.1.
	14.1								5.0	0.63	5.15	3.2											Combined flow in storm pipe @ DP-14.1, piped to private WQ Pond P4 @ DP-15.
	15	O	0.95	0.35	8.0	0.33	4.46	1.5	8.0	0.96	4.46	4.3											Runoff from Basin O, routed via swale to private WQ Pond P4 @ DP-15. Combines with flow from DP-14.1.
	15.1								120.0	115.46	0.40	46.4											Combined flow in storm pipe @ 15.1, piped to outfall.
	16	OS-1	0.41	0.43	6.9	0.18	4.69	0.8															Runoff from Basin OS-1, sheet flows offsite into private basin P1 @ DP-16.
	17	OS-2	0.79	0.30	5.0	0.23	5.17	1.2															Runoff from Basin OS-2, sheet flows offsite @ DP-17.
	18	OS-3	0.31	0.37	5.0	0.11	5.17	0.6															Runoff from Basin OS-3, sheet flows offsite @ DP-18.
	19	OS-4	1.20	0.44	5.0	0.53	5.17	2.7															Runoff from Basin OS-4, sheet flows offsite @ DP-19.

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: af Subdivision
Location: ado Springs
Design Storm: 100-Year

Project Name: Cloverleaf Subdivision - Proposed
Project No.: 2000-5158.01
Calculated By: RPD
Checked By:
Date: 9/8/20

		DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			
	Design Point	Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q_{street} (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	REMARKS
	1	A	4.39	0.62	11.9	2.70	6.49	17.5															Runoff from Basin A, collected by public 15' Type R on-grade inlet @ DP-1, piped to DP-4.1.
	2	B	3.14	0.54	11.4	1.71	6.61	11.3															Runoff from Basin B, collected by private Type C inlet @ DP-2, piped to DP-4.2.
	3	C	1.67	0.67	8.3	1.13	7.39	8.4															Runoff from Basin C, collected by public 10' Type R on-grade inlet @ DP-3, piped to DP-4.3.
	4	D	3.46	0.61	11.8	2.13	6.52	13.9															Runoff from Basin D, collected by public 15' Type R on-grade inlet @ DP-4, piped to DP-4.1.
	4.1								11.9	4.83	6.49	31.4											Combined flow in storm pipe @ DP-4.1, piped to DP-4.2.
	4.2								11.9	6.54	6.49	42.5											Combined flow in storm pipe @ DP-4.2, piped to DP-4.3.
	4.3								11.9	7.67	6.49	49.8											Combined flow in storm pipe @ DP-4.3, piped to DP-5.1.
	5	E	0.30	0.76	5.0	0.23	8.68	2.0															Runoff from Basin E, collected by public 5' Type R on-grade inlet @ DP-5, piped to DP-5.1.
	5.1								11.9	7.90	6.49	51.3											Combined flow in storm pipe @ DP-5.1, piped to private FSD EDB P2 @ DP-11.
	6	F	1.19	0.66	6.3	0.79	8.10	6.4															Runoff from Basin F, collected by public 5' Type R on-grade inlet @ DP-6, piped to DP-6.1.
	TB				120.0	126.77	0.67	85.0															Flow from tributary basins, routed through offsite detention pond, piped to DP-6.1.
	6.1								120.0	127.56	0.67	85.5											Combined flow (including off-site flow) in storm pipe @ DP-6.1, piped to DP-8.2.
	7	G	0.90	0.70	6.50	0.63	8.02	5.1															Runoff from Basin G, collected by public 5' Type R sump inlet @ DP-7, piped to DP-8.1.
	8	H	4.39	0.61	13.89	2.68	6.10	16.4															Runoff from Basin H, collected by public 15' Type R sump inlet @ DP-8, piped to DP-8.1.
	8.1								13.9	3.31	6.10	20.2											Combined flow in storm pipe @ DP-8.1, piped to DP-8.2.
	8.2								120.0	130.87	0.67	87.7											Combined flow in storm pipe @ DP-8.2, piped to DP-9.1.
	9	I	4.39	0.64	7.6	2.82	7.63	21.5															Runoff from Basin I, collected by public 15' Type R sump inlet @ DP-9, piped to DP-9.1.
	9.1								120.0	133.69	0.67	89.6											Combined flow in storm pipe @ DP-9.1, piped to DP-10.1.
	10	J	1.39	0.67	7.1	0.93	7.78	7.2															Runoff from Basin J, collected by public 5' Type R sump inlet @ DP-10, piped to DP-10.1.
	10.1								120.0	134.62	0.67	90.3											Combined flow in storm pipe @ DP-10.1, piped to private FSD EDB P2 @ DP-11.
	11	K	5.29	0.49	15.7	2.59	5.80	15.0	120.0	153.61	0.67	103.0											Runoff from Basin K, routed via swale into private FSD EDB P2 @ DP-11. Combines with flow from DP-10.1 and DP-5.1. Piped to DP-15.1.
	12	L	1.90	0.52	10.7	0.99	6.76	6.7															Runoff from Basin L, routed via swale to private FSD EDB P3 @ DP-12.
	13	M	0.54	0.66	5.0	0.36	8.66	3.1															Runoff from Basin M, collected by public 5' Type R on-grade inlet @ DP-13, piped to DP-14.1.
	14	N	0.63	0.67	5.0	0.42	8.68	3.6															Runoff from Basin N, collected by public 5' Type R on-grade inlet @ DP-14, piped to DP-14.1.
	14.1								5.0	0.78	8.66	6.8											Combined flow in storm pipe @ DP-14.1, piped to private WQ Pond P4 @ DP-15.
	15	O	0.95	0.53	8.0	0.50	7.49	3.7	8.0	1.28	7.49	9.6											Runoff from Basin O, routed via swale to private WQ Pond P4 @ DP-15. Combines with flow from DP-14.1.
	15.1								120.0	154.89	0.67	103.9											Combined flow in storm pipe @ 15.1, piped to outfall.
	16	OS-1	0.41	0.58	6.9	0.24	7.87	1.9															Runoff from Basin OS-1, sheet flows offsite into private basin P1 @ DP-16.
	17	OS-2	0.79	0.52	5.0	0.41	8.68	3.6															Runoff from Basin OS-2, sheet flows offsite @ DP-17.
	18	OS-3	0.31	0.57	5.0	0.18	8.68	1.6															Runoff from Basin OS-3, sheet flows offsite @ DP-18.
	19	OS-4	1.20	0.59	5.0	0.71	8.68	6.2															Runoff from Basin OS-4, sheet flows offsite @ DP-19.

Appendix C
Hydrologic Calculations (CUHP/SWMM)

COMPOSITE % IMPERVIOUS CALCULATIONS

Subdivision: Cloverleaf
Location: El Paso County

Project Name: Existing CUHP/SWMM Basins
Project No.: 2000-5158.01
Calculated By: REB
Checked By: REB
Date: 4/13/20

Basin ID	Total Area (ac)	Pasture/Meadow			Roads/Hardscape			1/2 Acre Residential			Basins Total Weighted % Imp.
		% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	
TX-1	108.70	0%	22.05	0.0%	100%	5.16	4.8%	25%	81.49	18.7%	23.5%
TX-2	27.20	0%	12.04	0.0%	100%	0.75	2.8%	25%	14.41	13.2%	16.0%
SX-3	27.60	0%	27.60	0.0%	100%	0.00	0.0%	25%	0.00	0.0%	0.0%
SX-4	5.20	0%	4.95	0.0%	100%	0.25	4.8%	25%	0.00	0.0%	4.8%
SX-5	4.30	0%	4.13	0.0%	100%	0.17	4.0%	25%	0.00	0.0%	4.0%
SX-6	49.10	0%	19.83	0.0%	100%	1.33	2.7%	25%	27.94	14.2%	16.9%
SX-7	44.60	0%	9.66	0.0%	100%	1.86	4.2%	25%	33.08	18.5%	22.7%
TOTAL	**266.70**										**18.3%**

Summary of CUHP Input Parameters (Version 2.0.1)
Existing Conditions - 5 yr

								Depression Storage		Horton's Infiltration Parameters			DCIA Level and Fractions			
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
TX-1	1	2-HOUR DESIGN STORM 5 YR	0.170	0.665	1.056	0.060	23.5	0.50	0.10	4.50	0.60	0.0018	2.00	0.12	0.38	18.41
TX-2	2	2-HOUR DESIGN STORM 5 YR	0.043	0.263	0.544	0.060	16.0	0.50	0.10	4.50	0.60	0.0018	2.00	0.08	0.34	12.08
SX-3	3	2-HOUR DESIGN STORM 5 YR	0.043	0.234	0.323	0.040	0.0	0.50	0.10	4.50	0.60	0.0018	2.00	0.00	0.00	0.00
SX-4	4	2-HOUR DESIGN STORM 5 YR	0.008	0.132	0.200	0.060	4.8	0.50	0.10	4.50	0.60	0.0018	2.00	0.00	0.14	3.41
SX-5	5	2-HOUR DESIGN STORM 5 YR	0.007	0.086	0.144	0.060	4.0	0.50	0.10	4.50	0.60	0.0018	2.00	0.00	0.12	2.84
SX-6	6	2-HOUR DESIGN STORM 5 YR	0.077	0.259	0.698	0.050	16.9	0.50	0.10	4.50	0.60	0.0018	2.00	0.08	0.34	12.82
SX-7	7	2-HOUR DESIGN STORM 5 YR	0.070	0.639	1.025	0.040	22.7	0.50	0.10	4.50	0.60	0.0018	2.00	0.11	0.37	17.72

Summary of CUHP Input Parameters (Version 2.0.1)
Existing Condtions - 100 yr

								Depression Storage		Horton's Infiltration Parameters			DCIA Level and Fractions			
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
TX-1	1	2-HOUR DESIGN STORM	0.170	0.665	1.056	0.060	23.5	0.50	0.10	4.50	0.60	0.0018	2.00	0.12	0.38	20.24
TX-2	2	2-HOUR DESIGN STORM	0.043	0.263	0.544	0.060	16.0	0.50	0.10	4.50	0.60	0.0018	2.00	0.08	0.34	13.47
SX-3	3	2-HOUR DESIGN STORM	0.043	0.234	0.323	0.040	0.0	0.50	0.10	4.50	0.60	0.0018	2.00	0.00	0.00	0.00
SX-4	4	2-HOUR DESIGN STORM	0.008	0.132	0.200	0.060	4.8	0.50	0.10	4.50	0.60	0.0018	2.00	0.00	0.14	3.89
SX-5	5	2-HOUR DESIGN STORM	0.007	0.086	0.144	0.060	4.0	0.50	0.10	4.50	0.60	0.0018	2.00	0.00	0.12	3.24
SX-6	6	2-HOUR DESIGN STORM	0.077	0.259	0.698	0.050	16.9	0.50	0.10	4.50	0.60	0.0018	2.00	0.08	0.34	14.27
SX-7	7	2-HOUR DESIGN STORM	0.070	0.639	1.025	0.040	22.7	0.50	0.10	4.50	0.60	0.0018	2.00	0.11	0.37	19.50

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)
Existing Conditions - 5 yr

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
TX-1	Tributary Existing Conditions Basin 1	0.113	0.165	53.0	7.02	27.6	4.96	11.7	96	394,581	0.54	213,183	60.0	47	213,182	0.43
TX-2	Tributary Existing Conditions Basin 2	0.122	0.092	48.3	3.70	25.1	2.62	6.2	26	98,736	0.46	45,815	56.0	11	45,815	0.40
SX-3	Site Existing Conditions Basin 3	0.163	0.118	40.5	3.98	21.0	2.81	6.6	32	100,188	0.31	31,003	55.0	9	31,001	0.33
SX-4	Site Existing Conditions Basin 4	0.150	0.052	46.7	2.16	24.3	1.52	3.6	5	18,876	0.35	6,696	54.0	2	6,696	0.32
SX-5	Site Existing Conditions Basin 5	0.152	0.048	35.5	1.61	18.5	1.14	2.7	6	15,609	0.35	5,419	51.0	2	5,418	0.40
SX-6	Site Existing Conditions Basin 6	0.121	0.119	43.1	4.23	22.4	2.99	7.1	53	178,233	0.47	84,305	55.0	22	84,302	0.45
SX-7	Site Existing Conditions Basin 7	0.114	0.111	84.9	7.52	44.2	5.32	12.5	25	161,898	0.53	86,133	66.0	12	86,132	0.28

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)
Existing Conditions 100-yr

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
TX-1	Tributary Existing Conditons Baisn 1	0.110	0.164	52.2	6.87	27.1	4.86	11.5	98	394,581	1.46	577,723	59.0	125	577,720	1.15
TX-2	Tributary Existing Conditons Baisn 2	0.120	0.091	47.9	3.64	24.9	2.57	6.1	27	98,736	1.38	136,205	55.0	31	136,206	1.15
SX-3	Site Existing Conditions Basin 3	0.163	0.118	40.5	3.98	21.0	2.81	6.6	32	100,188	1.21	121,642	54.0	33	121,635	1.20
SX-4	Site Existing Conditions Basin 4	0.149	0.051	46.7	2.13	24.3	1.51	3.6	5	18,876	1.26	23,820	53.0	6	23,818	1.08
SX-5	Site Existing Conditions Basin 5	0.151	0.048	35.5	1.60	18.5	1.13	2.7	6	15,609	1.25	19,573	51.0	6	19,570	1.35
SX-6	Site Existing Conditions Basin 6	0.119	0.118	42.7	4.16	22.2	2.94	6.9	54	178,233	1.39	247,637	54.0	63	247,623	1.28
SX-7	Site Existing Conditions Basin 7	0.111	0.110	83.6	7.37	43.5	5.21	12.3	25	161,898	1.45	235,527	67.0	34	235,526	0.76

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CFS
Process Models:
  Rainfall/Runoff ..... NO
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... NO
  Water Quality ..... NO
Flow Routing Method ..... KINWAVE
Starting Date 01/01/2005 00:00:00
Ending Date 01/04/2005 06:00:00
Antecedent Dry Days 0.0
Report Time Step 00:15:00
Routing Time Step ..... 30.00 sec

Flow Routing Continuity	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	77.348	25.205
Wet Weather Inflow	0.000	0.000
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	10.848	3.535
External Outflow	88.196	28.740
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

****
Highest Flow Instability Indexes
****
All links are stable.

****
Routing Time Step Summary
****
Minimum Time Step : 30.00 sec
Average Time Step : 30.00 sec
Maximum Time Step : 30.00 sec
Percent in Steady State : 0.00
Average Iterations per Step : 1.00
Percent Not Converging : 0.00

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
1	JUNCTION	0.00	0.00	7409.00	0 00:00	0.00
2	JUNCTION	0.00	0.00	7226.00	0 00:00	0.00
3	JUNCTION	0.00	0.00	7065.00	0 00:00	0.00
4	JUNCTION	0.00	0.00	7101.00	0 00:00	0.00
5	JUNCTION	0.00	0.00	7108.00	0 00:00	0.00
6	JUNCTION	0.00	0.00	7160.00	0 00:00	0.00
7	JUNCTION	0.00	0.00	7194.00	0 00:00	0.00
9	JUNCTION	0.00	0.00	7003.00	0 00:00	0.00
EX_28X42_CMP	JUNCTION	0.00	0.00	6992.00	0 00:00	0.00
EX_18_CMP	JUNCTION	0.00	0.00	6996.00	0 00:00	0.00
10	OUTFALL	0.00	0.00	6988.00	0 00:00	0.00
11	OUTFALL	0.00	0.00	7042.00	0 00:00	0.00
12	OUTFALL	0.00	0.00	7000.00	0 00:00	0.00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
1	JUNCTION	46.77	46.77	0 01:00	1.59	1.59	0.000
2	JUNCTION	10.94	10.94	0 00:56	0.343	0.343	0.000
3	JUNCTION	9.13	66.47	0 00:58	0.232	2.17	0.000
4	JUNCTION	1.69	1.69	0 00:54	0.0501	0.0501	0.000
5	JUNCTION	1.74	1.74	0 00:51	0.0405	0.0405	0.000
6	JUNCTION	22.27	22.27	0 00:55	0.631	0.631	0.000
7	JUNCTION	12.37	12.37	0 01:06	0.644	0.644	0.000
9	JUNCTION	0.00	66.47	0 00:58	0	2.17	0.000
EX_28X42_CMP	JUNCTION	0.00	102.20	0 00:57	0	28.1	0.000
EX_18_CMP	JUNCTION	12.00	13.69	0 00:54	25.2	25.3	

0.000							
10	OUTFALL	0.00	102.20	0	00:57	0	28.1
0.000							
11	OUTFALL	0.00	1.74	0	00:51	0	0.0405
0.000							
12	OUTFALL	0.00	12.37	0	01:06	0	0.644
0.000							

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
10	100.00	13.36	102.20	28.053
11	3.23	0.60	1.74	0.041
12	8.47	3.62	12.37	0.644
System	37.23	17.58	115.77	28.738

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
4	DUMMY	10.94	0 00:56			
5	DUMMY	66.47	0 00:58			
6	DUMMY	22.27	0 00:55			
7	DUMMY	1.69	0 00:54			
8	DUMMY	13.69	0 00:54			
9	DUMMY	102.20	0 00:57			
10	DUMMY	1.74	0 00:51			
11	DUMMY	12.37	0 01:06			
13	DUMMY	66.47	0 00:58			
14	DUMMY	46.77	0 01:00			

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Thu Apr 23 11:53:06 2020
Analysis ended on: Thu Apr 23 11:53:06 2020
Total elapsed time: < 1 sec

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CFS
Process Models:
  Rainfall/Runoff ..... NO
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... NO
  Water Quality ..... NO
Flow Routing Method ..... KINWAVE
Starting Date 01/01/2005 00:00:00
Ending Date 01/04/2005 06:00:00
Antecedent Dry Days 0.0
Report Time Step 00:15:00
Routing Time Step ..... 30.00 sec

Flow Routing Continuity	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	167.588	54.611
Wet Weather Inflow	0.000	0.000
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	31.268	10.189
External Outflow	198.857	64.800
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

****
Highest Flow Instability Indexes
****
All links are stable.

****
Routing Time Step Summary
****
Minimum Time Step : 30.00 sec
Average Time Step : 30.00 sec
Maximum Time Step : 30.00 sec
Percent in Steady State : 0.00
Average Iterations per Step : 1.00
Percent Not Converging : 0.00

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
1	JUNCTION	0.00	0.00	7409.00	0 00:00	0.00
2	JUNCTION	0.00	0.00	7226.00	0 00:00	0.00
3	JUNCTION	0.00	0.00	7065.00	0 00:00	0.00
4	JUNCTION	0.00	0.00	7101.00	0 00:00	0.00
5	JUNCTION	0.00	0.00	7108.00	0 00:00	0.00
6	JUNCTION	0.00	0.00	7160.00	0 00:00	0.00
7	JUNCTION	0.00	0.00	7194.00	0 00:00	0.00
9	JUNCTION	0.00	0.00	7003.00	0 00:00	0.00
EX_28X42_CMP	JUNCTION	0.00	0.00	6992.00	0 00:00	0.00
EX_18_CMP	JUNCTION	0.00	0.00	6996.00	0 00:00	0.00
10	OUTFALL	0.00	0.00	6988.00	0 00:00	0.00
11	OUTFALL	0.00	0.00	7042.00	0 00:00	0.00
12	OUTFALL	0.00	0.00	7000.00	0 00:00	0.00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
1	JUNCTION	124.80	124.80	0 00:59	4.32	4.32	0.000
2	JUNCTION	31.41	31.41	0 00:55	1.02	1.02	0.000
3	JUNCTION	33.04	188.19	0 00:57	0.91	6.25	0.000
4	JUNCTION	5.63	5.63	0 00:53	0.178	0.178	0.000
5	JUNCTION	5.81	5.81	0 00:51	0.146	0.146	0.000
6	JUNCTION	63.07	63.07	0 00:54	1.85	1.85	0.000
7	JUNCTION	33.89	33.89	0 01:07	1.76	1.76	0.000
9	JUNCTION	0.00	188.19	0 00:57	0	6.25	0.000
EX_28X42_CMP	JUNCTION	0.00	282.29	0 00:56	0	62.9	0.000
EX_18_CMP	JUNCTION	26.00	31.63	0 00:53	54.6	54.8	

0.000								
10	OUTFALL	0.00	282.29	0	00:56	0	62.9	
0.000								
11	OUTFALL	0.00	5.81	0	00:51	0	0.146	
0.000								
12	OUTFALL	0.00	33.89	0	01:07	0	1.76	
0.000								

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
10	100.00	29.94	282.29	62.887
11	3.50	1.99	5.81	0.146
12	8.61	9.74	33.89	1.762
System	37.37	41.67	320.10	64.796

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
4	DUMMY	31.41	0	00:55			
5	DUMMY	188.19	0	00:57			
6	DUMMY	63.07	0	00:54			
7	DUMMY	5.63	0	00:53			
8	DUMMY	31.63	0	00:53			
9	DUMMY	282.29	0	00:56			
10	DUMMY	5.81	0	00:51			
11	DUMMY	33.89	0	01:07			
13	DUMMY	188.19	0	00:57			
14	DUMMY	124.80	0	00:59			

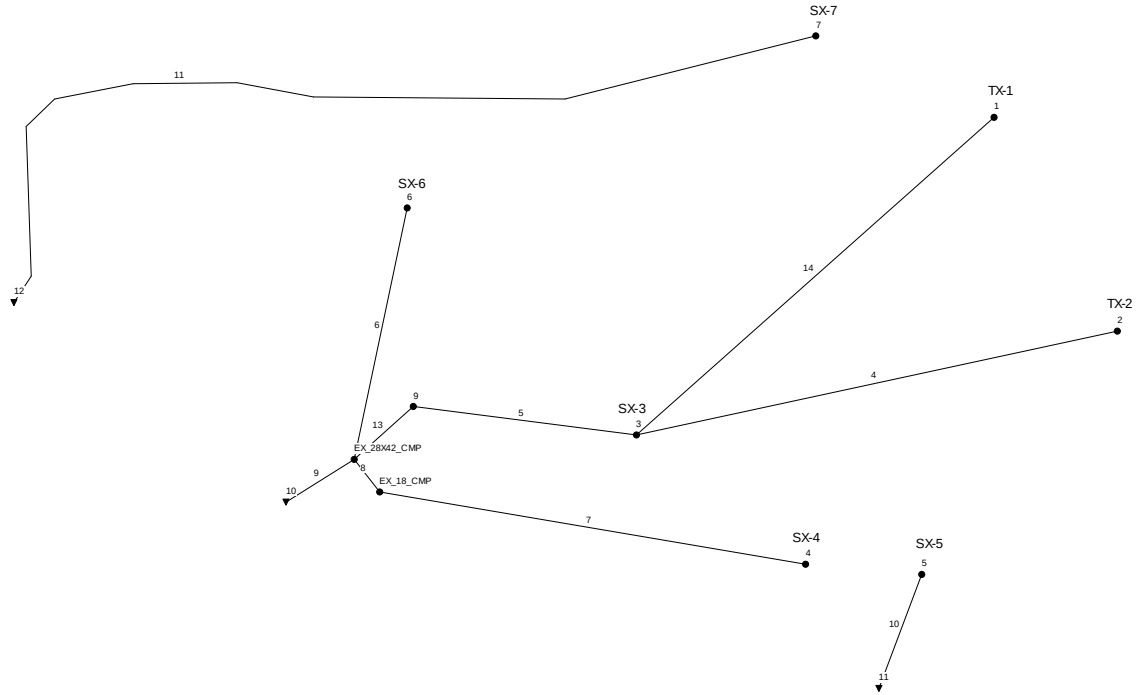
****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Thu Apr 23 09:01:01 2020
Analysis ended on: Thu Apr 23 09:01:01 2020
Total elapsed time: < 1 sec

SWMM EXISTING CONDITIONS MODEL

01/01/2005 00:15:00



COMPOSITE % IMPERVIOUS CALCULATIONS

Subdivision: Cloverleaf
Location: El Paso County

Project Name: Proposed CUHP/SWMM Basins
Project No.: 2000-5158.01
Calculated By: REB
Checked By: REB
Date: 9/3/20

Basin ID	Total Area (ac)	Pasture/Meadow			Roads/Hardscape			On-Site Basins (Per Rational)			1/2 Acre Residential			Basins Total Weighted % Imp.
		% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	% Imp.	Area (ac)	Weighted % Imp.	
TX-1	108.7	0%	22.1	0.0%	100%	5.2	4.8%	100%	0.0	0.0%	25%	81.5	18.7%	23.5%
TX-2	27.2	0%	12.0	0.0%	100%	0.8	2.8%	100%	0.0	0.0%	25%	14.4	13.2%	16.0%
S-3	30.5	0%	0.0	0.0%	100%	0.0	0.0%	59%	30.5	59.3%	25%	0.0	0.0%	59.3%
S-6	51.8	0%	19.3	0.0%	100%	1.3	2.4%	60%	2.1	2.4%	25%	29.2	14.1%	18.9%
S-7	44.6	0%	8.7	0.0%	100%	1.9	4.2%	100%	0.0	0.0%	25%	34.1	19.1%	23.3%
TOTAL	**262.80**													**25.9%**

Summary of CUHP Input Parameters (Version 2.0.1)
Proposed Conditions - 5yr

								Depression Storage		Horton's Infiltration Parameters			DCIA Level and Fractions			
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
TX-1	1	2-HOUR DESIGN STORM 5 YR	0.170	0.665	1.056	0.060	23.5	0.50	0.10	4.50	0.60	0.0018	2.00	0.12	0.38	18.41
TX-2	2	2-HOUR DESIGN STORM 5 YR	0.043	0.263	0.544	0.060	16.0	0.50	0.10	4.50	0.60	0.0018	2.00	0.08	0.34	12.08
S-3	3	2-HOUR DESIGN STORM 5 YR	0.048	0.279	0.460	0.030	59.3	0.40	0.10	4.50	0.60	0.0018	1.00	0.69	0.42	55.33
S-6	6	2-HOUR DESIGN STORM 5 YR	0.081	0.259	0.698	0.050	18.9	0.50	0.10	4.50	0.60	0.0018	2.00	0.09	0.35	14.49
S-7	7	2-HOUR DESIGN STORM 5 YR	0.070	0.639	1.025	0.040	23.3	0.50	0.10	4.50	0.60	0.0018	2.00	0.12	0.38	18.23

Summary of CUHP Input Parameters (Version 2.0.1)
Proposed Conditions - 100yr

								Depression Storage		Horton's Infiltration Parameters			DCIA Level and Fractions			
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
TX-1	1	2-HOUR DESIGN STORM	0.170	0.665	1.056	0.060	23.5	0.50	0.10	4.50	0.60	0.0018	2.00	0.12	0.38	20.24
TX-2	2	2-HOUR DESIGN STORM	0.043	0.263	0.544	0.060	16.0	0.50	0.10	4.50	0.60	0.0018	2.00	0.08	0.34	13.47
S-3	3	2-HOUR DESIGN STORM	0.048	0.279	0.460	0.030	59.3	0.40	0.10	4.50	0.60	0.0018	1.00	0.69	0.42	56.79
S-6	6	2-HOUR DESIGN STORM	0.081	0.259	0.698	0.050	18.9	0.50	0.10	4.50	0.60	0.0018	2.00	0.09	0.35	16.06
S-7	7	2-HOUR DESIGN STORM	0.070	0.639	1.025	0.040	23.3	0.50	0.10	4.50	0.60	0.0018	2.00	0.12	0.38	20.05

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)
Proposed Conditions - 5yr

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
TX-1		0.113	0.165	53.0	7.02	27.6	4.96	11.7	96	394,581	0.54	213,183	60.0	47	213,182	0.43
TX-2		0.122	0.092	48.3	3.70	25.1	2.62	6.2	26	98,736	0.46	45,815	56.0	11	45,815	0.40
S-3		0.086	0.145	24.1	2.98	12.5	2.10	5.0	59	110,715	1.02	112,490	48.0	40	112,477	1.30
S-6		0.118	0.120	41.6	4.15	21.6	2.93	6.9	58	188,034	0.49	92,731	55.0	25	92,727	0.48
S-7		0.113	0.111	84.5	7.48	44.0	5.28	12.5	25	161,898	0.54	87,135	66.0	13	87,135	0.28

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)
Proposed Conditions - 100yr

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
TX-1		0.110	0.164	52.2	6.87	27.1	4.86	11.5	98	394,581	1.46	577,723	59.0	125	577,720	1.15
TX-2		0.120	0.091	47.9	3.64	24.9	2.57	6.1	27	98,736	1.38	136,205	55.0	31	136,206	1.15
S-3		0.085	0.146	23.6	2.96	12.3	2.09	4.9	60	110,715	2.01	222,959	47.0	79	222,923	2.58
S-6		0.116	0.119	41.1	4.07	21.4	2.88	6.8	59	188,034	1.41	265,448	54.0	69	265,434	1.34
S-7		0.110	0.110	83.1	7.32	43.2	5.17	12.2	25	161,898	1.46	236,663	67.0	34	236,659	0.77

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CFS
Process Models:
  Rainfall/Runoff ..... NO
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... NO
  Water Quality ..... NO
Flow Routing Method ..... KINWAVE
Starting Date 01/01/2005 00:00:00
Ending Date 01/05/2005 06:00:00
Antecedent Dry Days 0.0
Report Time Step 00:15:00
Routing Time Step ..... 30.00 sec

Flow Routing Continuity	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.000	0.000
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	113.806	37.085
External Outflow	113.792	37.081
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.012	

****
Highest Flow Instability Indexes
****
All links are stable.

****
Routing Time Step Summary
****
Minimum Time Step : 30.00 sec
Average Time Step : 30.00 sec
Maximum Time Step : 30.00 sec
Percent in Steady State : 0.00
Average Iterations per Step : 1.00
Percent Not Converging : 0.00

****
Node Depth Summary
****

	Average Depth	Maximum Depth	Maximum HGL	Time of Max Occurrence	Reported Max Depth

Node	Type	Feet	Feet	Feet	days	hr:min	Feet
1	JUNCTION	0.00	0.00	7409.00	0	00:00	0.00
2	JUNCTION	0.00	0.00	7226.00	0	00:00	0.00
3	JUNCTION	0.00	0.00	7065.00	0	00:00	0.00
6	JUNCTION	0.00	0.00	7160.00	0	00:00	0.00
7	JUNCTION	0.00	0.00	7194.00	0	00:00	0.00
P2_out	JUNCTION	0.00	0.00	7003.00	0	00:00	0.00
EX_28X42_CMP	JUNCTION	0.00	0.00	6992.00	0	00:00	0.00
EX18CMP	JUNCTION	0.00	0.00	6993.00	0	00:00	0.00
10	OUTFALL	0.00	0.00	6988.00	0	00:00	0.00
12	OUTFALL	0.00	0.00	7000.00	0	00:00	0.00
P1	STORAGE	0.08	3.19	7069.19	0	01:36	3.18
P2	STORAGE	2.38	5.14	7030.14	0	01:33	5.14

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days	hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
1	JUNCTION	46.77	46.77	0	01:00	1.59	1.59	0.000
2	JUNCTION	10.94	10.94	0	00:56	0.343	0.343	0.000
3	JUNCTION	39.67	39.67	0	00:48	0.841	0.841	0.000
6	JUNCTION	25.11	25.11	0	00:55	0.694	0.694	0.000
7	JUNCTION	12.55	12.55	0	01:06	0.652	0.652	0.000
P2_out	JUNCTION	0.00	45.85	0	01:33	0	2.77	0.000
EX_28X42_CMP	JUNCTION	0.00	71.47	0	01:27	0	36.4	0.000
EX18CMP	JUNCTION	12.00	12.00	0	00:00	33	33	0.000
10	OUTFALL	0.00	71.47	0	01:27	0	36.4	0.000
12	OUTFALL	0.00	12.55	0	01:06	0	0.652	0.000
P1	STORAGE	0.00	57.56	0	00:59	0	1.94	0.044
P2	STORAGE	0.00	54.68	0	01:05	0	2.78	0.130

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days	hr:min	Maximum Outflow CFS
P1	1.312	0	0	0	73.694	28	0	01:35	33.95
P2	22.472	14	0	0	108.305	70	0	01:33	45.85

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
10	100.00	13.26	71.47	36.426
12	6.47	3.67	12.55	0.652

System	53.24	16.93	82.31	37.078

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
4	DUMMY	10.94	0	00:56			
5	DUMMY	39.67	0	00:48			
6	DUMMY	25.11	0	00:55			
9	DUMMY	71.47	0	01:27			
11	DUMMY	12.55	0	01:06			
13	DUMMY	45.85	0	01:33			
14	DUMMY	46.77	0	01:00			
15	DUMMY	12.00	0	00:00			
1	DUMMY	33.95	0	01:36			
2	DUMMY	45.85	0	01:33			

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Fri Sep 04 10:17:26 2020
Analysis ended on: Fri Sep 04 10:17:26 2020
Total elapsed time: < 1 sec

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CFS
Process Models:
  Rainfall/Runoff ..... NO
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... NO
  Water Quality ..... NO
Flow Routing Method ..... KINWAVE
Starting Date 01/01/2005 00:00:00
Ending Date 01/05/2005 06:00:00
Antecedent Dry Days 0.0
Report Time Step 00:15:00
Routing Time Step ..... 30.00 sec

Flow Routing Continuity	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.000	0.000
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	252.189	82.180
External Outflow	252.157	82.169
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.013	

****
Highest Flow Instability Indexes
****
All links are stable.

****
Routing Time Step Summary
****
Minimum Time Step : 30.00 sec
Average Time Step : 30.00 sec
Maximum Time Step : 30.00 sec
Percent in Steady State : 0.00
Average Iterations per Step : 1.00
Percent Not Converging : 0.00

****
Node Depth Summary
****

	Average Depth	Maximum Depth	Maximum HGL	Time of Max Occurrence	Reported Max Depth

Node	Type	Feet	Feet	Feet	days	hr:min	Feet
1	JUNCTION	0.00	0.00	7409.00	0	00:00	0.00
2	JUNCTION	0.00	0.00	7226.00	0	00:00	0.00
3	JUNCTION	0.00	0.00	7065.00	0	00:00	0.00
6	JUNCTION	0.00	0.00	7160.00	0	00:00	0.00
7	JUNCTION	0.00	0.00	7194.00	0	00:00	0.00
P2_out	JUNCTION	0.00	0.00	7003.00	0	00:00	0.00
EX_28X42_CMP	JUNCTION	0.00	0.00	6992.00	0	00:00	0.00
EX18CMP	JUNCTION	0.00	0.00	6993.00	0	00:00	0.00
10	OUTFALL	0.00	0.00	6988.00	0	00:00	0.00
12	OUTFALL	0.00	0.00	7000.00	0	00:00	0.00
P1	STORAGE	0.15	5.63	7071.63	0	01:41	5.62
P2	STORAGE	2.55	5.67	7030.67	0	01:42	5.67

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days	hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
1	JUNCTION	124.80	124.80	0	00:59	4.32	4.32	0.000
2	JUNCTION	31.41	31.41	0	00:55	1.02	1.02	0.000
3	JUNCTION	78.54	78.54	0	00:47	1.67	1.67	0.000
6	JUNCTION	69.49	69.49	0	00:54	1.99	1.99	0.000
7	JUNCTION	34.18	34.18	0	01:07	1.77	1.77	0.000
P2_out	JUNCTION	0.00	102.94	0	01:42	0	7	0.000
EX_28X42_CMP	JUNCTION	0.00	165.27	0	01:26	0	80.4	0.000
EX18CMP	JUNCTION	26.00	26.00	0	00:00	71.4	71.4	0.000
10	OUTFALL	0.00	165.27	0	01:26	0	80.4	0.000
12	OUTFALL	0.00	34.18	0	01:07	0	1.77	0.000
P1	STORAGE	0.00	155.84	0	00:58	0	5.34	0.040
P2	STORAGE	0.00	122.25	0	01:10	0	7.01	0.117

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 ft3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 ft3	Max Pcnt Full	Time of Max Occurrence days	hr:min	Maximum Outflow CFS
P1	4.726	2	0	0	235.195	89	0	01:41	85.09
P2	28.075	11	0	0	207.833	81	0	01:41	102.94

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
10	100.00	29.27	165.27	80.393
12	6.58	9.79	34.18	1.770

System	53.29	39.06	196.22	82.163

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days	hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
4	DUMMY	31.41	0	00:55			
5	DUMMY	78.54	0	00:47			
6	DUMMY	69.49	0	00:54			
9	DUMMY	165.27	0	01:26			
11	DUMMY	34.18	0	01:07			
13	DUMMY	102.94	0	01:42			
14	DUMMY	124.80	0	00:59			
15	DUMMY	26.00	0	00:00			
1	DUMMY	85.09	0	01:41			
2	DUMMY	102.94	0	01:42			

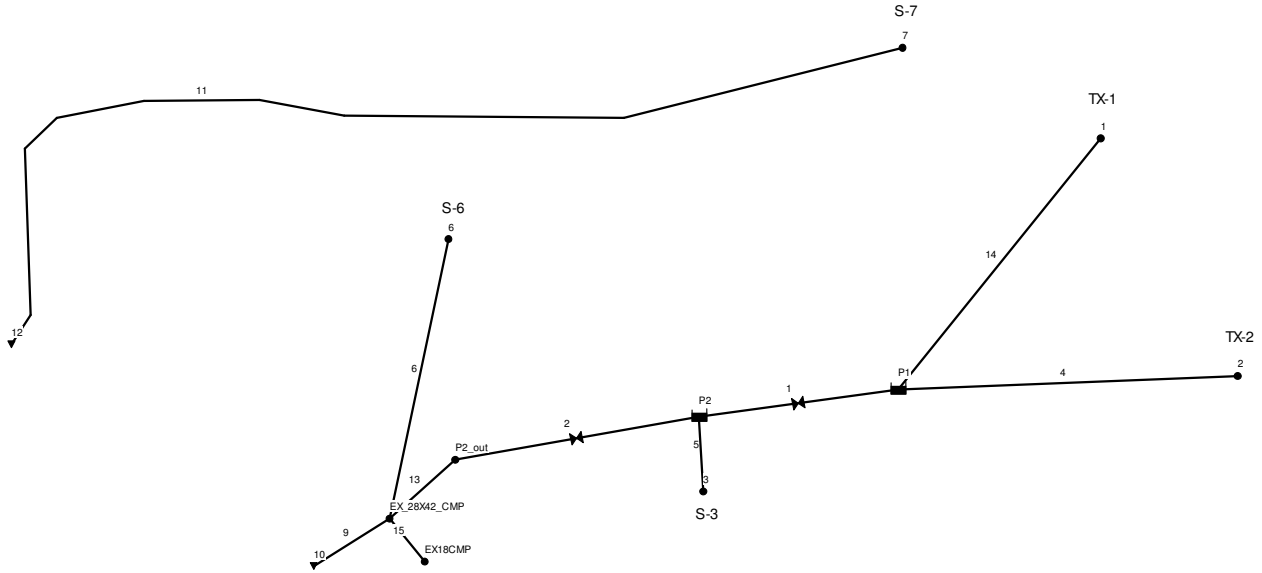
****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Fri Sep 04 09:38:11 2020
Analysis ended on: Fri Sep 04 09:38:11 2020
Total elapsed time: < 1 sec

PROPOSED CONDITIONS

01/01/2005 00:15:00



Summary of CUHP Input Parameters (Version 2.0.1)
Historic Conditions 5 yr

								Depression Storage		Horton's Infiltration Parameters			DCIA Level and Fractions			
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
H-1	H1	2-HOUR DESIGN STORM 5 YR	0.255	0.576	1.269	0.060	2.0	0.60	0.10	4.50	0.60	0.0018	2.00	0.01	0.06	1.42
H-2	H2	2-HOUR DESIGN STORM 5 YR	0.015	0.115	0.185	0.060	2.0	0.60	0.10	4.50	0.60	0.0018	2.00	0.00	0.06	1.42

Summary of CUHP Input Parameters (Version 2.0.1)
Historic Conditions 100 yr

								Depression Storage		Horton's Infiltration Parameters			DCIA Level and Fractions			
Catchment Name/ID	SWMM Node/ID	Raingage Name/ID	Area (sq.mi.)	Dist. to Centroid (miles)	Length (miles)	Slope (ft./ft.)	Percent Imperv.	Pervious (inches)	Imperv. (inches)	Initial Rate (in./hr.)	Final Rate (in.hr.)	Decay Coeff. (1/sec.)	DCIA Level	Dir. Con'ct Imperv. Fraction	Receiv. Perv. Fraction	Percent Eff. Imperv.
H-1	H1	2-HOUR DESIGN STORM	0.255	0.576	1.269	0.060	2.0	0.60	0.10	4.50	0.60	0.0018	2.00	0.01	0.06	1.62
H-2	H2	2-HOUR DESIGN STORM	0.015	0.115	0.185	0.060	2.0	0.60	0.10	4.50	0.60	0.0018	2.00	0.00	0.06	1.62

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)
Historic Conditions 5 yr

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
H-1		0.158	0.241	51.9	9.90	27.0	6.99	16.5	148	592,979	0.23	136,599	64.0	33	136,600	0.20
H-2		0.158	0.071	32.1	2.06	16.7	1.45	3.4	14	34,938	0.23	8,047	53.0	3	8,046	0.29

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)
Historic Conditions 100 yr

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
H-1	Historic flow for comparison to basins TX-1, TX-2, and SX-3/S-3	0.157	0.240	51.8	9.85	27.0	6.96	16.4	148	592,979	1.14	673,696	63.0	152	673,702	0.93
H-2	Historic flow for comparsion to Basin S-4 (for information only)	0.157	0.071	32.1	2.05	16.7	1.45	3.4	14	34,938	1.14	39,691	51.0	13	39,687	1.33

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

WARNING 08: elevation drop exceeds length for Conduit 1

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CFS
Process Models:
  Rainfall/Runoff ..... NO
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... YES
  Ponding Allowed ..... NO
  Water Quality ..... NO
Flow Routing Method ..... KINWAVE
Starting Date 01/01/2005 00:00:00
Ending Date 01/04/2005 06:00:00
Antecedent Dry Days 0.0
Report Time Step 00:15:00
Routing Time Step ..... 30.00 sec

Flow Routing Continuity	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.000	0.000
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	3.320	1.082
External Outflow	3.320	1.082
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

****
Highest Flow Instability Indexes
****
All links are stable.

****
Routing Time Step Summary
****
Minimum Time Step : 30.00 sec
Average Time Step : 30.00 sec
Maximum Time Step : 30.00 sec
Percent in Steady State : 0.00
Average Iterations per Step : 1.00

Percent Not Converging : 0.00

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
H1	JUNCTION	0.00	0.00	7409.00	0 00:00	0.00
H2	JUNCTION	0.00	0.00	7108.00	0 00:00	0.00
1	OUTFALL	0.00	0.00	7004.00	0 00:00	0.00
2	OUTFALL	0.00	0.00	7047.00	0 00:00	0.00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
H1	JUNCTION	32.57	32.57	0 01:04	1.02	1.02	0.000
H2	JUNCTION	2.84	2.84	0 00:53	0.0602	0.0602	0.000
1	OUTFALL	0.00	32.57	0 01:04	0	1.02	0.000
2	OUTFALL	0.00	2.84	0 00:53	0	0.0602	0.000

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
1	4.99	9.75	32.57	1.022

2	2.97	0.96	2.84	0.060
System	3.98	10.71	34.93	1.082

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
2	DUMMY	2.84	0 00:53			
1	DUMMY	32.57	0 01:04			

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Thu Apr 23 16:35:05 2020
Analysis ended on: Thu Apr 23 16:35:05 2020
Total elapsed time: < 1 sec

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)
--------------------------------------------------------------

WARNING 08: elevation drop exceeds length for Conduit 1

***********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
***********************************************************

****************
Analysis Options
****************
Flow Units ............... CFS
Process Models:
  Rainfall/Runoff ........ NO
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Flow Routing Method ...... KINWAVE
Starting Date ............ 01/01/2005 00:00:00
Ending Date .............. 01/04/2005 06:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:15:00
Routing Time Step ........ 30.00 sec


**************************        Volume        Volume
Flow Routing Continuity        acre-feet      10^6 gal
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.000         0.000
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........        16.377         5.337
External Outflow .........        16.377         5.337
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


*******************************
Highest Flow Instability Indexes
*******************************
All links are stable.


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :    30.00 sec
Average Time Step           :    30.00 sec
Maximum Time Step           :    30.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     1.00
```

Percent Not Converging : 0.00

****
Node Depth Summary
****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
H1	JUNCTION	0.00	0.00	7409.00	0 00:00	0.00
H2	JUNCTION	0.00	0.00	7108.00	0 00:00	0.00
1	OUTFALL	0.00	0.00	7004.00	0 00:00	0.00
2	OUTFALL	0.00	0.00	7047.00	0 00:00	0.00

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
H1	JUNCTION	152.16	152.16	0 01:03	5.04	5.04	0.000
H2	JUNCTION	12.83	12.83	0 00:51	0.297	0.297	0.000
1	OUTFALL	0.00	152.16	0 01:03	0	5.04	0.000
2	OUTFALL	0.00	12.83	0 00:51	0	0.297	0.000

****
Node Flooding Summary
****

No nodes were flooded.

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
1	5.20	46.11	152.16	5.039

2	3.24	4.37	12.83	0.297
System	4.22	50.48	163.16	5.336

****
Link Flow Summary
****

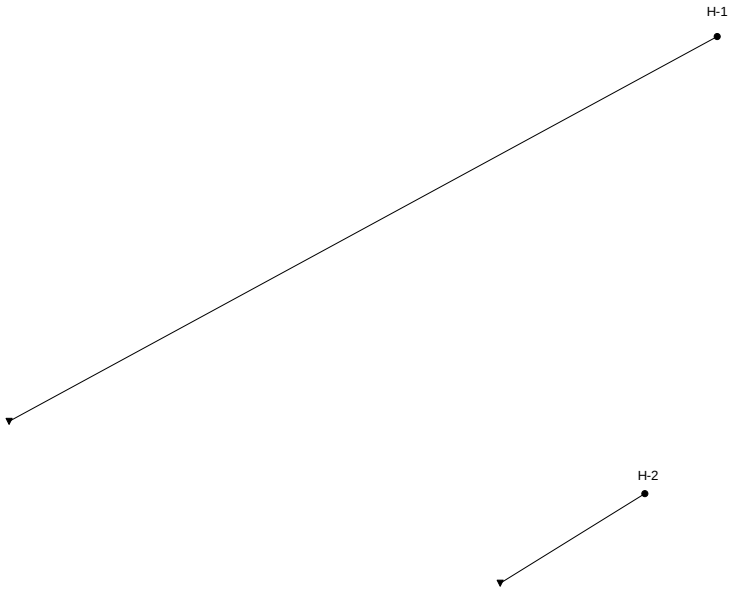
Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
2	DUMMY	12.83	0 00:51			
1	DUMMY	152.16	0 01:03			

****
Conduit Surcharge Summary
****

No conduits were surcharged.

Analysis begun on: Thu Apr 23 14:49:49 2020
Analysis ended on: Thu Apr 23 14:49:49 2020
Total elapsed time: < 1 sec

SWMM HISTORIC CONDITIONS MODEL



5-yr 2 Hour Design Storm Distribution, <= 1 square mile

Comment Per Tables 6-2 & 6-3 El Paso County DCM V1 (updated)

Note: Time must be of the form **h:mm**. Entering an improperly formatted time value (eg: 0:120 instead of 2:00) may reset the nun

5-yr 1hr depth 1.5

Time	Depth	Incremental	Cumulative
0:05	0.021	0.014	0.014
0:10	0.048	0.032	0.046
0:15	0.05	0.033	0.079
0:20	0.062	0.041	0.12
0:25	0.089	0.059	0.179
0:30	0.119	0.079	0.258
0:35	0.245	0.163	0.421
0:40	0.437	0.291	0.712
0:45	0.168	0.112	0.824
0:50	0.102	0.068	0.892
0:55	0.065	0.043	0.935
1:00	0.055	0.037	0.972
1:05	0.048	0.032	1.004
1:10	0.021	0.014	1.018
1:15	0.018	0.012	1.03
1:20	0.016	0.011	1.041
1:25	0.017	0.011	1.052
1:30	0.016	0.011	1.063
1:35	0.014	0.009	1.072
1:40	0.015	0.01	1.082
1:45	0.013	0.009	1.091
1:50	0.014	0.009	1.1
1:55	0.013	0.009	1.109
2:00	0.015	0.01	1.119
2:05	0		

100-YR 2-Hour Design Storm Distribution, <=1 square mile

Comment Per Tables 6-2 and 6-3 El Paso County DCM V1 (Updated)

Note: Time must be of the form **h:mm**. Entering an improperly formatted time value (eg: 0:120 instead of 2:00) may reset the number form

100yr 1-hr depth 2.52

Time	Depth	Incremental	Cumulative
0:05	0.035	0.014	0.014
0:10	0.081	0.032	0.046
0:15	0.083	0.033	0.079
0:20	0.103	0.041	0.12
0:25	0.149	0.059	0.179
0:30	0.199	0.079	0.258
0:35	0.411	0.163	0.421
0:40	0.733	0.291	0.712
0:45	0.282	0.112	0.824
0:50	0.171	0.068	0.892
0:55	0.108	0.043	0.935
1:00	0.093	0.037	0.972
1:05	0.081	0.032	1.004
1:10	0.035	0.014	1.018
1:15	0.03	0.012	1.03
1:20	0.028	0.011	1.041
1:25	0.028	0.011	1.052
1:30	0.028	0.011	1.063
1:35	0.023	0.009	1.072
1:40	0.025	0.01	1.082
1:45	0.023	0.009	1.091
1:50	0.023	0.009	1.1
1:55	0.023	0.009	1.109
2:00	0.025	0.01	1.119
2:05	0		

Appendix D
Hydraulic Calculations

Project: Cloverleaf Subdivision

Basin ID: P1 (Private Volume Attenuation Pond for Offsite Basins)

P1 Stage-Storage					
Elevation	Stage	Area [sf]	Area [ac]	Volume [cf]	Volume [ac-ft]
7065	0	0	0	0	0
7066	1	6,872	0.158	3,367	0.077
7067	2	28,992	0.666	21,079	0.484
7068	3	54,318	1.247	63,023	1.447
7069	4	64,525	1.481	122,444	2.811
7070	5	70,404	1.616	189,909	4.360
7071	6	76,447	1.755	263,334	6.045

Pond P1 Outlet Curve	
Head (ft)	Flow (cfs)
0	0
0.5	1.18
1	4.13
1.5	8.61
2	14.5
2.5	21.71
3	30.2
3.5	39.92
4	50.83
4.5	62.91
5	76.13
5.5	83.4
6	90.08

Project: Cloverleaf Subdivision

Basin ID: P2 (Private Full-Spectrum Extended Detention Basin)

P2 Stage-Storage					
Elevation	Stage	Area [sf]	Area [ac]	Volume [cf]	Volume [ac-ft]
7022	0	0	0	0	0
7023	1	1,202	0.028	589	0.014
7024	2	7,565	0.174	4,909	0.113
7025	3	22,215	0.510	19,874	0.456
7026	4	43,195	0.992	52,579	1.207
7027	5	52,898	1.214	100,626	2.310
7028	6	57,025	1.309	155,587	3.572

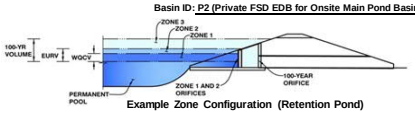
Pond P2 Outlet Curve	
Head (ft)	Flow (cfs)
0	0
0.5	0.04
1	0.06
1.5	0.07
2	0.13
2.5	0.18
3	0.23
3.5	0.34
4	0.45
4.1	0.46
4.2	0.48
4.3	0.5
4.4	0.51
4.5	2.18
4.6	6.14
4.7	11.39
4.8	17.72
4.9	24.94
5	32.95
5.1	41.69
5.2	51.09
5.3	61.12
5.4	71.7
5.5	82.87
5.6	94.57
5.7	106.77
5.8	109.32
5.9	110.13
6	110.94

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Clover Leaf

Basin ID: P2 (Private FSD EDB for Onsite Main Pond Basins)



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	30.50	acres
Watershed Length =	1,700	ft
Watershed Slope =	0.038	ft/ft
Watershed Imperviousness =	59.30%	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) =	0.594	acre-feet
Excess Urban Runoff Volume (EURV) =	1.960	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.607	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	2.165	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	2.831	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	3.743	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	4.394	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	5.248	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	1.505	acre-feet
Approximate 5-yr Detention Volume =	2.034	acre-feet
Approximate 10-yr Detention Volume =	2.626	acre-feet
Approximate 25-yr Detention Volume =	2.842	acre-feet
Approximate 50-yr Detention Volume =	2.963	acre-feet
Approximate 100-yr Detention Volume =	3.239	acre-feet

Optional User Override 1-hr Precipitation

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

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.594	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.366	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.279	acre-feet
Total Detention Basin Volume =	3.239	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)
7022	**Top of Micropool**	--	0.00	--	--	--	0	0.000		
7023		--	1.00	--	--	--	1,202	0.028	589	0.014
7024		--	2.00	--	--	--	7,565	0.174	4,909	0.113
7025.00		--	3.00	--	--	--	22,215	0.510	19,874	0.456
7026.00		--	4.00	--	--	--	43,195	0.992	52,579	1.207
7027.00		--	5.00	--	--	--	52,898	1.214	100,626	2.310
7028.00		--	6.00	--	--	--	57,025	1.309	155,587	3.572

POND P2 - FULL SPECTRUM EXTENDED DETENTION BASIN (SIZED FOR ON-SITE TRIBUTARY AREAS)

Pond P2 Drain Times							
Days	Hours	Depth (ft)	Volume (ft3)	Total Inflow (cfs)	Total Outflow (cfs)	Time Until Empty (hours)	Design Water Surface
0	0:00:00	0	-	0	0	80.50	
0	0:15:00	0.80	191.66	1.59	0.05	80.25	
0	0:30:00	2.30	5,196.71	12.07	0.16	80.00	
0	0:45:00	3.91	46,993.54	93.52	0.43	79.75	
0	1:00:00	5.05	133,941.60	116.3	37.61	79.50	
0	1:15:00	5.50	186,055.00	120.29	83.16	79.25	
0	1:30:00	5.65	204,975.80	109.33	100.18	79.00	
0	1:45:00	5.67	207,603.10	100.75	102.78	78.75	100-YR WSEL
0	2:00:00	5.63	202,896.90	90.99	98.7	78.50	
0	2:15:00	5.57	194,343.80	80.86	91.1	78.25	
0	2:30:00	5.49	183,951.40	68.87	81.84	78.00	
0	2:45:00	5.39	171,686.10	57.58	70.93	77.75	
0	3:00:00	5.29	159,871.00	48.18	60.48	77.50	
0	3:15:00	5.20	149,171.70	39.88	51.06	77.25	
0	3:30:00	5.11	139,519.00	32.65	42.72	77.00	
0	3:45:00	5.03	130,658.10	25.84	35.22	76.75	
0	4:00:00	4.94	122,176.10	19.04	28.22	76.50	
0	4:15:00	4.86	113,966.90	12.94	21.7	76.25	
0	4:30:00	4.77	106,358.80	7.96	15.94	76.00	
0	4:45:00	4.69	99,489.55	3.79	11.04	75.75	
0	5:00:00	4.62	93,414.63	1.22	7.23	75.50	
0	5:15:00	4.56	88,873.65	0.46	4.73	75.25	
0	5:30:00	4.52	85,522.57	0	3.02	75.00	EURV + WQCV = 85,377 cu-ft
0	5:45:00	4.49	83,314.84	0	2.05	74.75	
0	6:00:00	4.47	81,636.27	0	1.68	74.50	
0	6:15:00	4.45	80,264.22	0	1.37	74.25	
0	6:30:00	4.44	79,145.46	0	1.12	74.00	
0	6:45:00	4.42	78,235.11	0	0.91	73.75	
0	7:00:00	4.41	77,495.63	0	0.74	73.50	
0	7:15:00	4.41	76,895.81	0	0.6	73.25	
0	7:30:00	4.40	76,407.16	0	0.51	73.00	
0	7:45:00	4.39	75,948.59	0	0.51	72.75	
0	8:00:00	4.39	75,490.59	0	0.51	72.50	
0	8:15:00	4.38	75,033.17	0	0.51	72.25	
0	8:30:00	4.37	74,576.33	0	0.51	72.00	
0	8:45:00	4.37	74,120.08	0	0.51	71.75	
0	9:00:00	4.36	73,664.41	0	0.51	71.50	
0	9:15:00	4.35	73,209.33	0	0.51	71.25	
0	9:30:00	4.35	72,754.84	0	0.5	71.00	
0	9:45:00	4.34	72,300.93	0	0.5	70.75	
0	10:00:00	4.33	71,847.62	0	0.5	70.50	
0	10:15:00	4.33	71,394.91	0	0.5	70.25	

Pond P2 Drain Times							
Days	Hours	Depth (ft)	Volume (ft3)	Total Inflow (cfs)	Total Outflow (cfs)	Time Until Empty (hours)	Design Water Surface
0	10:30:00	4.32	70,942.78	0	0.5	70.00	
0	10:45:00	4.31	70,491.27	0	0.5	69.75	
0	11:00:00	4.31	70,040.34	0	0.5	69.50	
0	11:15:00	4.30	69,590.02	0	0.5	69.25	
0	11:30:00	4.29	69,140.59	0	0.5	69.00	
0	11:45:00	4.29	68,692.38	0	0.5	68.75	
0	12:00:00	4.28	68,245.38	0	0.5	68.50	
0	12:15:00	4.27	67,799.59	0	0.49	68.25	
0	12:30:00	4.27	67,355.02	0	0.49	68.00	
0	12:45:00	4.26	66,911.68	0	0.49	67.75	
0	13:00:00	4.25	66,469.56	0	0.49	67.50	
0	13:15:00	4.25	66,028.67	0	0.49	67.25	
0	13:30:00	4.24	65,589.02	0	0.49	67.00	
0	13:45:00	4.23	65,150.59	0	0.49	66.75	
0	14:00:00	4.23	64,713.40	0	0.49	66.50	
0	14:15:00	4.22	64,277.45	0	0.48	66.25	
0	14:30:00	4.21	63,842.74	0	0.48	66.00	
0	14:45:00	4.20	63,409.28	0	0.48	65.75	
0	15:00:00	4.20	62,977.07	0	0.48	65.50	
0	15:15:00	4.19	62,546.11	0	0.48	65.25	
0	15:30:00	4.18	62,116.40	0	0.48	65.00	
0	15:45:00	4.18	61,687.95	0	0.48	64.75	
0	16:00:00	4.17	61,260.76	0	0.47	64.50	
0	16:15:00	4.16	60,834.84	0	0.47	64.25	
0	16:30:00	4.16	60,410.18	0	0.47	64.00	
0	16:45:00	4.15	59,986.80	0	0.47	63.75	
0	17:00:00	4.14	59,564.69	0	0.47	63.50	
0	17:15:00	4.13	59,143.85	0	0.47	63.25	
0	17:30:00	4.13	58,724.30	0	0.47	63.00	
0	17:45:00	4.12	58,306.04	0	0.46	62.75	
0	18:00:00	4.11	57,889.06	0	0.46	62.50	
0	18:15:00	4.11	57,473.37	0	0.46	62.25	
0	18:30:00	4.10	57,058.97	0	0.46	62.00	
0	18:45:00	4.09	56,645.42	0	0.46	61.75	
0	19:00:00	4.08	56,232.53	0	0.46	61.50	
0	19:15:00	4.08	55,820.29	0	0.46	61.25	
0	19:30:00	4.07	55,408.71	0	0.46	61.00	
0	19:45:00	4.06	54,997.80	0	0.46	60.75	
0	20:00:00	4.05	54,587.55	0	0.46	60.50	
0	20:15:00	4.05	54,177.97	0	0.45	60.25	
0	20:30:00	4.04	53,769.06	0	0.45	60.00	
0	20:45:00	4.03	53,360.82	0	0.45	59.75	

Pond P2 Drain Times							
Days	Hours	Depth (ft)	Volume (ft3)	Total Inflow (cfs)	Total Outflow (cfs)	Time Until Empty (hours)	Design Water Surface
0	21:00:00	4.02	52,953.27	0	0.45	59.50	
0	21:15:00	4.02	52,546.39	0	0.45	59.25	
0	21:30:00	4.01	52,140.20	0	0.45	59.00	
0	21:45:00	4.00	51,734.70	0	0.45	58.75	
0	22:00:00	3.99	51,330.14	0	0.45	58.50	
0	22:15:00	3.99	50,927.09	0	0.45	58.25	
0	22:30:00	3.98	50,525.56	0	0.45	58.00	
0	22:45:00	3.97	50,125.57	0	0.44	57.75	
0	23:00:00	3.96	49,727.10	0	0.44	57.50	
0	23:15:00	3.96	49,330.17	0	0.44	57.25	
0	23:30:00	3.95	48,934.78	0	0.44	57.00	
0	23:45:00	3.94	48,540.92	0	0.44	56.75	
1	0:00:00	3.93	48,148.59	0	0.44	56.50	
1	0:15:00	3.92	47,757.81	0	0.43	56.25	
1	0:30:00	3.92	47,368.57	0	0.43	56.00	
1	0:45:00	3.91	46,980.88	0	0.43	55.75	
1	1:00:00	3.90	46,594.72	0	0.43	55.50	
1	1:15:00	3.89	46,210.12	0	0.43	55.25	
1	1:30:00	3.89	45,827.06	0	0.42	55.00	
1	1:45:00	3.88	45,445.56	0	0.42	54.75	
1	2:00:00	3.87	45,065.60	0	0.42	54.50	
1	2:15:00	3.86	44,687.20	0	0.42	54.25	
1	2:30:00	3.85	44,310.36	0	0.42	54.00	
1	2:45:00	3.85	43,935.07	0	0.42	53.75	
1	3:00:00	3.84	43,561.35	0	0.41	53.50	
1	3:15:00	3.83	43,189.19	0	0.41	53.25	
1	3:30:00	3.82	42,818.59	0	0.41	53.00	
1	3:45:00	3.81	42,449.55	0	0.41	52.75	
1	4:00:00	3.81	42,082.09	0	0.41	52.50	
1	4:15:00	3.80	41,716.20	0	0.41	52.25	
1	4:30:00	3.79	41,351.87	0	0.4	52.00	
1	4:45:00	3.78	40,989.13	0	0.4	51.75	
1	5:00:00	3.77	40,627.95	0	0.4	51.50	
1	5:15:00	3.77	40,268.36	0	0.4	51.25	
1	5:30:00	3.76	39,910.35	0	0.4	51.00	
1	5:45:00	3.75	39,553.92	0	0.4	50.75	
1	6:00:00	3.74	39,199.07	0	0.39	50.50	
1	6:15:00	3.73	38,845.82	0	0.39	50.25	
1	6:30:00	3.73	38,494.15	0	0.39	50.00	
1	6:45:00	3.72	38,144.07	0	0.39	49.75	
1	7:00:00	3.71	37,795.60	0	0.39	49.50	
1	7:15:00	3.70	37,448.71	0	0.38	49.25	

Pond P2 Drain Times							
Days	Hours	Depth (ft)	Volume (ft3)	Total Inflow (cfs)	Total Outflow (cfs)	Time Until Empty (hours)	Design Water Surface
1	7:30:00	3.69	37,103.43	0	0.38	49.00	
1	7:45:00	3.69	36,759.75	0	0.38	48.75	
1	8:00:00	3.68	36,417.68	0	0.38	48.50	
1	8:15:00	3.67	36,077.21	0	0.38	48.25	
1	8:30:00	3.66	35,738.35	0	0.38	48.00	
1	8:45:00	3.65	35,401.10	0	0.37	47.75	
1	9:00:00	3.65	35,065.47	0	0.37	47.50	
1	9:15:00	3.64	34,731.45	0	0.37	47.25	
1	9:30:00	3.63	34,399.06	0	0.37	47.00	
1	9:45:00	3.62	34,068.29	0	0.37	46.75	
1	10:00:00	3.61	33,739.15	0	0.36	46.50	
1	10:15:00	3.60	33,411.63	0	0.36	46.25	
1	10:30:00	3.60	33,085.75	0	0.36	46.00	
1	10:45:00	3.59	32,761.50	0	0.36	45.75	
1	11:00:00	3.58	32,438.89	0	0.36	45.50	
1	11:15:00	3.57	32,117.93	0	0.36	45.25	
1	11:30:00	3.56	31,798.60	0	0.35	45.00	
1	11:45:00	3.55	31,480.92	0	0.35	44.75	
1	12:00:00	3.55	31,164.90	0	0.35	44.50	
1	12:15:00	3.54	30,850.52	0	0.35	44.25	
1	12:30:00	3.53	30,537.81	0	0.35	44.00	
1	12:45:00	3.52	30,226.75	0	0.34	43.75	
1	13:00:00	3.51	29,917.36	0	0.34	43.50	
1	13:15:00	3.50	29,609.64	0	0.34	43.25	
1	13:30:00	3.50	29,303.58	0	0.34	43.00	
1	13:45:00	3.49	28,999.21	0	0.34	42.75	
1	14:00:00	3.48	28,696.51	0	0.34	42.50	
1	14:15:00	3.47	28,395.49	0	0.33	42.25	
1	14:30:00	3.46	28,096.15	0	0.33	42.00	
1	14:45:00	3.45	27,798.51	0	0.33	41.75	
1	15:00:00	3.44	27,502.56	0	0.33	41.50	
1	15:15:00	3.44	27,208.31	0	0.33	41.25	
1	15:30:00	3.43	26,915.76	0	0.32	41.00	
1	15:45:00	3.42	26,624.92	0	0.32	40.75	
1	16:00:00	3.41	26,335.79	0	0.32	40.50	
1	16:15:00	3.40	26,048.37	0	0.32	40.25	
1	16:30:00	3.39	25,762.67	0	0.32	40.00	WQCV = 25,874 cu-ft
1	16:45:00	3.38	25,478.69	0	0.31	39.75	
1	17:00:00	3.38	25,196.44	0	0.31	39.50	
1	17:15:00	3.37	24,915.93	0	0.31	39.25	
1	17:30:00	3.36	24,637.15	0	0.31	39.00	
1	17:45:00	3.35	24,360.12	0	0.31	38.75	

Pond P2 Drain Times							
Days	Hours	Depth (ft)	Volume (ft3)	Total Inflow (cfs)	Total Outflow (cfs)	Time Until Empty (hours)	Design Water Surface
1	18:00:00	3.34	24,084.83	0	0.3	38.50	
1	18:15:00	3.33	23,811.29	0	0.3	38.25	
1	18:30:00	3.32	23,539.52	0	0.3	38.00	
1	18:45:00	3.31	23,269.50	0	0.3	37.75	
1	19:00:00	3.30	23,001.26	0	0.3	37.50	
1	19:15:00	3.30	22,734.79	0	0.3	37.25	
1	19:30:00	3.29	22,470.10	0	0.29	37.00	
1	19:45:00	3.28	22,207.19	0	0.29	36.75	
1	20:00:00	3.27	21,946.08	0	0.29	36.50	
1	20:15:00	3.26	21,686.77	0	0.29	36.25	
1	20:30:00	3.25	21,429.26	0	0.29	36.00	
1	20:45:00	3.24	21,173.56	0	0.28	35.75	
1	21:00:00	3.23	20,919.68	0	0.28	35.50	
1	21:15:00	3.22	20,667.62	0	0.28	35.25	
1	21:30:00	3.21	20,417.39	0	0.28	35.00	
1	21:45:00	3.20	20,169.00	0	0.27	34.75	
1	22:00:00	3.19	19,922.46	0	0.27	34.50	
1	22:15:00	3.19	19,677.77	0	0.27	34.25	
1	22:30:00	3.18	19,434.94	0	0.27	34.00	
1	22:45:00	3.17	19,193.98	0	0.27	33.75	
1	23:00:00	3.16	18,954.90	0	0.26	33.50	
1	23:15:00	3.15	18,717.70	0	0.26	33.25	
1	23:30:00	3.14	18,482.40	0	0.26	33.00	
1	23:45:00	3.13	18,248.99	0	0.26	32.75	
2	0:00:00	3.12	18,017.51	0	0.26	32.50	
2	0:15:00	3.11	17,787.94	0	0.25	32.25	
2	0:30:00	3.10	17,560.30	0	0.25	32.00	
2	0:45:00	3.09	17,334.61	0	0.25	31.75	
2	1:00:00	3.08	17,110.87	0	0.25	31.50	
2	1:15:00	3.07	16,889.09	0	0.25	31.25	
2	1:30:00	3.06	16,669.29	0	0.24	31.00	
2	1:45:00	3.05	16,451.47	0	0.24	30.75	
2	2:00:00	3.04	16,235.65	0	0.24	30.50	
2	2:15:00	3.03	16,021.84	0	0.24	30.25	
2	2:30:00	3.02	15,810.05	0	0.23	30.00	
2	2:45:00	3.01	15,600.31	0	0.23	29.75	
2	3:00:00	3.00	15,392.59	0	0.23	29.50	
2	3:15:00	2.99	15,186.21	0	0.23	29.25	
2	3:30:00	2.98	14,980.78	0	0.23	29.00	
2	3:45:00	2.97	14,776.28	0	0.23	28.75	
2	4:00:00	2.96	14,572.74	0	0.23	28.50	
2	4:15:00	2.95	14,370.14	0	0.22	28.25	

Pond P2 Drain Times							
Days	Hours	Depth (ft)	Volume (ft3)	Total Inflow (cfs)	Total Outflow (cfs)	Time Until Empty (hours)	Design Water Surface
2	4:30:00	2.93	14,168.50	0	0.22	28.00	
2	4:45:00	2.92	13,967.82	0	0.22	27.75	
2	5:00:00	2.91	13,768.10	0	0.22	27.50	
2	5:15:00	2.90	13,569.34	0	0.22	27.25	
2	5:30:00	2.89	13,371.55	0	0.22	27.00	
2	5:45:00	2.88	13,174.74	0	0.22	26.75	
2	6:00:00	2.87	12,978.90	0	0.22	26.50	
2	6:15:00	2.86	12,784.04	0	0.22	26.25	
2	6:30:00	2.85	12,590.17	0	0.21	26.00	
2	6:45:00	2.84	12,397.29	0	0.21	25.75	
2	7:00:00	2.83	12,205.39	0	0.21	25.50	
2	7:15:00	2.82	12,014.50	0	0.21	25.25	
2	7:30:00	2.80	11,824.61	0	0.21	25.00	
2	7:45:00	2.79	11,635.72	0	0.21	24.75	
2	8:00:00	2.78	11,447.84	0	0.21	24.50	
2	8:15:00	2.77	11,260.98	0	0.21	24.25	
2	8:30:00	2.76	11,075.14	0	0.21	24.00	
2	8:45:00	2.75	10,890.33	0	0.2	23.75	
2	9:00:00	2.74	10,706.54	0	0.2	23.50	
2	9:15:00	2.72	10,523.79	0	0.2	23.25	
2	9:30:00	2.71	10,342.09	0	0.2	23.00	
2	9:45:00	2.70	10,161.43	0	0.2	22.75	
2	10:00:00	2.69	9,981.82	0	0.2	22.50	
2	10:15:00	2.68	9,803.27	0	0.2	22.25	
2	10:30:00	2.67	9,625.79	0	0.2	22.00	
2	10:45:00	2.65	9,449.37	0	0.2	21.75	
2	11:00:00	2.64	9,274.03	0	0.19	21.50	
2	11:15:00	2.63	9,099.78	0	0.19	21.25	
2	11:30:00	2.62	8,926.62	0	0.19	21.00	
2	11:45:00	2.61	8,754.55	0	0.19	20.75	
2	12:00:00	2.59	8,583.59	0	0.19	20.50	
2	12:15:00	2.58	8,413.75	0	0.19	20.25	
2	12:30:00	2.57	8,245.02	0	0.19	20.00	
2	12:45:00	2.56	8,077.42	0	0.19	19.75	
2	13:00:00	2.54	7,910.96	0	0.18	19.50	
2	13:15:00	2.53	7,745.64	0	0.18	19.25	
2	13:30:00	2.52	7,581.48	0	0.18	19.00	
2	13:45:00	2.50	7,418.48	0	0.18	18.75	
2	14:00:00	2.49	7,256.66	0	0.18	18.50	
2	14:15:00	2.48	7,096.02	0	0.18	18.25	
2	14:30:00	2.46	6,936.57	0	0.18	18.00	
2	14:45:00	2.45	6,778.33	0	0.18	17.75	

Pond P2 Drain Times							
Days	Hours	Depth (ft)	Volume (ft3)	Total Inflow (cfs)	Total Outflow (cfs)	Time Until Empty (hours)	Design Water Surface
2	15:00:00	2.44	6,621.31	0	0.17	17.50	
2	15:15:00	2.42	6,465.51	0	0.17	17.25	
2	15:30:00	2.41	6,310.95	0	0.17	17.00	
2	15:45:00	2.40	6,157.65	0	0.17	16.75	
2	16:00:00	2.38	6,005.62	0	0.17	16.50	
2	16:15:00	2.37	5,854.87	0	0.17	16.25	
2	16:30:00	2.35	5,705.42	0	0.17	16.00	
2	16:45:00	2.34	5,557.28	0	0.16	15.75	
2	17:00:00	2.32	5,410.47	0	0.16	15.50	
2	17:15:00	2.31	5,265.01	0	0.16	15.25	
2	17:30:00	2.29	5,120.92	0	0.16	15.00	
2	17:45:00	2.28	4,978.22	0	0.16	14.75	
2	18:00:00	2.26	4,836.93	0	0.16	14.50	
2	18:15:00	2.25	4,697.07	0	0.15	14.25	
2	18:30:00	2.23	4,558.67	0	0.15	14.00	
2	18:45:00	2.21	4,421.76	0	0.15	13.75	
2	19:00:00	2.20	4,286.36	0	0.15	13.50	
2	19:15:00	2.18	4,152.51	0	0.15	13.25	
2	19:30:00	2.16	4,020.24	0	0.15	13.00	
2	19:45:00	2.14	3,889.59	0	0.14	12.75	
2	20:00:00	2.12	3,760.60	0	0.14	12.50	
2	20:15:00	2.10	3,633.31	0	0.14	12.25	
2	20:30:00	2.08	3,507.79	0	0.14	12.00	
2	20:45:00	2.06	3,384.08	0	0.14	11.75	
2	21:00:00	2.04	3,262.26	0	0.13	11.50	
2	21:15:00	2.02	3,142.40	0	0.13	11.25	
2	21:30:00	2.00	3,024.59	0	0.13	11.00	
2	21:45:00	1.97	2,909.18	0	0.13	10.75	
2	22:00:00	1.95	2,796.35	0	0.12	10.50	
2	22:15:00	1.93	2,686.08	0	0.12	10.25	
2	22:30:00	1.90	2,578.39	0	0.12	10.00	
2	22:45:00	1.88	2,473.25	0	0.12	9.75	
2	23:00:00	1.85	2,370.68	0	0.11	9.50	
2	23:15:00	1.83	2,270.67	0	0.11	9.25	
2	23:30:00	1.81	2,173.22	0	0.11	9.00	
2	23:45:00	1.78	2,078.31	0	0.1	8.75	
3	0:00:00	1.76	1,985.95	0	0.1	8.50	
3	0:15:00	1.74	1,896.14	0	0.1	8.25	
3	0:30:00	1.71	1,808.86	0	0.1	8.00	
3	0:45:00	1.69	1,724.12	0	0.09	7.75	
3	1:00:00	1.67	1,641.91	0	0.09	7.50	
3	1:15:00	1.64	1,562.23	0	0.09	7.25	

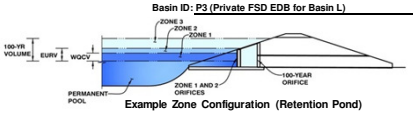
Pond P2 Drain Times							
Days	Hours	Depth (ft)	Volume (ft3)	Total Inflow (cfs)	Total Outflow (cfs)	Time Until Empty (hours)	Design Water Surface
3	1:30:00	1.62	1,485.06	0	0.08	7.00	
3	1:45:00	1.60	1,410.41	0	0.08	6.75	
3	2:00:00	1.57	1,338.27	0	0.08	6.50	
3	2:15:00	1.55	1,268.62	0	0.08	6.25	
3	2:30:00	1.53	1,201.48	0	0.07	6.00	
3	2:45:00	1.50	1,136.82	0	0.07	5.75	
3	3:00:00	1.48	1,073.93	0	0.07	5.50	
3	3:15:00	1.46	1,011.49	0	0.07	5.25	
3	3:30:00	1.43	949.49	0	0.07	5.00	
3	3:45:00	1.41	887.94	0	0.07	4.75	
3	4:00:00	1.38	826.87	0	0.07	4.50	
3	4:15:00	1.35	766.28	0	0.07	4.25	
3	4:30:00	1.32	706.21	0	0.07	4.00	
3	4:45:00	1.29	646.69	0	0.07	3.75	
3	5:00:00	1.26	587.74	0	0.07	3.50	
3	5:15:00	1.22	529.41	0	0.06	3.25	
3	5:30:00	1.18	471.76	0	0.06	3.00	
3	5:45:00	1.14	414.86	0	0.06	2.75	
3	6:00:00	1.09	358.83	0	0.06	2.50	
3	6:15:00	1.02	303.85	0	0.06	2.25	
3	6:30:00	0.93	250.84	0	0.06	2.00	
3	6:45:00	0.83	201.19	0	0.05	1.75	
3	7:00:00	0.73	155.07	0	0.05	1.50	
3	7:15:00	0.62	112.69	0	0.04	1.25	
3	7:30:00	0.51	74.29	0	0.04	1.00	
3	7:45:00	0.38	42.20	0	0.03	0.75	
3	8:00:00	0.26	19.02	0	0.02	0.50	
3	8:15:00	0.13	4.84	0	0.01	0.25	
3	8:30:00	-	-	0	0	0.00	Pond Empty

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Cloverleaf Subdivision

Basin ID: P3 (Private FSD EDB for Basin L)



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	1.90	acres
Watershed Length =	660	ft
Watershed Slope =	0.045	ft/ft
Watershed Imperviousness =	41.40%	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) =	0.029	acre-feet
Excess Urban Runoff Volume (EURV) =	0.083	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.066	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.091	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.128	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	0.190	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	0.232	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	0.287	acre-feet
500-yr Runoff Volume (P1 = 3 in.) =	0.381	acre-feet
Approximate 2-yr Detention Volume =	0.061	acre-feet
Approximate 5-yr Detention Volume =	0.085	acre-feet
Approximate 10-yr Detention Volume =	0.117	acre-feet
Approximate 25-yr Detention Volume =	0.130	acre-feet
Approximate 50-yr Detention Volume =	0.136	acre-feet
Approximate 100-yr Detention Volume =	0.156	acre-feet

Optional User Override 1-hr Precipitation

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

Stage-Storage Calculation

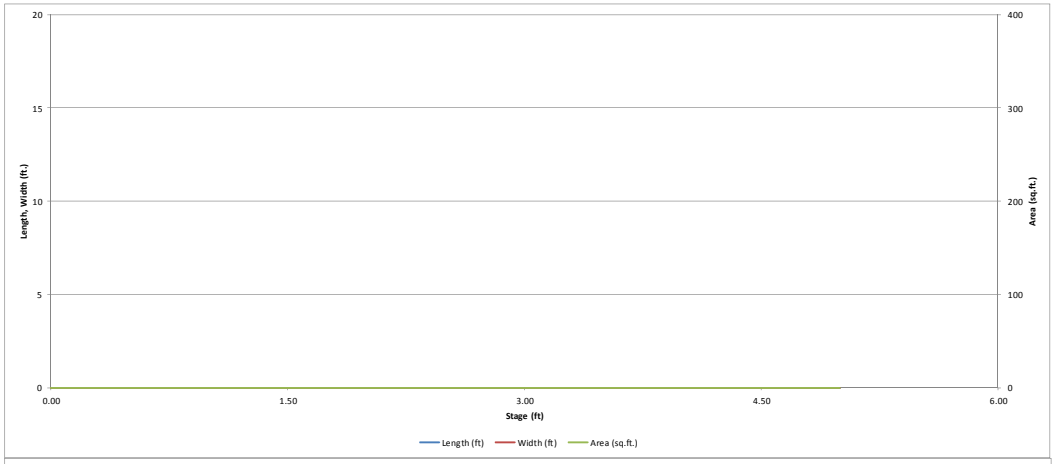
Zone 1 Volume (WQCV) =	0.029	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.054	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.073	acre-feet
Total Detention Basin Volume =	0.156	acre-feet
Initial Surcharge Volume (I_{SV}) =	user	ft^3
Initial Surcharge Depth (I_{SD}) =	user	ft
Total Available Detention 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_{IA}) =	user	ft^2
Surcharge Volume Length (L_{SV}) =	user	ft
Surcharge Volume Width (W_{SV}) =	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

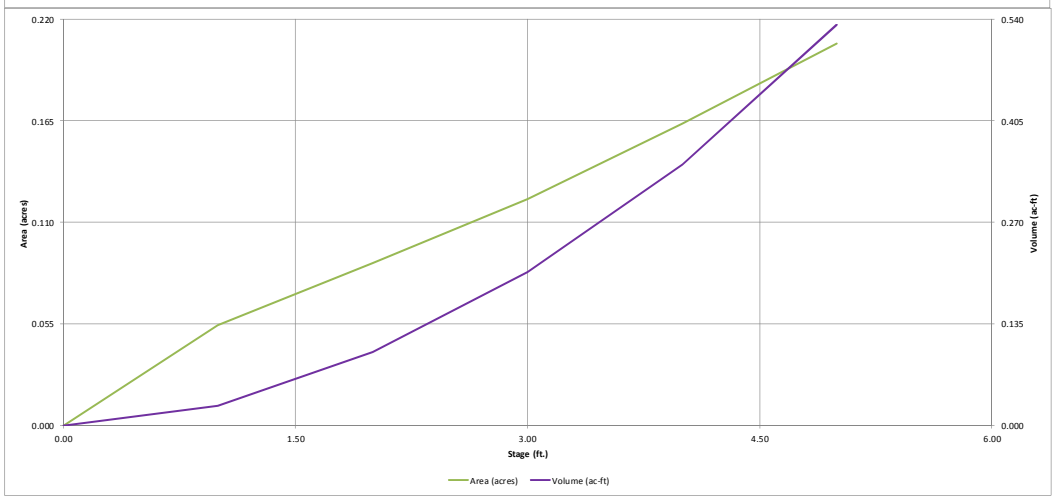
Depth Increment = ft

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)
7045 Top of Micropool	--	0.00	--	--	--	0	0.000		
7046	--	1.00	--	--	--	2,374	0.054	1,163	0.027
7047	--	2.00	--	--	--	3,833	0.088	4,252	0.098
7048.00	--	3.00	--	--	--	5,335	0.122	8,874	0.204
7049.00	--	4.00	--	--	--	7,124	0.164	15,104	0.347
7050.00	--	5.00	--	--	--	9,003	0.207	23,167	0.532

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



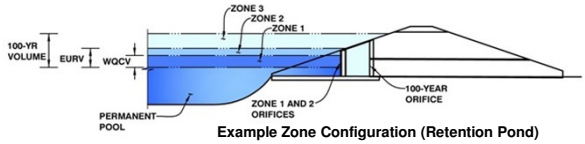


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Cloverleaf Subdivision

Basin ID: P3 (Private FSD EDB for Basin L)



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.04	0.029	Orifice Plate
Zone 2 (EURV)	1.82	0.054	Orifice Plate
Zone 3 (100-year)	2.59	0.073	Weir&Pipe (Restrict)
		0.156	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	1.82	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.80	1.80					
Orifice Area (sq. inches)	0.31	0.31	0.31					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	1.83	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	1.83	N/A	feet
Over Flow Weir Slope Length =	2.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	16.85	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	2.80	N/A	ft^2
Overflow Grate Open Area w/ Debris =	1.40	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	2.70		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.17	N/A	ft^2
Outlet Orifice Centroid =	0.13	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	0.80	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	1.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

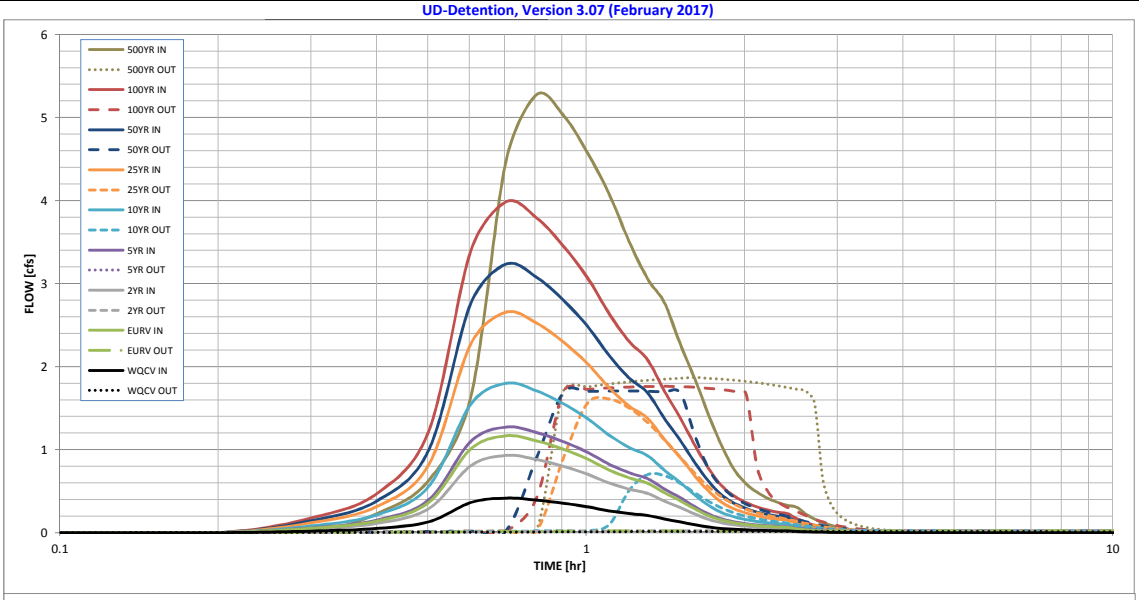
Spillway Design Flow Depth=	0.59	feet
Stage at Top of Freeboard =	4.59	feet
Basin Area at Top of Freeboard =	0.19	acres

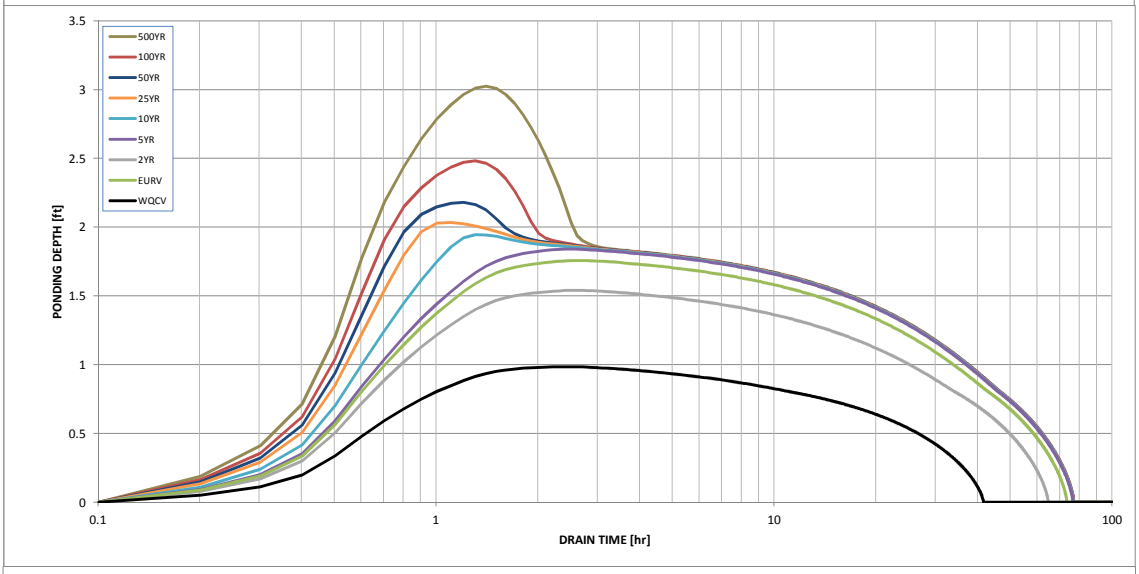
Routed Hydrograph Results

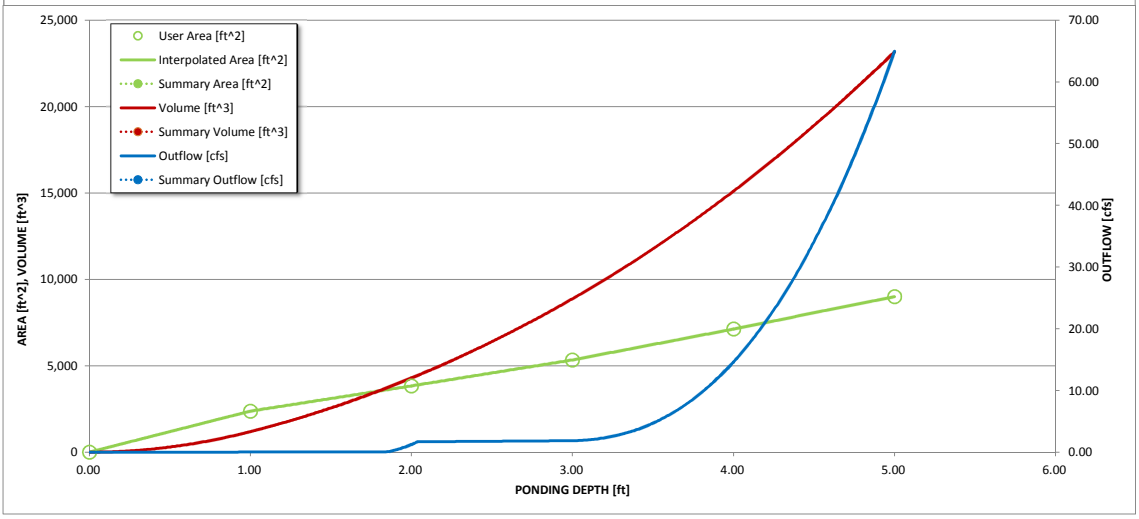
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.00
Calculated Runoff Volume (acre-ft) =	0.029	0.083	0.066	0.091	0.128	0.190	0.232	0.287	0.381
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.029	0.082	0.065	0.090	0.128	0.190	0.232	0.287	0.381
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.15	0.52	0.73	0.99	1.40
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.0	0.3	1.0	1.4	1.9	2.7
Peak Inflow Q (cfs) =	0.4	1.2	0.9	1.3	1.8	2.7	3.2	4.0	5.3
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.7	1.6	1.7	1.8	1.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.5	2.4	1.6	1.2	0.9	0.7
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.2	0.5	0.6	0.6	0.6
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	67	59	69	67	64	62	59	55
Time to Drain 99% of Inflow Volume (hours) =	**40**	71	62	73	73	71	70	69	68
Maximum Ponding Depth (ft) =	0.99	1.76	1.54	1.84	1.94	2.03	2.18	2.48	3.02
Area at Maximum Ponding Depth (acres) =	0.05	0.08	0.07	0.08	0.09	0.09	0.09	0.10	0.12
Maximum Volume Stored (acre-ft) =	0.026	0.078	0.062	0.085	0.093	0.101	0.114	0.145	0.206

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	WORKBOOK
	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]
6.04 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:06:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:12:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:18:07	0.02	0.05	0.04	0.06	0.08	0.12	0.15	0.18	0.24
0.828	0:24:10	0.05	0.14	0.11	0.16	0.22	0.32	0.39	0.48	0.63
	0:30:12	0.13	0.37	0.29	0.40	0.56	0.83	1.00	1.23	1.63
	0:36:14	0.36	1.01	0.80	1.10	1.55	2.27	2.76	3.39	4.47
	0:42:17	0.42	1.17	0.93	1.27	1.80	2.65	3.23	3.98	5.27
	0:48:19	0.39	1.11	0.88	1.21	1.71	2.52	3.08	3.79	5.03
	0:54:22	0.35	1.00	0.80	1.10	1.55	2.29	2.80	3.45	4.57
	1:00:24	0.31	0.89	0.70	0.97	1.37	2.04	2.49	3.07	4.07
	1:06:26	0.26	0.75	0.60	0.82	1.17	1.74	2.13	2.63	3.50
	1:12:29	0.23	0.66	0.52	0.72	1.03	1.52	1.86	2.30	3.06
	1:18:31	0.21	0.60	0.47	0.65	0.93	1.38	1.68	2.08	2.77
	1:24:34	0.17	0.48	0.38	0.53	0.75	1.12	1.38	1.70	2.27
	1:30:36	0.13	0.38	0.30	0.42	0.60	0.91	1.11	1.38	1.85
	1:36:38	0.09	0.28	0.22	0.31	0.45	0.68	0.84	1.05	1.41
	1:42:41	0.07	0.20	0.16	0.22	0.33	0.50	0.61	0.77	1.04
	1:48:43	0.05	0.15	0.12	0.17	0.24	0.37	0.45	0.56	0.76
	1:54:46	0.04	0.12	0.09	0.13	0.19	0.29	0.35	0.44	0.59
	2:00:48	0.03	0.10	0.08	0.11	0.16	0.24	0.29	0.36	0.49
	2:06:50	0.03	0.09	0.07	0.09	0.13	0.20	0.25	0.31	0.41
	2:12:53	0.03	0.08	0.06	0.08	0.12	0.18	0.22	0.27	0.36
	2:18:55	0.02	0.07	0.05	0.07	0.11	0.16	0.20	0.25	0.33
	2:24:58	0.02	0.06	0.05	0.07	0.10	0.15	0.18	0.23	0.30
	2:31:00	0.02	0.05	0.04	0.05	0.07	0.11	0.13	0.17	0.22
	2:37:02	0.01	0.03	0.03	0.04	0.05	0.08	0.10	0.12	0.16
	2:43:05	0.01	0.02	0.02	0.03	0.04	0.06	0.07	0.09	0.12
	2:49:07	0.01	0.02	0.01	0.02	0.03	0.04	0.05	0.07	0.09
	2:55:10	0.00	0.01	0.01	0.01	0.02	0.03	0.04	0.05	0.06
	3:01:12	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.03	0.04
	3:07:14	0.00	0.01	0.00	0.01	0.01	0.01	0.02	0.02	0.03
	3:13:17	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02
	3:19:19	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
	3:25:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	3:31:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:37:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:43:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:49:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:01:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:07:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:13:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:19:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:31:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:37:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:43:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:49:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:02:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:08:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:14:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:26:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:32:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:38:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:44:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:56:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:02:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:08:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:14:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:20:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:26:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:32:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:38:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:44:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:50:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:56:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:02:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:08:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:14:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

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

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

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

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

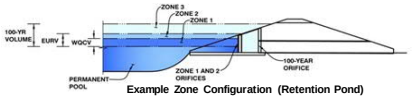
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Cloverleaf Subdivision

Basin ID: P4 (Private WQ pond on west side of site)



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	2.12	acres
Watershed Length =	400	ft
Watershed Slope =	0.075	ft/ft
Watershed Imperviousness =	60.30%	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) =	0.042	acre-feet
Excess Urban Runoff Volume (EURV) =	0.139	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.114	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.153	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.200	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	0.263	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	0.308	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	0.367	acre-feet
500-yr Runoff Volume (P1 = 3 in.) =	0.469	acre-feet
Approximate 2-yr Detention Volume =	0.107	acre-feet
Approximate 5-yr Detention Volume =	0.144	acre-feet
Approximate 10-yr Detention Volume =	0.185	acre-feet
Approximate 25-yr Detention Volume =	0.201	acre-feet
Approximate 50-yr Detention Volume =	0.209	acre-feet
Approximate 100-yr Detention Volume =	0.228	acre-feet

Optional User Override 1-hr Precipitation

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

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.042	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.042	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

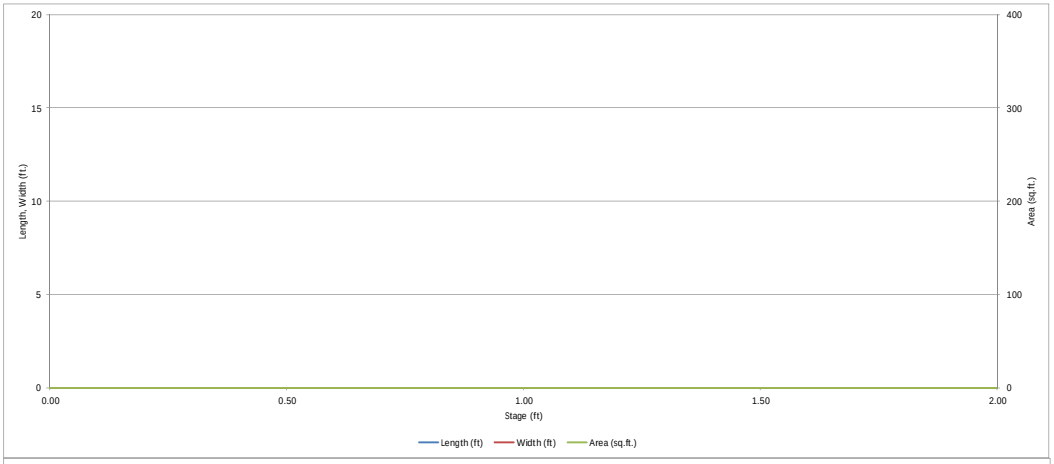
Total detention volume is less than 100-year volume.

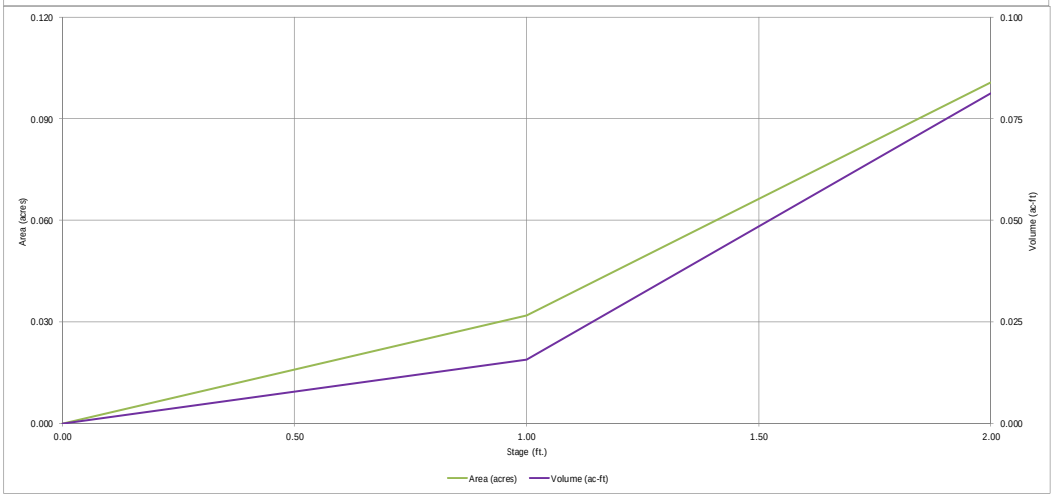
Depth Increment = ft

	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)
7004	**Top of Micropool**	--	0.00	--	--	--	0	0.000		
7005		--	1.00	--	--	--	1,392	0.032	682	0.016
7006		--	2.00	--	--	--	4,381	0.101	3,539	0.081

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



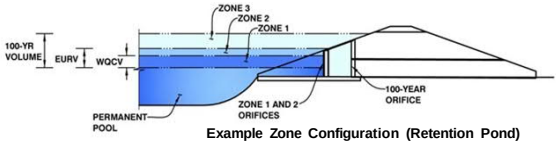


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Cloverleaf Subdivision

Basin ID: P4 (Private WQ pond on west side of site)



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.53	0.042	Orifice Plate
Zone 2			
Zone 3			
		0.042	Total

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

			Calculated Parameters for Underdrain		
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

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

			Calculated Parameters for Plate		
Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	1.47	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00							
Orifice Area (sq. inches)	0.35							

	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		Calculated Parameters for Vertical Orifice	Not Selected	Not Selected	
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =			ft^2
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =			feet
Vertical Orifice Diameter =			inches				

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

	Not Selected	Not Selected		Calculated Parameters for Overflow Weir	Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =			feet
Overflow Weir Front Edge Length =			feet	Over Flow Weir Slope Length =			feet
Overflow Weir Slope =			H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =			should be ≥ 4
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =			ft^2
Overflow Grate Open Area % =			%, grate open area/total area	Overflow Grate Open Area w/ Debris =			ft^2
Debris Clogging % =			%				

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

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

User Input: Emergency Spillway (Rectangular or Trapezoidal)

			Calculated Parameters for Spillway		
Spillway Invert Stage=		ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=		feet
Spillway Crest Length =		feet	Stage at Top of Freeboard =		feet
Spillway End Slopes =		H:V	Basin Area at Top of Freeboard =		acres
Freeboard above Max Water Surface =		feet			

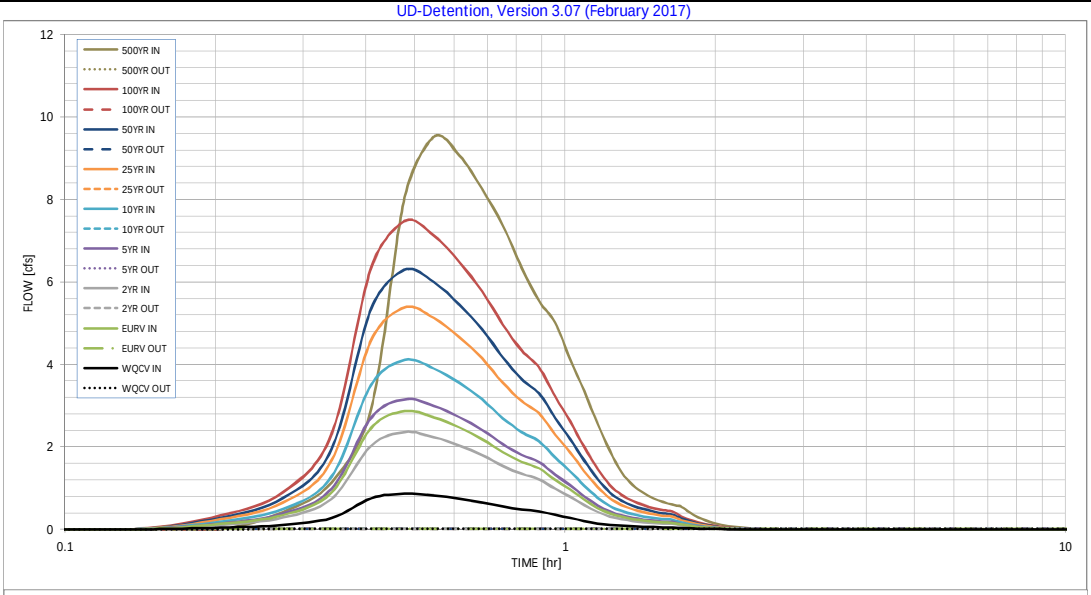
Routed Hydrograph Results

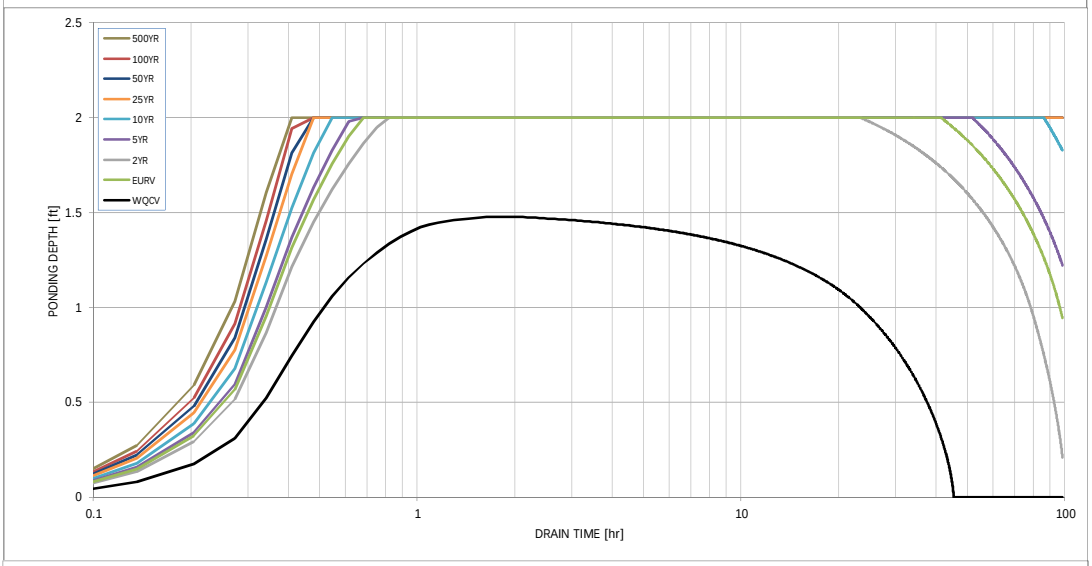
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.00
Calculated Runoff Volume (acre-ft) =	0.042	0.139	0.114	0.153	0.200	0.263	0.308	0.367	0.469
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.041	0.139	0.114	0.153	0.200	0.263	0.308	0.367	0.468
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.03	0.25	0.79	1.09	1.46	2.06
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.1	0.5	1.7	2.3	3.1	4.4
Peak Inflow Q (cfs) =	0.9	2.9	2.4	3.2	4.1	5.4	6.3	7.5	9.5
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.0	0.0	0.0	0.0	0.0
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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) =	42	>120	94	>120	>120	>120	>120	>120	>120
Time to Drain 99% of Inflow Volume (hours) =	44	>120	98	>120	>120	>120	>120	>120	>120
Maximum Ponding Depth (ft) =	1.48	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Area at Maximum Ponding Depth (acres) =	0.06	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Maximum Volume Stored (acre-ft) =	0.039	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081

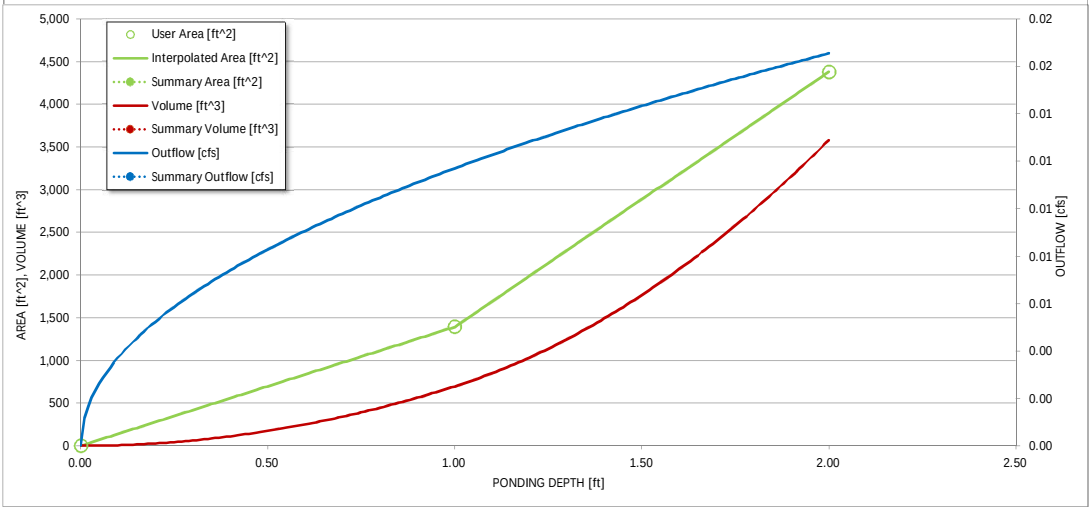
NOTE: THIS IS A PRIVATE WATER QUALITY POND.

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	WORKBOOK
	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]
4.10 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:04:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:08:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:12:18	0.04	0.13	0.11	0.14	0.19	0.24	0.28	0.34	0.42
1.220	0:16:24	0.11	0.35	0.29	0.38	0.50	0.65	0.76	0.90	1.14
	0:20:30	0.27	0.89	0.74	0.98	1.28	1.67	1.95	2.31	2.93
	0:24:36	0.75	2.46	2.03	2.70	3.51	4.59	5.35	6.35	8.05
	0:28:42	0.87	2.86	2.36	3.15	4.10	5.38	6.30	7.48	9.52
	0:32:48	0.82	2.72	2.24	3.00	3.90	5.12	5.99	7.13	9.07
	0:36:54	0.74	2.47	2.03	2.72	3.55	4.66	5.45	6.48	8.26
	0:41:00	0.65	2.19	1.80	2.41	3.15	4.14	4.85	5.77	7.36
	0:45:06	0.55	1.87	1.53	2.06	2.70	3.56	4.17	4.97	6.34
	0:49:12	0.48	1.64	1.34	1.80	2.36	3.11	3.64	4.33	5.53
	0:53:18	0.43	1.48	1.21	1.63	2.13	2.81	3.29	3.92	5.01
	0:57:24	0.35	1.20	0.98	1.33	1.74	2.30	2.70	3.22	4.12
	1:01:30	0.28	0.96	0.79	1.07	1.40	1.86	2.19	2.62	3.36
	1:05:36	0.20	0.72	0.59	0.80	1.06	1.41	1.66	2.00	2.57
	1:09:42	0.14	0.52	0.42	0.58	0.77	1.03	1.22	1.47	1.90
	1:13:48	0.11	0.39	0.31	0.43	0.57	0.76	0.89	1.07	1.38
	1:17:54	0.09	0.30	0.25	0.34	0.44	0.59	0.70	0.84	1.08
	1:22:00	0.07	0.25	0.20	0.28	0.37	0.49	0.57	0.69	0.89
	1:26:06	0.06	0.21	0.18	0.24	0.31	0.42	0.49	0.59	0.75
	1:30:12	0.05	0.19	0.15	0.21	0.28	0.37	0.43	0.52	0.66
	1:34:18	0.05	0.17	0.14	0.19	0.25	0.33	0.39	0.46	0.60
	1:38:24	0.05	0.16	0.13	0.18	0.23	0.31	0.36	0.43	0.55
	1:42:30	0.03	0.12	0.10	0.13	0.17	0.22	0.26	0.32	0.40
	1:46:36	0.02	0.09	0.07	0.09	0.12	0.16	0.19	0.23	0.30
	1:50:42	0.02	0.06	0.05	0.07	0.09	0.12	0.14	0.17	0.22
	1:54:48	0.01	0.05	0.04	0.05	0.07	0.09	0.10	0.12	0.16
	1:58:54	0.01	0.03	0.03	0.04	0.05	0.06	0.07	0.09	0.11
	2:03:00	0.01	0.02	0.02	0.02	0.03	0.04	0.05	0.06	0.08
	2:07:06	0.00	0.02	0.01	0.02	0.02	0.03	0.04	0.04	0.06
	2:11:12	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.04
	2:15:18	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.02	0.02
	2:19:24	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
	2:23:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:27:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:31:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:39:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:44:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:48:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:52:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:56:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:04:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:08:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:12:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:16:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:29:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:33:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:37:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:41:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:49:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:53:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:57:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:01:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:06:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:14:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:18:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:22:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:26:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:34:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:38:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:42:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:47:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:51:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

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

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

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

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

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

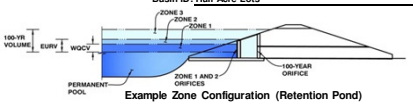
Sand Filter Sizing for lots 148-150 (Half Acre Lots)

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Cloverleaf Subdivision

Basin ID: Half-Acre Lots



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	SF		
Watershed Area =	0.50	acres	
Watershed Length =	200	ft	
Watershed Slope =	0.050	ft/ft	
Watershed Imperviousness =	25.00%	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 =	12.0	hours	
Location for 1-hr Rainfall Depths =	User Input		
Water Quality Capture Volume (WQCV) =	0.004	acre-feet	
Excess Urban Runoff Volume (EURV) =	0.013	acre-feet	
2-yr Runoff Volume (P1 = 1.19 in.) =	0.010	acre-feet	
5-yr Runoff Volume (P1 = 1.5 in.) =	0.014	acre-feet	
10-yr Runoff Volume (P1 = 1.75 in.) =	0.022	acre-feet	
25-yr Runoff Volume (P1 = 2 in.) =	0.040	acre-feet	
50-yr Runoff Volume (P1 = 2.25 in.) =	0.051	acre-feet	
100-yr Runoff Volume (P1 = 2.52 in.) =	0.066	acre-feet	
500-yr Runoff Volume (P1 = 3 in.) =	0.092	acre-feet	
Approximate 2-yr Detention Volume =	0.009	acre-feet	
Approximate 5-yr Detention Volume =	0.013	acre-feet	
Approximate 10-yr Detention Volume =	0.020	acre-feet	
Approximate 25-yr Detention Volume =	0.023	acre-feet	
Approximate 50-yr Detention Volume =	0.025	acre-feet	
Approximate 100-yr Detention Volume =	0.030	acre-feet	

Optional User Override 1-hr Precipitation

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

Stage-Storage Calculation

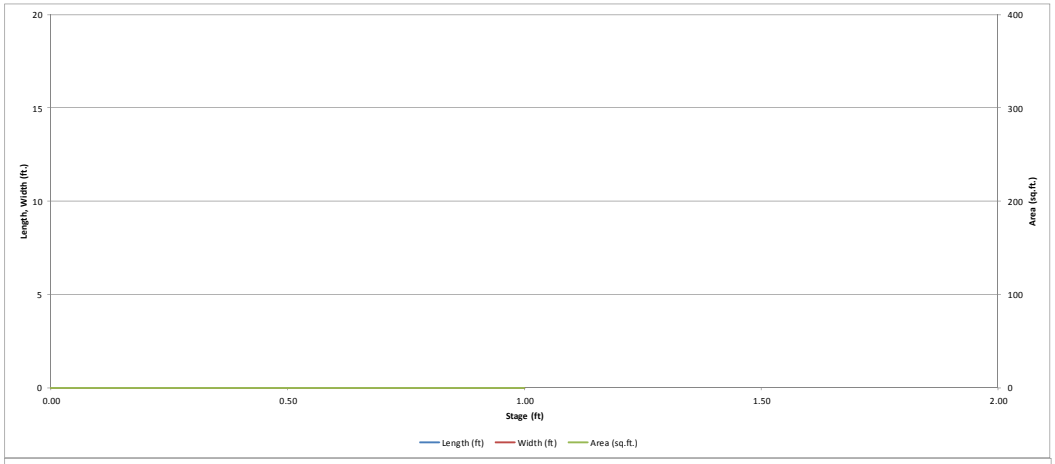
Zone 1 Volume (WQCV) =	0.004	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.008	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.017	acre-feet
Total Detention Basin Volume =	0.030	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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

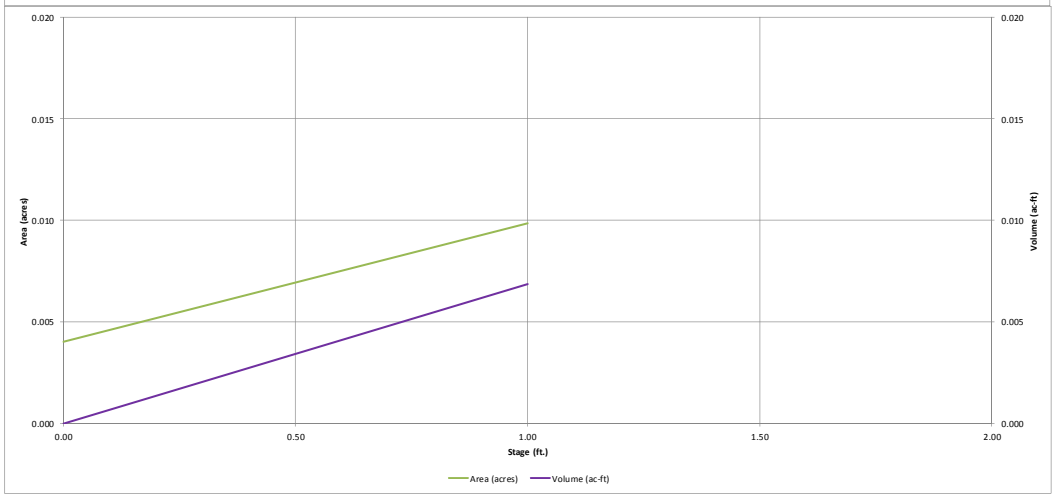
Depth Increment = ft

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)
7000 **Media Surface**	--	0.00	--	--	--	176	0.004		
7001	--	1.00	--	--	--	429	0.010	298	0.007

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)





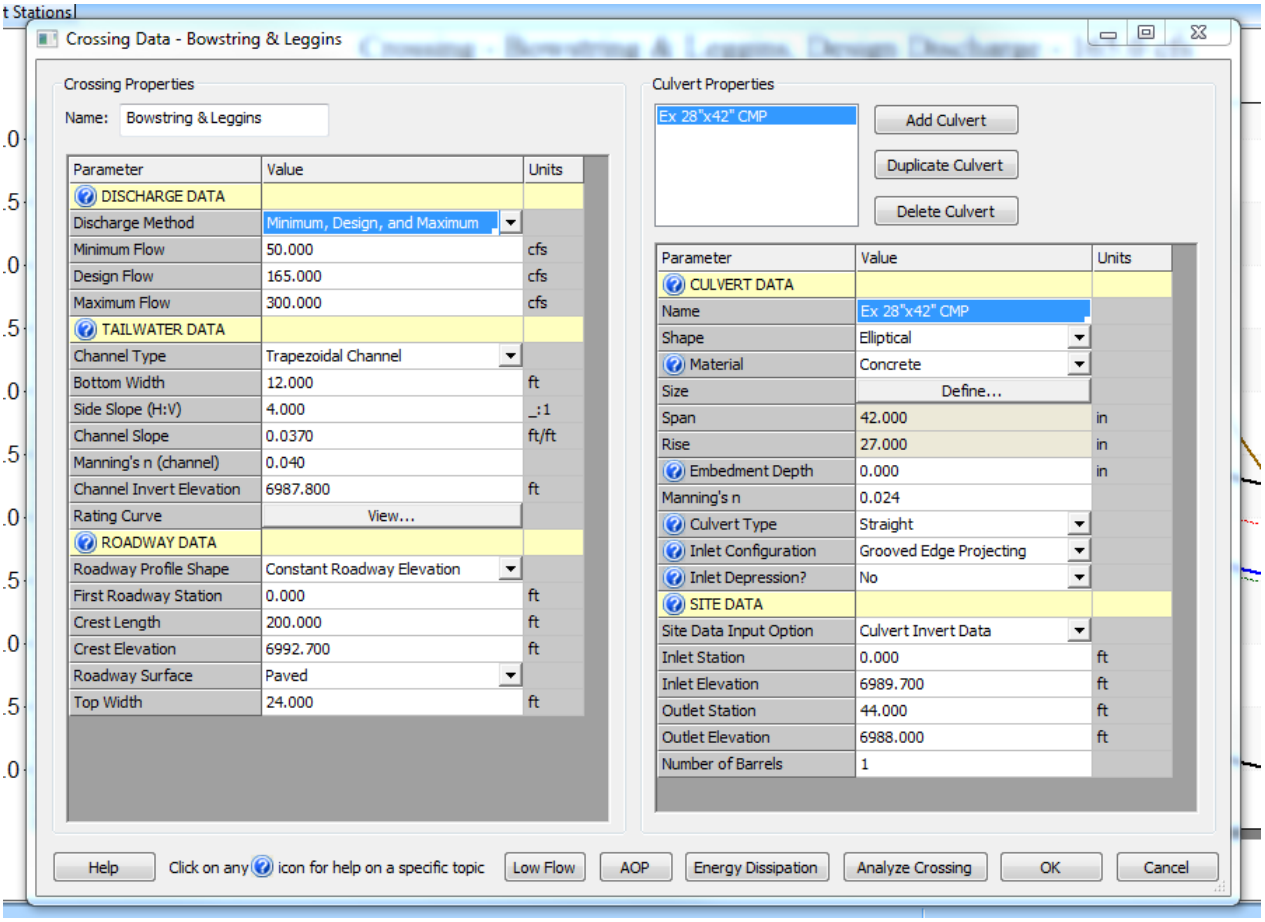
HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: Bowstring & Leggins

Headwater Elevation (ft)	Total Discharge (cfs)	Ex 28"x42" CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
6992.74	50.00	44.73	4.82	11
6992.83	75.00	46.06	28.52	6
6992.90	100.00	46.99	52.75	5
6992.96	125.00	47.77	76.85	4
6993.01	150.00	48.46	101.35	4
6993.03	165.00	48.84	115.74	3
6993.10	200.00	49.65	149.82	3
6993.14	225.00	50.18	174.60	3
6993.18	250.00	50.69	199.18	3
6993.22	275.00	51.17	223.76	3
6993.25	300.00	51.64	248.33	3
6992.70	44.12	44.12	0.00	Overtopping

Proposed Q100 = 165 cfs (existing = 282 cfs)



Appendix E
Reference Material

J·R ENGINEERING
A Westrian Company

FINAL DRAINAGE REPORT
FOR
WALTERS COMMONS

APRIL 2005

Prepared For:

PULTE HOME CORPORATION
1975 Research Parkway
Colorado Springs, CO 80920
(719) 536-4200

Prepared By:

JR ENGINEERING
4310 ArrowsWest Drive
Colorado Springs, CO 80907
(719) 593-2593

Job No. 9170.72

FINAL DRAINAGE REPORT
FOR
WALTERS COMMONS

DRAINAGE REPORT STATEMENT

J·R ENGINEERING
A Westrian Company

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

COLORADO REGISTERED TROY D. KENT 35996 PROFESSIONAL ENGINEER

Troy D. Kent, Colorado P.E. #35996
For and On Behalf of JR Engineering

5/2/05
Date

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

Business Name: Pulte Homes

By:

Title: Senior Project Manager

Address: 1975 Research Parkway

Colorado Springs, CO 80920

EL PASO COUNTY ONLY:
Filed in accordance with Section 51.1 of the El Paso Land Development Code, as amended.

John A. McCarty
John McCarty
County Engineer/Director

5-4-05
Date

Conditions:

4310 ArrowsWest Drive, Colorado Springs, CO 80907
719-593-2593 • Fax: 719-528-6613 • www.jrengineering.com

As indicated in the Basin Summary on the previous page, the rational method yields higher runoff amounts in all cases. This is consistent with what would be expected when applying the two methodologies to the same basin.

PROPOSED DRAINAGE CONDITIONS

Walters Commons is a proposed 291-unit townhome project on 32.3 acres. Filing 1 consists of 178 units on 18.7 acres. Proposed drainage patterns are as identified on the PROPOSED DRAINAGE MAP located in the Appendix. The general drainage concept is to collect developed runoff via a proposed R.C.P. storm sewer system and transport the runoff to two private on-site detention ponds located on the south and southwest sides of the proposed development.

The proposed private storm sewer and detention pond system will be designed to release storm water at historic rates into the Higby Road right-of-way and existing storm drain facilities under Higby Road. (See the EXISTING DRAINAGE MAP in the Appendix).

The proposed Walters Commons Development has been divided into 13 on-site sub-basins labeled A-M. Twelve off-site basins with the prefix "OS" have been identified to account for the remaining drainage from the existing sub-basins that flow through the site to four critical design points.

Proposed on-site Drainage Basin A (Q_5= 1 cfs, Q_{100}= 3 cfs), Basin B (Q_5= 3 cfs, Q_{100}= 6 cfs), Basin C (Q_5= 5 cfs, Q_{100}= 10 cfs) and Basin D (Q_5= 1 cfs, Q_{100}= 2 cfs) are comprised of a multi-family residential development and will drain to the northwest. Storm water from OS-3, Basins C and D flows through the north ditch of Magic Lamp Way to the east roadside ditch of Bowstring Road toward DP4. Proposed flows at DP4 combine with flows from Basin A in the ditch east of Bowstring and flow toward DP1. Existing flows from OS-4 will be intercepted on-site by an area inlet at DP3 and flow via an 24" storm pipe to DP2. The developed flows of Basin B are intercepted by a proposed private inlet at DP2, combine with pipe flows from DP3, and travel through a proposed private 24" R.C.P. storm sewer to DP1. The total developed flows from Basins A, B, C, D, OS-2, OS-3 and OS-4 at DP1 are Q_5= 12 cfs and Q_{100}= 27 cfs. The existing flow at DP1 is Q_5= 6 cfs, Q_{100}= 16 cfs. The flows from DP1 travel north along Bowstring Road to an existing 24" CMP

storm drain under Leggins Way and then through an existing 36" CMP storm drain under Bowstring Road and outlet into a 6' wide by 4' deep grass ditch on the Lewis Palmer High School property. These pipes and grass ditch have adequate capacity to carry the developed flows and will not need to be modified. (See Existing Facility Hydraulic Calculations in the Appendix). Existing Roadside ditches along Magic Lamp Way and Bowstring Road has 10 cfs capacity. The east ditch of Bowstring Road will be regarded from Magic Lamp Way to the north property line as part of the Bowstring Road paving improvements. This regarded ditch will direct flows from Magic Lamp Way, under Timber Run through the proposed 24" RCP culvert to the existing ditch north of the property line. The capacity of this ditch will be 13 cfs, developed flows in the 100-year condition through this ditch are 12 cfs.

Off-site Drainage Basin OS-5 (Q_5= 19 cfs, Q_{100}= 47 cfs) is comprised primarily of undeveloped area and a small portion of street. This off-site basin is part of EB1b. (See EXISTING DRAINAGE MAP in the Appendix). OS-5 flows travel through Country Ridge Estates and combine with OS-6 (Q_5= 3 cfs, Q_{100}= 7 cfs) and travel along the south ditch of Magic Lamp Way to the east ditch of Bowstring Road to DP7 in the southwest corner of the site (See Proposed Drainage Map in the Appendix).

Offsite flows from OS-7 (Q_5= 4 cfs, Q_{100}= 10 cfs) combine with on-site basin I (Q_5= 0.2 cfs, Q_{100}= 1 cfs), flow through the southern portion of the existing Country Ridge Estates and flow onto the proposed development at Basin G (Q_5= 5 cfs, Q_{100}= 10 cfs). A proposed private 20' At-Grade inlet at DP5 intercepts these flows. The intercepted flows will be routed through an 18" RCP storm sewer to the proposed sump inlet at DP6. (See Proposed Drainage Map.)

Bypass flow from the inlet at DP5 (Q_5= 2 cfs, Q_{100}= 6 cfs) continues into Basin F in the curb and gutter of Yellow Dogwood Heights and is intercepted at DP6 by a proposed 20' private sump inlet (See Inlet Sizing Calculations in the Appendix). The developed flows at DP6 sump inlet at (Q_5= 15 cfs, Q_{100}= 30 cfs). Combined flows from DP5 and DP6 will be routed to a proposed private detention pond through a proposed private 24" R.C.P. storm pipe. This 0.79 acre-foot detention facility will have an allowable outflow equal to or less than 78 cfs to ensure that peak drainage flows at Design Point 7 (DP7) are reduced to the historic rates of Q_5= 33 cfs and Q_{100}= 78 cfs. (See EXISTING

HYDROLOGIC CALCULATIONS in the Appendix). Developed Flows at DP7 include drainage from DP5, DP6, Basin E, Basin M, OS-6 and OS-5. The total developed flows in the proposed detention pond (DP6a) are $Q_5 = 17$ cfs and $Q_{100} = 36$ cfs. As mentioned above, the outfall structure will restrict 100-year flow from the proposed detention pond to ensure that DP7 flows are 78 cfs or less. Calculations for the outfall structure for this detention facility can be found in the "Storm Sewer Routing and Proposed Drainage Structures" section of this report.

Flows from Basin OS-9 ($Q_5 = 2$ cfs, $Q_{100} = 4$ cfs) travel on-site to Proposed Basin H ($Q_5 = 10$ cfs, $Q_{100} = 20$ cfs). A proposed curb opening and concrete swale at DP8 intercept flows from these basins. Flows from DP8 are routed through the swale to a 24" RCP storm sewer and outlet into the proposed 1.83 acre-ft detention pond on the south-central portion of the development. Bypass flows at DP8 ($Q_5 = 5$ cfs, $Q_{100} = 8$ cfs) will continue along Yellow Dogwood Heights to the sump inlet at DP6. (See Proposed Drainage Map in the Appendix.)

At Design Point 9, drainage from Basin OS-11 ($Q_5 = 2$ cfs, $Q_{100} = 4$ cfs) and Basin L ($Q_5 = 1$ cfs, $Q_{100} = 2$ cfs), Basin K ($Q_5 = 8$ cfs, $Q_{100} = 17$ cfs) combines for a resultant flow of $Q_5 = 9$ cfs and $Q_{100} = 19$ cfs. This water is intercepted by a proposed 10' private sump inlet on Burning Bush Point and routed to the proposed 1.83 acre-ft detention facility by a proposed private 24" R.C.P. storm sewer. This proposed detention facility will have an allowable outflow equal to or less than 30 cfs to ensure that peak drainage flows at DP10 are reduced to the historic rate of $Q_{100} = 30$ cfs. The outfall structure for this detention facility is detailed in the "Storm Sewer Routing and Proposed Drainage Structures" section of this report.

A 30" proposed private RCP storm sewer will transport developed flows from future Filing 2 of the Walters Commons development to the proposed 1.83 acre-feet detention pond mentioned above. Proposed flows through this storm sewer are $Q_{100} = 35$ cfs. The capacity of this proposed storm drain is 83 cfs. This storm drain will have a temporary plug installed in the southeast corner of Filing 1. (See Proposed Drainage Map in the Appendix.) The total developed flows to the above mentioned detention pond are $Q_5 = 37$ cfs and $Q_{100} = 77$ cfs. The outfall structure from this pond is designed to limit flows at DP10 to the historic rate of $Q_{100} = 30$ cfs. Detention pond and outfall structure sizing will be discussed in a later portion of this report.

primarily undeveloped with the exception of a small portion of Cloverleaf Road on the east side of the basin. The calculations for the 5-year and 100-year storm flows for Basin EB2 can be found in the Appendix, EXISTING HYDROLOGIC CALCULATIONS. The existing flows at DP10 are 12 cfs for the 5-year storm and 30 cfs for the 100-year storm. Proposed Drainage Basins J,K OS-10, OS-11 and Future Filing 2 Developed Flows will result in Q_5 = 37 cfs and Q_{100} = 77 cfs at DP10 after the site is developed. The existing structure at DP10 is a 24" storm sewer that flows under Higby Road. This storm sewer has a capacity of 40 cfs at its current slope. Because development and proposed flow patterns will significantly increase flow quantities at DP10 (Q_{100} = 77 cfs), a proposed 1.83 acre-ft, on-site detention pond will be designed to maintain historical flows (Q_{100}=30 cfs) at DP10 through the existing 24" storm outfall facility. (See PROPOSED DRAINAGE MAP in the Appendix). The proposed outfall structure linking the detention pond to the existing 24" storm drain is a 30" private RCP storm sewer at 1% slope .This outfall structure is further detailed in the "Storm Sewer Routing and Proposed Drainage Structures" section of this report. Future storm drain improvements per the "Drainage Master Plan for Jackson Creek, Teachout Creek and No Name Creek Final Report" will include an extension of the existing 24" storm facility under Higby Road to the south. (See PROPOSED OFF-SITE DRAINAGE MAP in the Appendix). As this future storm drain facility may be several years from construction, the existing swale south of Higby Road will be adequate to handle the developed flows from Walters Commons. (See EXISTING FACILITY HYDRAULIC CALCULATIONS in the Appendix). The existing swale that flows from the highpoint in Cloverleaf Road and continues along the north side of Higby Road to DP10 has an existing capacity of 28 cfs. The proposed developed flows through this swale are 10 cfs in the 100-yr condition, therefore the existing swale has adequate capacity (See EXISITING FACILITY HYDRAULIC CALCULATIONS in the Appendix.)

Design Point 11

Design Point 11 will connect to the future Walters Commons Filing 2 development and transport developed flows from a proposed Filing 2 inlet to the 1.83 acre-ft detention pond in Filing 1 via a proposed 24" and 30" private RCP storm sewer. The developed flows at DP11 from future Filing 2 are Q_5 = 18 cfs and Q_{100} = 35 cfs as calculated in the approved Preliminary Drainage Report for Walters Commons. The storm drain sizing calculations can be found in the Proposed Facility Hydraulic Calculations in the Appendix of this report.

Design Point 12

Design Point 12 is located in the NW corner of the proposed Cloverleaf Road and Walters Point intersection. The existing flows at DP12 are $Q_5 = 2$ cfs and $Q_{100} = 4$ cfs. Developed flows at DP12 from Basin OS-3 and a small portion of the proposed Walters Point will be $Q_5 = 2$ cfs and $Q_{100} = 5$ cfs. Flows from DP12 are will move under Walters Point via a proposed private 24" culvert and travel to the south through Basin OS –11 in the roadside ditch west of Cloverleaf Road and continue along Higby Road to the proposed type C inlet at DP-10. Developed Flows at DP12 are 1 cfs higher than historic flows, therefore the existing swales will be adequate for increase developed flows (See EXISTING FACILITY HYDRAULIC CALCULATIONS in the Appendix). Calculations for the proposed culvert under Walters Point can be found in the Proposed Facility Hydraulic Calculations in the Appendix. The capacity of the existing swale from DP12 to DP7 is discussed above in "Design Point 10."

The two existing swales that receive developed flows from DP7 and DP10 mentioned above meet capacity for the 100-year storm event. Riprap dissipaters will reduce and disperse discharges to non-erosive velocities. The existing swales have established vegetation, therefore bank erosion and sedimentation down stream will not be significant as developed flows are only slightly higher than existing. Future improvements detailed in the Master Drainage Report include underground culverts connecting to the culverts under Higby Road and discharging to Teachout Creek.

STORM SEWER ROUTING AND PROPOSED DRAINAGE STRUCTURES

Pipe Design Point 101

The proposed storm drain facility at DP3 will collect off-site flows from basin OS-4 ($Q_5 = 4$ cfs and $Q_{100} = 8$ cfs) in a proposed area-inlet in the north portion of basin B. Flows will be diverted to DP1 via a proposed private 24" RCP storm drain. The total flow through pipe 101 is $Q_5 = 4$ cfs and $Q_{100} = 8$ cfs.

Pipe Design Point 102

Flows at DP2 are collected in a proposed 5' sump inlet and travel via a proposed 24" RCP private storm drain and combine with flows from DP3 at a WYE in the northwest corner of the site. Flows

the pond to restrict the flows consists of four parts. There will be a 4' diameter manhole structure connected to the 36" culvert exiting the pond. This manhole structure will have two orifices to accept flows: a 1.2' diameter pipe with invert 6992', and a 1.4' diameter pipe with invert 6996'. The emergency overflow weir is located at 6999.5', just above the 100-year water surface elevation. Storms greater than the 100-year storm will overtop the pond and flow into the existing elliptical CMP flowing west under Bowstring Road. Both the 1.4' diameter pipe and the 1.2' diameter pipe will have a trash rack grate. Pond calculations can be found in the Proposed Detention Pond Calculations in the Appendix.

Another pond will be built at DP 10 to maintain historic rates for flows existing the site at the existing 2.3' diameter CMP flowing under Higby Road. The historic flows at this point are 12 cfs and 30 cfs for the 5 and 100-year storms respectively. Developed flows at the point are proposed to be 37 cfs and 77 cfs. To maintain historic flows, the required storage for this pond is 1.833 acre-feet. The 5 and 100-year water surface elevations in the pond as shown on the proposed drainage map are approximately 7009.5' and 7012'.

The outlet structure that will be built in the pond to restrict the flows consists of four parts. There will be a 4' diameter manhole structure connected to the 30" culvert exiting the pond. This manhole structure will have two orifices to accept flows: a 1.1' diameter pipe with invert 7002', and a 2.0' diameter pipe with invert 7009.5'. The emergency overflow weir is located at 7012', just above the 100-year water surface elevation. Storms greater than the 100-year storm will overtop the pond and flow into the existing pipe under Higby Road. Both the 1.1' diameter pipe and the 2.0' diameter pipe will have a trash rack grate Pond calculations can be found in the Proposed Detention Pond Calculations in the Appendix.

PROPOSED BASIN PARAMETERS

WALTERS COMMONS
FINAL DRAINAGE REPORT~ FILING NO. 1
(Area Runoff Summary)

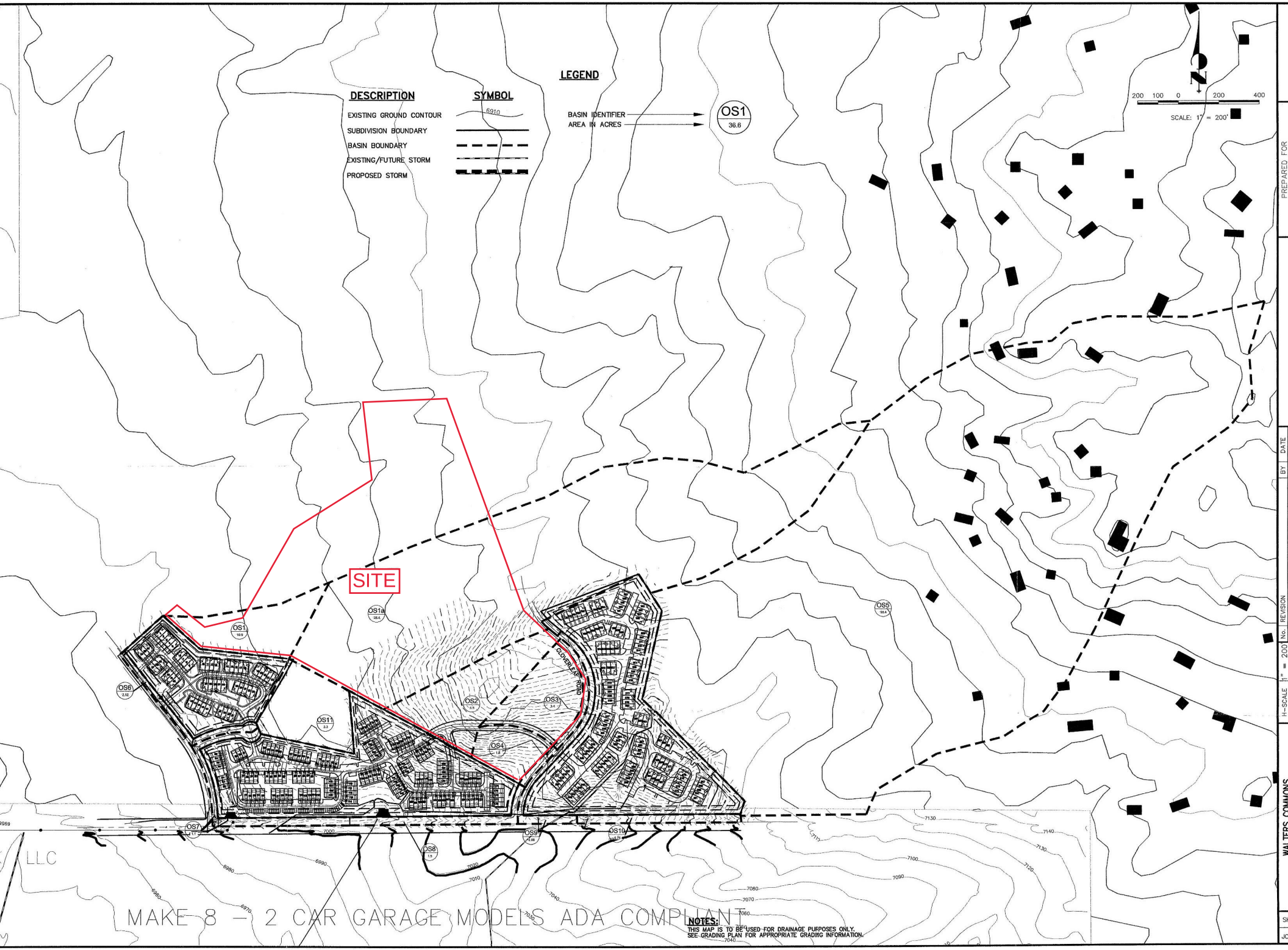
		IMPERVIOUS AREA			PERVIOUS AREA			WEIGHTED	
BASIN	TOTAL AREA (Acres)	AREA (Acres)	C(5)	C(100)	AREA (Acres)	C(5)	C(100)	C(5)	C(100)
OS - 1	0.5	0.1	0.90	0.95	0.4	0.25	0.35	0.34	0.43
OS - 2	0.2	0.2	0.90	0.95	0.0	0.25	0.35	0.90	0.95
OS - 3	0.4	0.2	0.90	0.95	0.2	0.25	0.35	0.59	0.67
OS - 4	5.7	0.0	0.90	0.95	5.7	0.25	0.35	0.25	0.35
OS - 5	32.1	0.0	0.35	0.45	32.1	0.25	0.35	0.25	0.35
OS-6	1.1	0.6	0.90	0.95	0.6	0.25	0.35	0.57	0.64
OS-7	6.8	0.0	0.90	0.95	6.8	0.25	0.35	0.25	0.35
OS-8	0.3	0.0	0.90	0.95	0.3	0.25	0.35	0.25	0.35
OS-9	2.3	0.0	0.90	0.95	2.3	0.25	0.35	0.25	0.35
OS-10	3.2	0.0	0.90	0.95	3.2	0.25	0.35	0.25	0.35
OS-11	1.7	0.0	0.90	0.95	1.7	0.25	0.35	0.25	0.35
OS-12	1.5	0.8	0.90	0.95	0.8	0.25	0.35	0.58	0.65
A	0.9	0.3	0.90	0.95	0.6	0.25	0.35	0.49	0.57
B	1.8	0.6	0.90	0.95	1.2	0.25	0.35	0.48	0.56
C	2.7	1.5	0.90	0.95	1.3	0.25	0.35	0.60	0.68
D	0.4	0.2	0.90	0.95	0.2	0.25	0.35	0.62	0.70
E	0.7	0.1	0.90	0.95	0.6	0.25	0.35	0.35	0.44
F	2.2	1.2	0.90	0.95	1.0	0.25	0.35	0.60	0.68
G	1.6	1.2	0.90	0.95	0.4	0.25	0.35	0.72	0.78
H	4.6	1.6	0.90	0.95	3.1	0.25	0.35	0.47	0.55
I	0.2	0.0	0.90	0.95	0.2	0.25	0.35	0.25	0.35
J	6.2	0.1	0.90	0.95	6.1	0.25	0.35	0.26	0.36
K	3.3	1.2	0.90	0.95	2.1	0.25	0.35	0.49	0.57
L	0.2	0.2	0.90	0.95	0.0	0.25	0.35	0.90	0.95
M	0.3	0.0	0.90	0.95	0.3	0.25	0.35	0.25	0.35

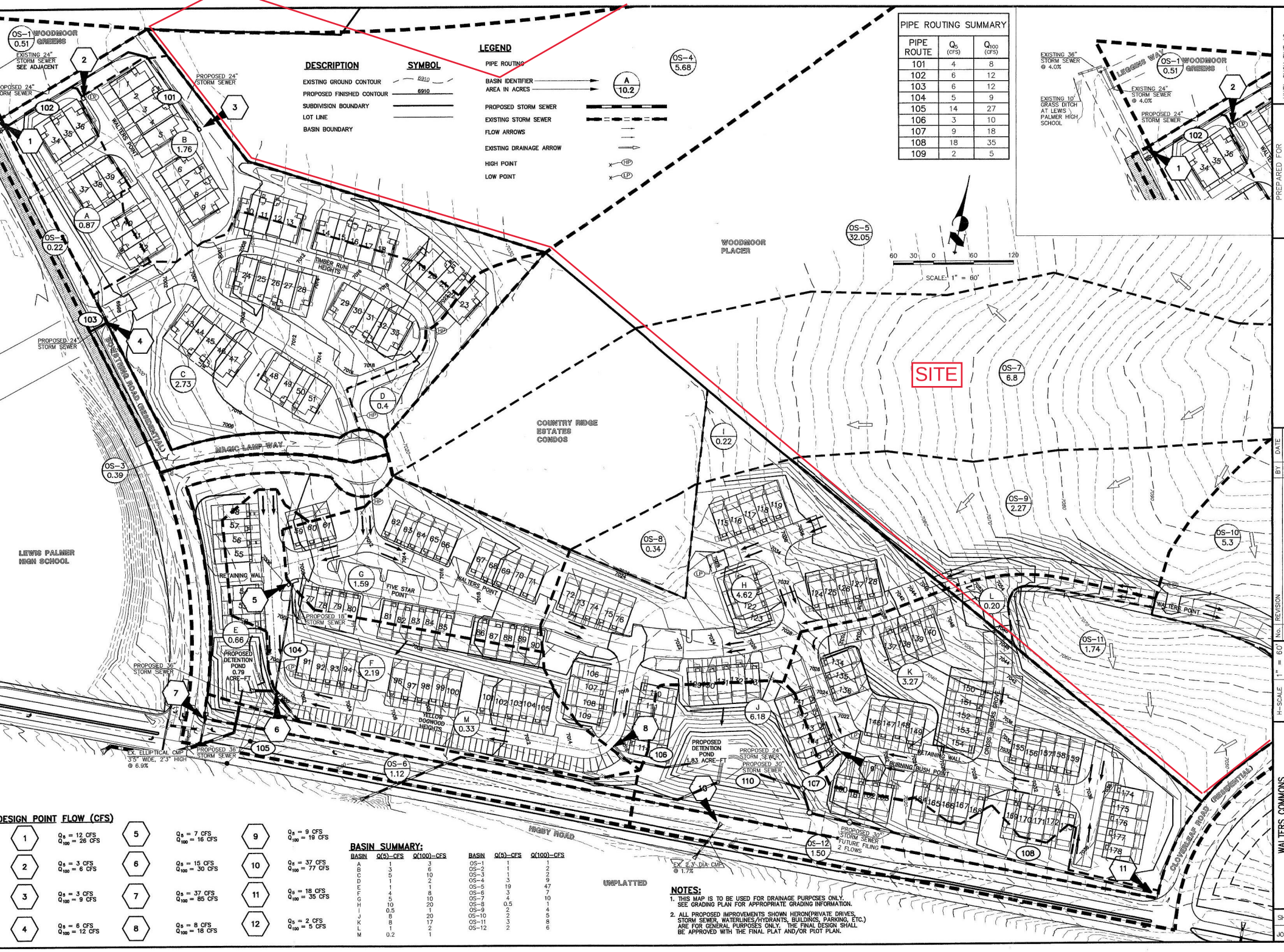
DRAINAGE MAPS

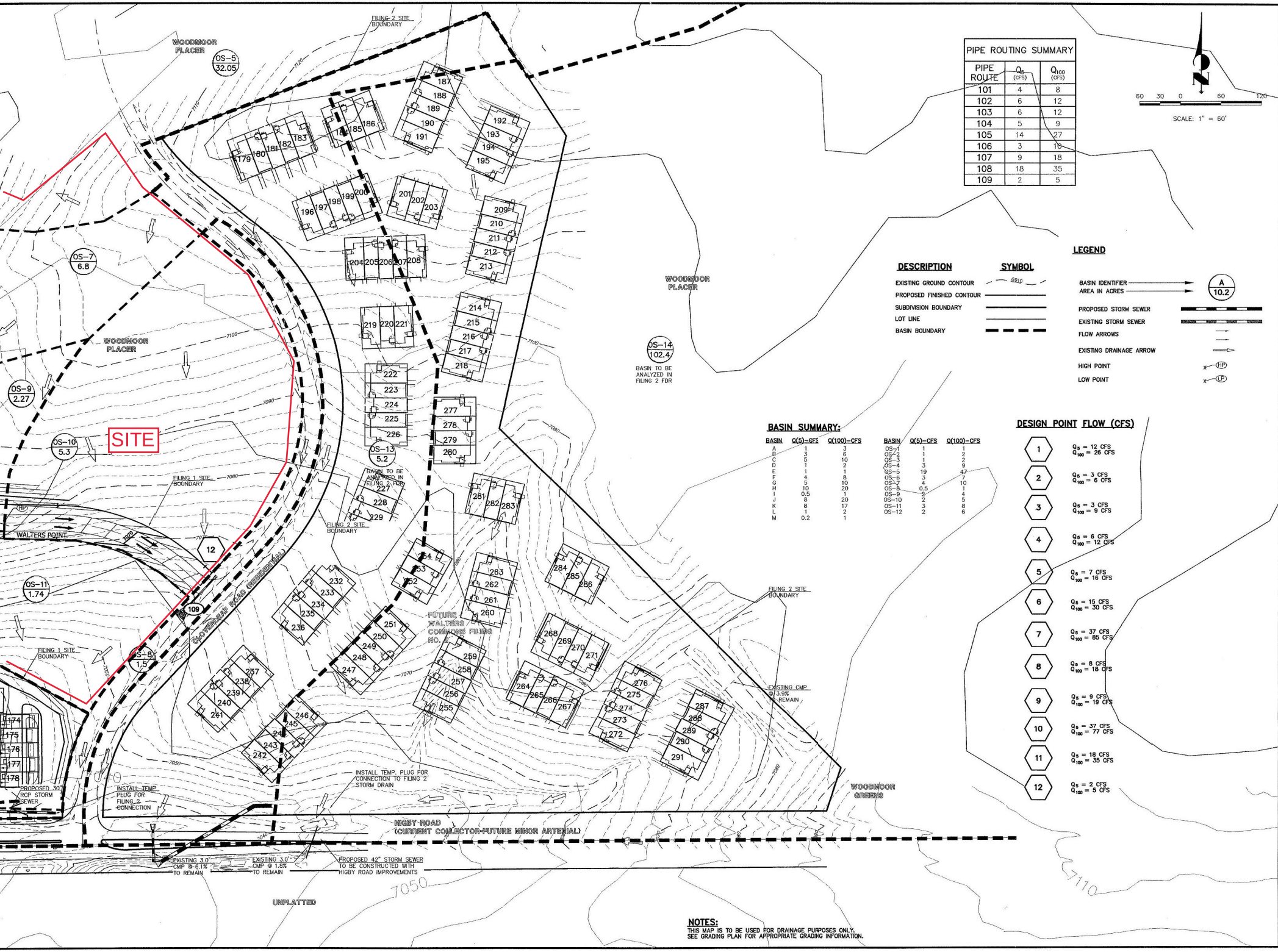
PROPOSED OFF-SITE DRAINAGE MAP

PROPOSED ON-SITE DRAINAGE MAP

EXISTING DRAINAGE MAP


LEGEND
DESCRIPTION
SYMBOL
EXISTING GROUND CONTOUR
6910
SUBDIVISION BOUNDARY
BASIN BOUNDARY
EXISTING/FUTURE STORM
PROPOSED STORM
BASIN IDENTIFIER
AREA IN ACRES
OS1
36.6
N
200 100 0 200 400
SCALE: 1" = 200'
SITE
OS1a
OS1
OS2
OS3
OS4
OS5
OS6
OS7
OS8
OS9
OS10
OS11
FLOYERLEE ROAD
LLC
MAKE 8 – 2 CAR GARAGE MODELS ADA COMPLIANT
NOTES:
THIS MAP IS TO BE USED FOR DRAINAGE PURPOSES ONLY.
SEE GRADING PLAN FOR APPROPRIATE GRADING INFORMATION.
PREPARED FOR
BY
DATE
No.
REVISION
H-SCALE 1" = 200'
WALTERS COMMONS
SHEET
JOB


LEGEND
DESCRIPTION
SYMBOL
EXISTING GROUND CONTOUR
PROPOSED FINISHED CONTOUR
SUBDIVISION BOUNDARY
LOT LINE
BASIN BOUNDARY
PIPE ROUTING
BASIN IDENTIFIER
AREA IN ACRES
PROPOSED STORM SEWER
EXISTING STORM SEWER
FLOW ARROWS
EXISTING DRAINAGE ARROW
HIGH POINT
LOW POINT
PIPE ROUTING SUMMARY
PIPE ROUTE | Q5 (CFS) | Q100 (CFS)
101 | 4 | 8
102 | 6 | 12
103 | 6 | 12
104 | 5 | 9
105 | 14 | 27
106 | 3 | 10
107 | 9 | 18
108 | 18 | 35
109 | 2 | 5
SCALE: 1" = 60'
SITE
WOODMOOR PLACER
COUNTRY RIDGE ESTATES CONDOS
LEWIS PALMER HIGH SCHOOL
UNPLATTED
WOODMOOR GREENS
TIMBER RUN HEIGHTS
WALTERS POINT
MAGIC LAMP WAY
FIVE STAR POINT
YELLOW DOGWOOD HEIGHTS
BURNING BUSH POINT
CROSS TIMBERS POINT
LEGENDS WAY
HIGBY ROAD
CLOVERLEAF ROAD (RESIDENTIAL)
PROPOSED DETENTION POND 0.79 ACRE-FT
PROPOSED DETENTION POND 1.83 ACRE-FT
RETAINING WALL
EX. ELLIPTICAL CMP 3'5" WIDE, 2'3" HIGH @ 6.9%
EX. 2'3" DIA. CMP @ 1.7%
PROPOSED 30" STORM SEWER FUTURE FILING 2 FLOWS
EXISTING 36" STORM SEWER @ 4.0%
EXISTING 10' GRASS DITCH AT LEWIS PALMER HIGH SCHOOL
EXISTING 24" STORM SEWER @ 4.0%
PROPOSED 24" STORM SEWER
PROPOSED 36" STORM SEWER
PROPOSED 18" STORM SEWER
PROPOSED 30" STORM SEWER
DESIGN POINT FLOW (CFS)
1 Q5 = 12 CFS Q100 = 26 CFS
2 Q5 = 3 CFS Q100 = 6 CFS
3 Q5 = 3 CFS Q100 = 9 CFS
4 Q5 = 6 CFS Q100 = 12 CFS
5 Q5 = 7 CFS Q100 = 16 CFS
6 Q5 = 15 CFS Q100 = 30 CFS
7 Q5 = 37 CFS Q100 = 85 CFS
8 Q5 = 8 CFS Q100 = 18 CFS
9 Q5 = 9 CFS Q100 = 19 CFS
10 Q5 = 37 CFS Q100 = 77 CFS
11 Q5 = 18 CFS Q100 = 35 CFS
12 Q5 = 2 CFS Q100 = 5 CFS
BASIN SUMMARY:
BASIN | Q(5)-CFS | Q(100)-CFS | BASIN | Q(5)-CFS | Q(100)-CFS
A 1 3 | OS-1 1 1
B 3 6 | OS-2 1 2
C 5 10 | OS-3 1 2
D 1 2 | OS-4 3 9
E 1 1 | OS-5 19 47
F 4 8 | OS-6 3 7
G 5 10 | OS-7 4 10
H 10 20 | OS-8 0.5 1
I 0.5 1 | OS-9 2 4
J 8 20 | OS-10 2 5
K 8 17 | OS-11 3 8
L 1 2 | OS-12 2 6
M 0.2 1
NOTES:
1. THIS MAP IS TO BE USED FOR DRAINAGE PURPOSES ONLY. SEE GRADING PLAN FOR APPROPRIATE GRADING INFORMATION.
2. ALL PROPOSED IMPROVEMENTS SHOWN HERON(PRIVATE DRIVES, STORM SEWER, WATERLINES/HYDRANTS, BUILDINGS, PARKING, ETC.) ARE FOR GENERAL PURPOSES ONLY. THE FINAL DESIGN SHALL BE APPROVED WITH THE FINAL PLAT AND/OR PLOT PLAN.
PREPARED FOR
BY DATE
No. REVISION
H-SCALE 1" = 60'
WALTERS COMMONS



PIPE ROUTING SUMMARY		
PIPE ROUTE	Q_5 (CFS)	Q_{100} (CFS)
101	4	8
102	6	12
103	6	12
104	5	9
105	14	27
106	3	10
107	9	18
108	18	35
109	2	5

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	
SUBDIVISION BOUNDARY	
LOT LINE	
BASIN BOUNDARY	
BASIN IDENTIFIER / AREA IN ACRES	A 10.2
PROPOSED STORM SEWER	
EXISTING STORM SEWER	
FLOW ARROWS	
EXISTING DRAINAGE ARROW	
HIGH POINT	HP
LOW POINT	LP

BASIN SUMMARY:

BASIN	Q(5)-CFS	Q(100)-CFS
A	1	3
B	3	6
C	5	10
D	1	2
E	1	1
F	4	8
G	5	10
H	10	20
I	0.5	1
J	8	20
K	8	17
L	1	2
M	0.2	1

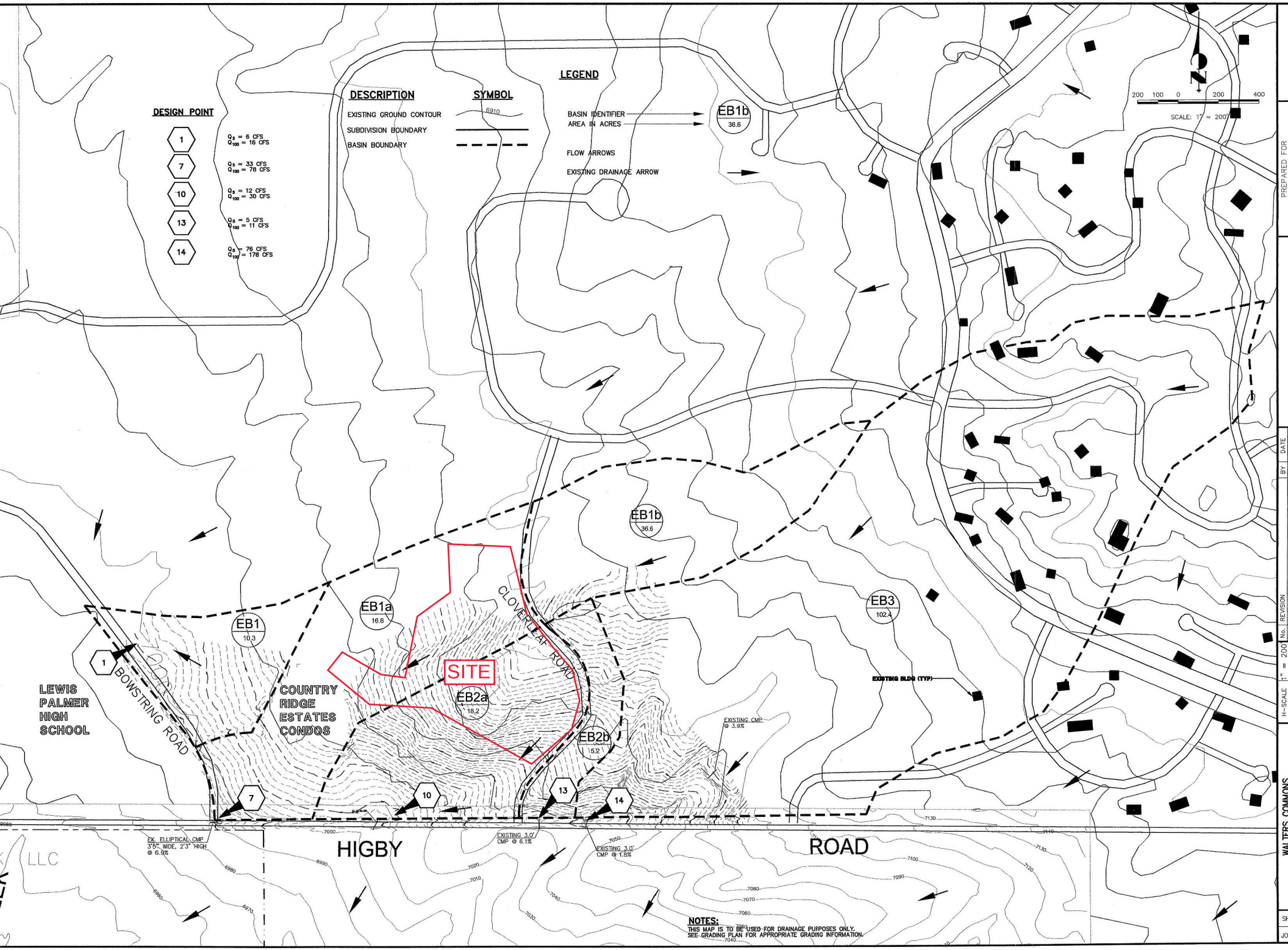
BASIN	Q(5)-CFS	Q(100)-CFS
OS-1	1	1
OS-2	1	2
OS-3	1	2
OS-4	3	9
OS-5	19	47
OS-6	3	7
OS-7	4	10
OS-8	0.5	1
OS-9	2	4
OS-10	2	5
OS-11	3	8
OS-12	2	6

DESIGN POINT FLOW (CFS)

1	Q_5 = 12 CFS, Q_{100} = 26 CFS
2	Q_5 = 3 CFS, Q_{100} = 6 CFS
3	Q_5 = 3 CFS, Q_{100} = 9 CFS
4	Q_5 = 6 CFS, Q_{100} = 12 CFS
5	Q_5 = 7 CFS, Q_{100} = 16 CFS
6	Q_5 = 15 CFS, Q_{100} = 30 CFS
7	Q_5 = 37 CFS, Q_{100} = 85 CFS
8	Q_5 = 8 CFS, Q_{100} = 18 CFS
9	Q_5 = 9 CFS, Q_{100} = 19 CFS
10	Q_5 = 37 CFS, Q_{100} = 77 CFS
11	Q_5 = 18 CFS, Q_{100} = 35 CFS
12	Q_5 = 2 CFS, Q_{100} = 5 CFS

NOTES:
THIS MAP IS TO BE USED FOR DRAINAGE PURPOSES ONLY.
SEE GRADING PLAN FOR APPROPRIATE GRADING INFORMATION.

PREPARED FOR | BY | DATE | No. | REVISION | H-SCALE 1" = 60' | WALTERS COMMONS | SI | JO


DESIGN POINT
1
7
10
13
14
Q_5 = 6 CFS
Q_{100} = 16 CFS
Q_5 = 33 CFS
Q_{100} = 78 CFS
Q_5 = 12 CFS
Q_{100} = 30 CFS
Q_5 = 5 CFS
Q_{100} = 11 CFS
Q_5 = 76 CFS
Q_{100} = 178 CFS
DESCRIPTION
SYMBOL
EXISTING GROUND CONTOUR
6910
SUBDIVISION BOUNDARY
BASIN BOUNDARY
LEGEND
BASIN IDENTIFIER
AREA IN ACRES
EB1b
36.6
FLOW ARROWS
EXISTING DRAINAGE ARROW
200 100 0 200 400
SCALE: 1" = 200'
EB1b
36.6
EB1a
16.6
EB1
10.3
EB3
102.4
SITE
EB2a
18.2
EB2b
15.2
CLOVERLEAF ROAD
BOWSTRING ROAD
LEWIS PALMER HIGH SCHOOL
COUNTRY RIDGE ESTATES CONDOS
EXISTING BLDG (TYP)
EXISTING CMP @ 3.9%
EX. ELLIPTICAL CMP 3'5" WIDE, 2'3" HIGH @ 6.9%
EXISTING 3.0' CMP @ 6.1%
EXISTING 3.0' CMP @ 1.8%
HIGBY
ROAD
LLC
NOTES:
THIS MAP IS TO BE USED FOR DRAINAGE PUPPOSES ONLY.
SEE GRADING PLAN FOR APPROPRIATE GRADING INFORMATION.
PREPARED FOR
BY DATE
No. REVISION
H-SCALE 1" = 200'
WATERS COMMONS
SH
JO

J·R ENGINEERING
A Westrian Company

ADDENDUM TO
FINAL DRAINAGE REPORT
FOR
WALTERS COMMONS

November 2006

Prepared For:

PULTE HOME CORPORATION
1975 Research Parkway
Colorado Springs, CO 80920
(719) 536-4200

Prepared By:

JR ENGINEERING
4310 ArrowsWest Drive
Colorado Springs, CO 80907
(719) 593-2593

Job No. 9170.72

ADDENDUM TO
FINAL DRAINAGE REPORT
FOR
WALTERS COMMONS

J·R ENGINEERING
A Westrian Company

DRAINAGE REPORT STATEMENT

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

COLORADO REGISTERED A BRAMLETT PROFESSIONAL ENGINEER

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

11/20/06
Date

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

Business Name: Pulte Homes

By:

Title: Vice President of Land

Address: 1975 Research Parkway

Colorado Springs, CO 80920

EL PASO COUNTY ONLY:
Filed in accordance with Section 51.1 of the El Paso Land Development Code, as amended.

for John McCarty, P.E.
County Engineer/Director

11-22-06
Date

Conditions:

4310 ArrowsWest Drive, Colorado Springs, CO 80907
719-593-2593 • Fax: 719-528-6613 • www.jrengineering.com

ADDENDUM TO FINAL DRAINAGE REPORT FOR WALTERS COMMONS

PURPOSE

The purpose of this addendum is to identify changes to the approved final drainage report, as a result of construction procedures and current drainage conditions at the intersection of Cloverleaf Rd. and Higby Rd. The previously approved drainage patterns for drainage basin A-1, referred to as OS-10 and OS-8 in the approved Final Drainage Report for Walters Commons, have been revised from the original design. See attached Proposed On-Site Drainage Area Map for more information. It is the intent of this report to calculate the revised storm water runoff quantities as a result of revisions to the Walters Commons development. In addition, recommend proposed drainage facilities and calculate impacts to current storm sewer routing.

GENERAL DESCRIPTION

The general description for this project has remained the same, except that the project is now platted as Walter Commons Filing 1. For more information, see the approved Final Drainage Report for Walters Commons Filing 1.

PROPOSED DRAINAGE ADDENDUM

In the previously approved drainage report for Walters Commons Filing 1, runoff from Basin A-1 (see Proposed On-Site Drainage Map) was captured by a drainage ditch along the west side of Cloverleaf Rd. The runoff was then conveyed south paralleling the road to the intersection of Cloverleaf Rd. and Higby Rd. At this point the runoff was routed west in a drainage ditch along the north side of Higby Rd to DP-10 of the previously approved drainage report for Walters Commons Filing 1. The drainage ditch along the north side of Higby Rd. was never constructed. In it's place, a curb line was constructed and the ditch was removed to prevent relocating utilities in this area. As a result, the runoff from basin A-1 currently discharges into Higby Rd. at the intersection of Cloverleaf Rd. and Higby Rd., resulting in concentrated storm water entering Higby Rd.

This Addendum proposes that a Type-C CDOT inlet be constructed at the northwest corner of the intersection of Cloverleaf Road and Higby Road to collect the additional storm water from basin A-1 (Q_5 = 4 cfs and Q_{100} = 10 cfs). The runoff collected by the inlet will be routed south via 15' of 18" RCP to the existing 30" RCP, (Design point 11) installed with the original design. From this point the runoff is routed to the proposed 1.83 acre-ft detention pond.

The pond's current design does not accommodate basin A-1, but the effects of the increased runoff (Q_5 = 4 cfs and Q_{100} = 10 cfs) will be negligible to the function of the pond. The pond will function as previously approved except in the most extreme 100-yr event. During this storm event, the pond will over top the spillway (Q_{100} = 7cfs) and be collected by the existing 24" storm sewer pipe located at DP-10. Since DP-10 was the original collection point of basin A-1, we feel that the impacts are minimal to this system. In addition, the existing 24" storm sewer pipe has a capacity of 17.8 cfs, which is more than adequate to convey the additional runoff that will overtop the spillway. See Appendix for backup calculations.

ADDENDUM IMPACTS TO FACILITIES

Design Point 10

Design Point 10 is in the same location as in the previously approved drainage report for Walters Commons Filing 1. Only minimal flows that overtop the existing detention pond weir (Q_{100} = 7cfs) will be captured by the existing 24"storm sewer and conveyed under Higby Rd. The existing storm sewer pipe has a full flow capacity of 17.8cfs, which is more than adequate to convey the discharge. See Appendix for backup calculations.

Design Point 11

Design Point 11 is in the same location as in the previously approved drainage report for Walters Commons Filing 1, but now incorporates the additional flow captured at DP-13 as well as the existing flows at DP 14. Anticipated flows at this location will be Q_5 = 32 cfs and Q_{100} = 66 cfs.

Design Point 13

Design Point 13 is located at the northwest corner of the intersection of Cloverleaf Road and Higby

Road. A proposed Type-C CDOT inlet will be installed at this location to capture the existing flows from drainage basin A-1. The flows will be approximately Q_5 = 4 cfs and Q_{100} = 10 cfs.

Design Point 14

Design Point 14 is the same design point as design point 6 in the previously approved drainage report for Walters Commons Filing 2. The flows at this design point will be generated by the Walters Commons Filing 2 project. Flows in this existing pipe are Q_5 = 28 cfs and Q_{100} = 56 cfs.

STORM SEWER ROUTING AND PROPOSED DRAINAGE STRUCTURES

Pipe Design Point 108

Incorporates the developed flows from Walters Commons Filing 2 (DP-14) and the rerouted flows from drainage basin A-1 (DP-13). The runoff will travel to the existing 1.83 arce-ft detention pond in Filing 1 via an existing 30" RCP storm sewer. The existing facility will now convey Q_5 = 32 cfs and Q_{100} = 66 cfs. The existing pipe has adequate capacity (Full flow capacity = 66 CFS) to convey this additional runoff. See Proposed Facility Hydraulic Calculations for more information.

Pipe Design Point 200

This design point incorporates the flows at DP-13 from drainage basin A-1. The flows will be conveyed via an 18" RCP storm sewer (Full flow capacity = 70 CFS) from the proposed Type-C CDOT inlet to the existing 30" RCP storm sewer. This proposed facility will carry Q_5 = 4 cfs and Q_{100} = 10 cfs. See Proposed Facility Hydraulic Calculations for more information.

Pipe Design Point 201

This design point incorporates the flows that overtop the existing detention pond's weir in the most extreme event. Per the revised pond calculations located in the Appendix, 7cfs will overtop the spillway for roughly 35 minutes. The runoff will be conveyed under Higby Rd. by an existing 24" storm sewer (Full Flow Capacity = 17.8cfs). See Proposed Facility Hydraulic Calculations and Proposed Detention Pond Calculations for more information.

All other conditions will remain consistent with the previously approved Final Drain Report for Walters Commons.

SUMMARY

We conclude that the installation of a Type-C CDOT inlet at the intersection of Cloverleaf Rd. and Higby Rd. will be adequate to collect and convey the existing runoff from drainage basin A-1. This conclusion is based on the fact that the existing storm sewer has adequate capacity for the increased flow. In addition, the existing detention pond will face minimal impacts, except in the most extreme event, due to the increased runoff. In the event of a 100-yr storm, the pond will overtop via the emergency spillway and be conveyed under Higby Rd. through the existing 24" CMP storm sewer. Finally, the proposed improvement will eliminate the concentrated runoff that is currently entering into Higby Rd.

PREPARED BY:

JR Engineering

Kevan P. Kuhnel, E.I.
Engineer II

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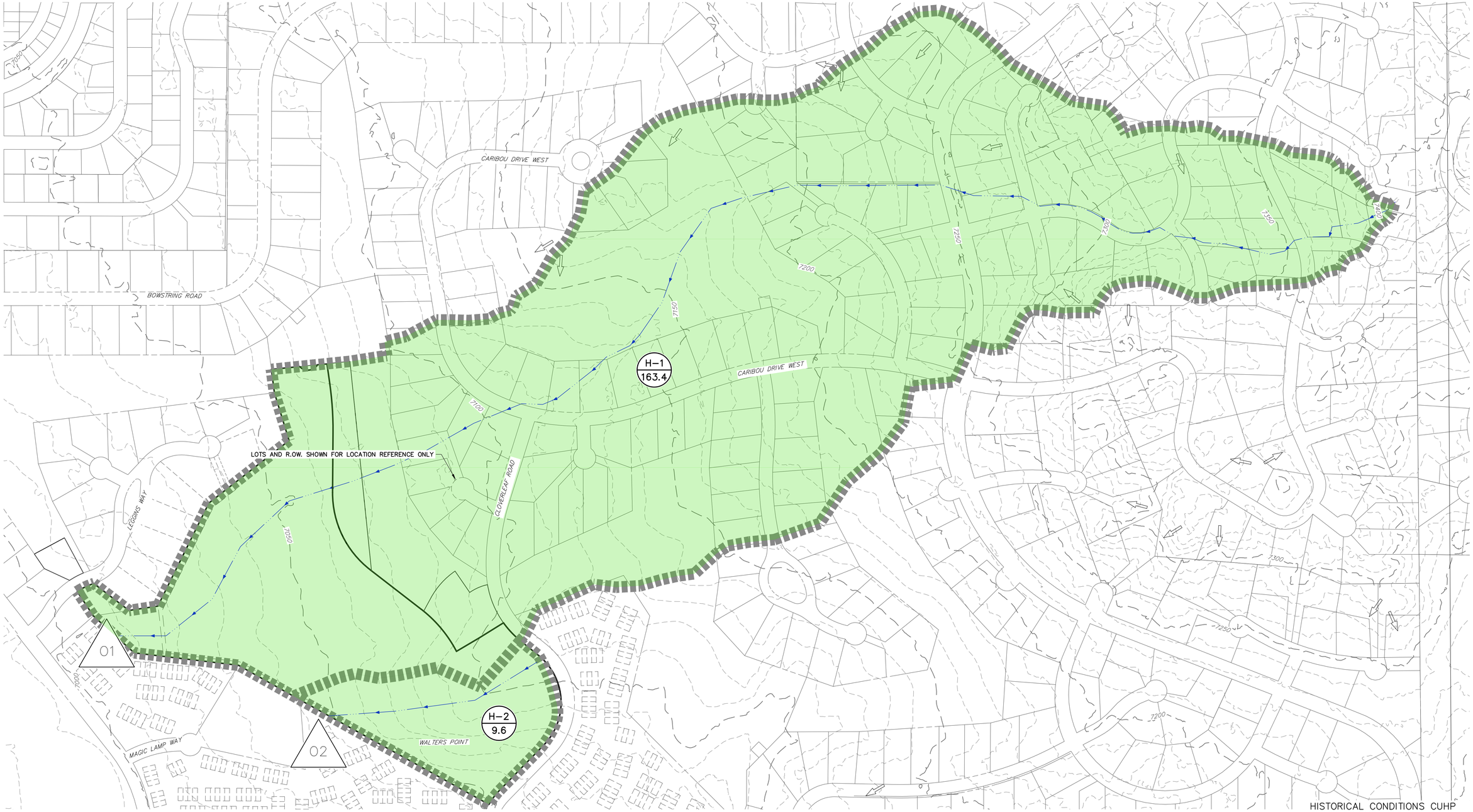
Appendix F
Drainage Maps

CLOVERLEAF SUBDIVISION

HISTORICAL CONDITIONS CUHP SWMM BASINS MAP



CUHP BASIN RUNOFF SUMMARY TABLE - HISTORIC CONDITIONS				
Basin ID	SWMM Junction	Area (ac)	Q5 (cfs)	Q100 (cfs)
H-1	1	163.36	32.6	124.8
H-2	2	9.62	2.8	31.4

SWMM DESIGN POINT/NODE SUMMARY - HISTORIC CONDITIONS			
SWMM Junction	Q5 (cfs)	Q100 (cfs)	Comments
OUTFALL 1	32.6	124.8	Runoff from Basin H-1
OUTFALL 2	2.8	31.4	Runoff from Basin H-2

200 100 0 200 400

ORIGINAL SCALE: 1" = 200'

HISTORICAL CONDITIONS CUHP
SWMM BASINS MAP
CLOVERLEAF SUBDIVISION
JOB NO. 25158.01
09/09/2020
SHEET 1 OF 6

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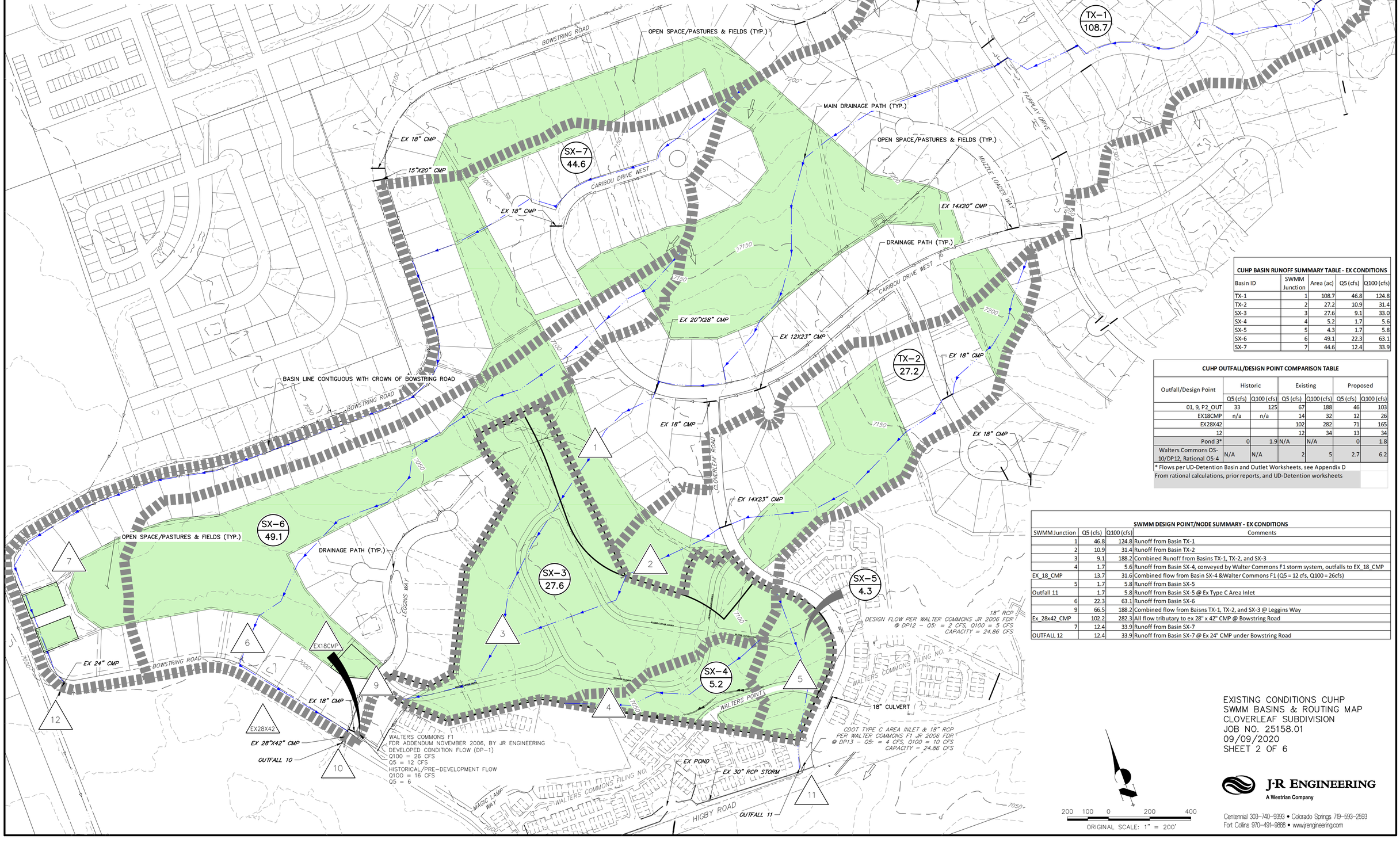
CLOVERLEAF SUBDIVISION

EXISTING CONDITIONS CUHP SWMM BASINS & ROUTING MAP



CUHP BASIN RUNOFF SUMMARY TABLE - EX CONDITIONS

Basin ID	SWMM Junction	Area (ac)	Q5 (cfs)	Q100 (cfs)
TX-1	1	108.7	46.8	124.8
TX-2	2	27.2	10.9	31.4
SX-3	3	27.6	9.1	33.0
SX-4	4	5.2	1.7	5.6
SX-5	5	4.3	1.7	5.8
SX-6	6	49.1	22.3	63.1
SX-7	7	44.6	12.4	33.9

CUHP OUTFALL/DESIGN POINT COMPARISON TABLE

Outfall/Design Point	Historic		Existing		Proposed	
	Q5 (cfs)	Q100 (cfs)	Q5 (cfs)	Q100 (cfs)	Q5 (cfs)	Q100 (cfs)
01, 9, P2_OUT	33	125	67	188	46	103
EX18CMP	n/a	n/a	14	32	12	26
EX28X42			102	282	71	165
12			12	34	13	34
Pond 3*	0	1.9	N/A	N/A	0	1.8
Walters Commons OS-10/DP12, Rational OS-4	N/A	N/A	2	5	2.7	6.2

* Flows per UD-Detention Basin and Outlet Worksheets, see Appendix D
From rational calculations, prior reports, and UD-Detention worksheets

SWMM DESIGN POINT/NODE SUMMARY - EX CONDITIONS

SWMM Junction	Q5 (cfs)	Q100 (cfs)	Comments
1	46.8	124.8	Runoff from Basin TX-1
2	10.9	31.4	Runoff from Basin TX-2
3	9.1	188.2	Combined Runoff from Basins TX-1, TX-2, and SX-3
4	1.7	5.6	Runoff from Basin SX-4, conveyed by Walter Commons F1 storm system, outfalls to EX_18_CMP
EX_18_CMP	13.7	31.6	Combined flow from Basin SX-4 &Walter Commons F1 (Q5 = 12 cfs, Q100 = 26cfs)
5	1.7	5.8	Runoff from Basin SX-5
Outfall 11	1.7	5.8	Runoff from Basin SX-5 @ Ex Type C Area Inlet
6	22.3	63.1	Runoff from Basin SX-6
9	66.5	188.2	Combined flow from Baisns TX-1, TX-2, and SX-3 @ Leggins Way
Ex_28x42_CMP	102.2	282.3	All flow tributary to ex 28" x 42" CMP @ Bowstring Road
7	12.4	33.9	Runoff from Basin SX-7
OUTFALL 12	12.4	33.9	Runoff from Basin SX-7 @ Ex 24" CMP under Bowstring Road

EXISTING CONDITIONS CUHP
SWMM BASINS & ROUTING MAP
CLOVERLEAF SUBDIVISION
JOB NO. 25158.01
09/09/2020
SHEET 2 OF 6

200 100 0 200 400
ORIGINAL SCALE: 1" = 200'

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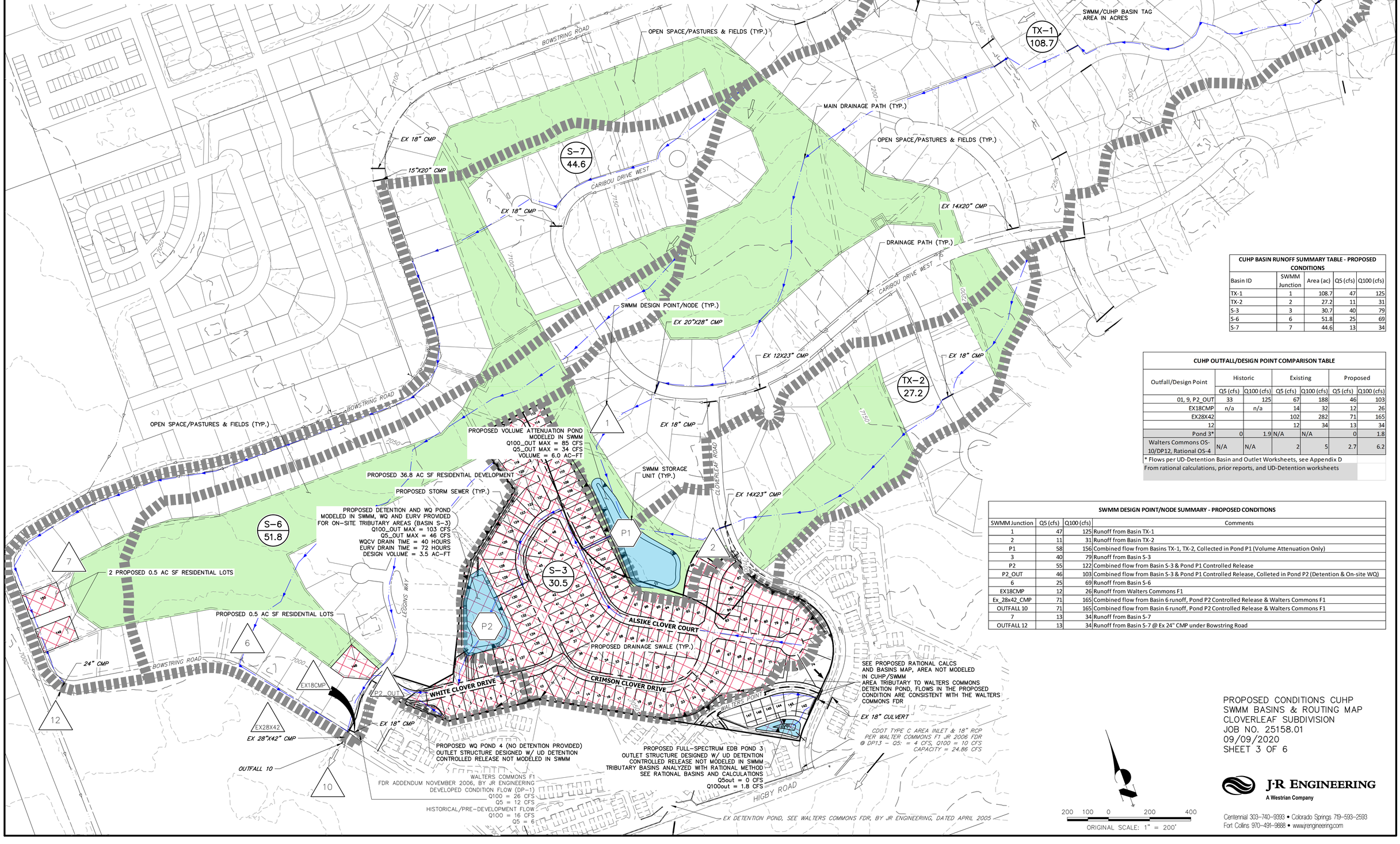
CLOVERLEAF SUBDIVISION

PROPOSED CONDITIONS CUHP SWMM BASINS & ROUTING MAP



CUHP BASIN RUNOFF SUMMARY TABLE - PROPOSED CONDITIONS

Basin ID	SWMM Junction	Area (ac)	Q5 (cfs)	Q100 (cfs)
TX-1	1	108.7	47	125
TX-2	2	27.2	11	31
S-3	3	30.7	40	79
S-6	6	51.8	25	69
S-7	7	44.6	13	34

CUHP OUTFALL/DESIGN POINT COMPARISON TABLE

Outfall/Design Point	Historic		Existing		Proposed	
	Q5 (cfs)	Q100 (cfs)	Q5 (cfs)	Q100 (cfs)	Q5 (cfs)	Q100 (cfs)
01, 9, P2_OUT	33	125	67	188	46	103
EX18CMP	n/a	n/a	14	32	12	26
EX28X42			102	282	71	165
12			12	34	13	34
Pond 3*	0	1.9	N/A	N/A	0	1.8
Walters Commons OS-10/DP12, Rational OS-4	N/A	N/A	2	5	2.7	6.2

* Flows per UD-Detention Basin and Outlet Worksheets, see Appendix D
From rational calculations, prior reports, and UD-Detention worksheets

SWMM DESIGN POINT/NODE SUMMARY - PROPOSED CONDITIONS

SWMM Junction	Q5 (cfs)	Q100 (cfs)	Comments
1	47	125	Runoff from Basin TX-1
2	11	31	Runoff from Basin TX-2
P1	58	156	Combined flow from Basins TX-1, TX-2, Collected in Pond P1 (Volume Attenuation Only)
3	40	79	Runoff from Basin S-3
P2	55	122	Combined flow from Basin S-3 & Pond P1 Controlled Release
P2_OUT	46	103	Combined flow from Basin S-3 & Pond P1 Controlled Release, Colleted in Pond P2 (Detention & On-site WQ)
6	25	69	Runoff from Basin S-6
EX18CMP	12	26	Runoff from Walters Commons F1
Ex_28x42_CMP	71	165	Combined flow from Basin 6 runoff, Pond P2 Controlled Release & Walters Commons F1
OUTFALL 10	71	165	Combined flow from Basin 6 runoff, Pond P2 Controlled Release & Walters Commons F1
7	13	34	Runoff from Basin S-7
OUTFALL 12	13	34	Runoff from Basin S-7 @ Ex 24" CMP under Bowstring Road

PROPOSED CONDITIONS CUHP
SWMM BASINS & ROUTING MAP
CLOVERLEAF SUBDIVISION
JOB NO. 25158.01
09/09/2020
SHEET 3 OF 6

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CLOVERLEAF SUBDIVISION

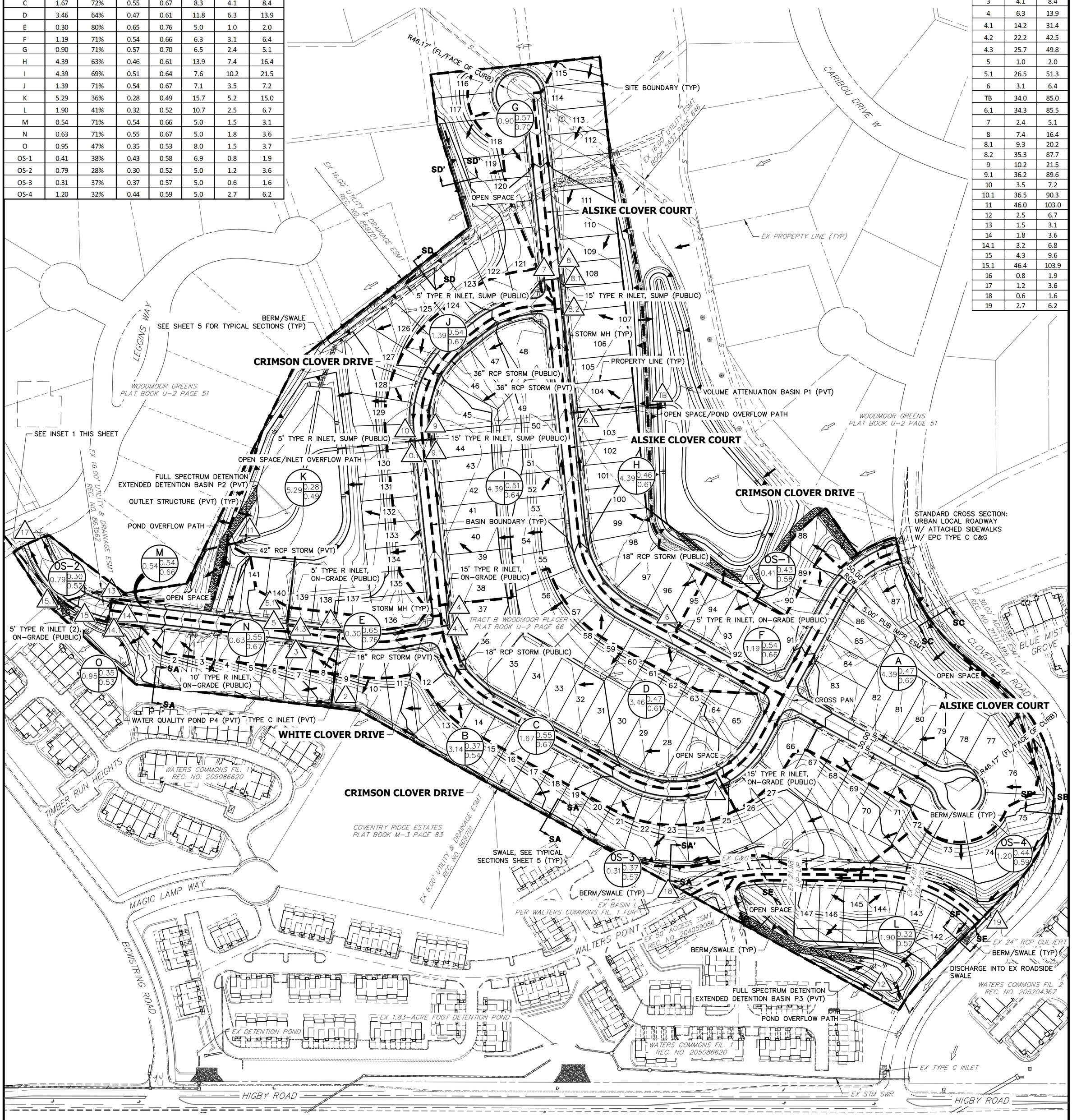
PROPOSED DRAINAGE MAP

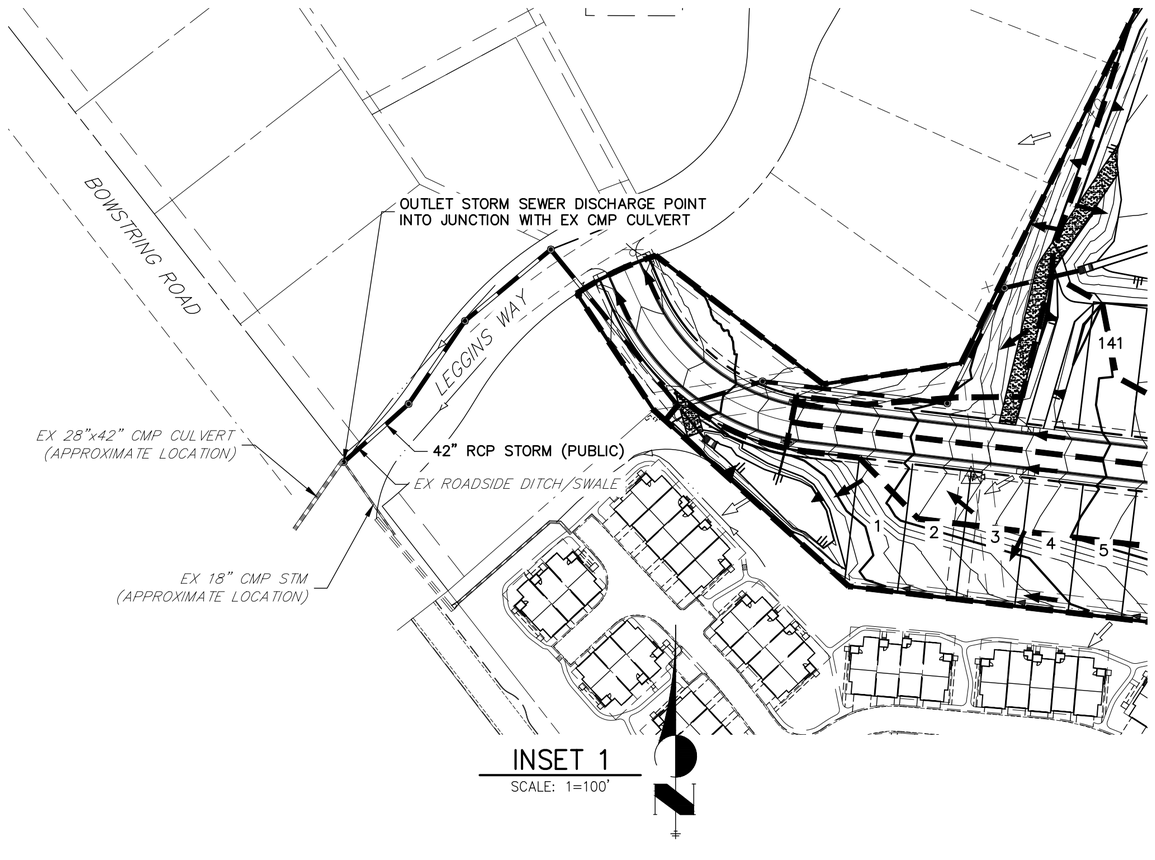
BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A	4.39	61%	0.47	0.62	11.9	7.9	17.5
B	3.14	52%	0.37	0.54	11.4	4.6	11.3
C	1.67	72%	0.55	0.67	8.3	4.1	8.4
D	3.46	64%	0.47	0.61	11.8	6.3	13.9
E	0.30	80%	0.65	0.76	5.0	1.0	2.0
F	1.19	71%	0.54	0.66	6.3	3.1	6.4
G	0.90	71%	0.57	0.70	6.5	2.4	5.1
H	4.39	63%	0.46	0.61	13.9	7.4	16.4
I	4.39	69%	0.51	0.64	7.6	10.2	21.5
J	1.39	71%	0.54	0.67	7.1	3.5	7.2
K	5.29	36%	0.28	0.49	15.7	5.2	15.0
L	1.90	41%	0.32	0.52	10.7	2.5	6.7
M	0.54	71%	0.54	0.66	5.0	1.5	3.1
N	0.63	71%	0.55	0.67	5.0	1.8	3.6
O	0.95	47%	0.35	0.53	8.0	1.5	3.7
OS-1	0.41	38%	0.43	0.58	6.9	0.8	1.9
OS-2	0.79	28%	0.30	0.52	5.0	1.2	3.6
OS-3	0.31	37%	0.37	0.57	5.0	0.6	1.6
OS-4	1.20	32%	0.44	0.59	5.0	2.7	6.2

DESIGN POINT SUMMARY TABLE

DP	Q5	Q100
1	7.9	17.5
2	4.6	11.3
3	4.1	8.4
4	6.3	13.9
4.1	14.2	31.4
4.2	22.2	42.5
4.3	25.7	49.8
5	1.0	2.0
5.1	26.5	51.3
6	3.1	6.4
TB	34.0	85.0
6.1	34.3	85.5
7	2.4	5.1
8	7.4	16.4
8.1	9.3	20.2
8.2	35.3	87.7
9	10.2	21.5
9.1	36.2	89.6
10	3.5	7.2
10.1	36.5	90.3
11	46.0	103.0
12	2.5	6.7
13	1.5	3.1
14	1.8	3.6
14.1	3.2	6.8
15	4.3	9.6
15.1	46.4	103.9
16	0.8	1.9
17	1.2	3.6
18	0.6	1.6
19	2.7	6.2





INSET 1
SCALE: 1=100'

LAYER LINETYPE LEGEND

	EXISTING	PROPOSED
BOUNDARY LINE		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
CENTERLINE		
STORM SEWER		
SWALE/WATERWAY FLOWLINE		
INDEX CONTOUR	6100	
INTERMEDIATE CONTOUR		6100
DEPRESSION CONT. (INDEX)	6100	
DEPRESSION CONT. (INTER)		6100
CURB & GUTTER		

SUB-BASIN DRAINAGE AREA

BASIN TAG (A: 4.1 / 0.47 / 0.62)

DESIGN POINT DESIGNATION (1)

FLOW DIRECTION (PROPOSED)

FLOW DIRECTION (EXISTING)

100 50 0 100

ORIGINAL SCALE: 1" = 100'

PROPOSED DRAINAGE MAP
CLOVERLEAF SUBDIVISION
JOB NO. 25158.01
9/9/20
SHEET 4 OF 6

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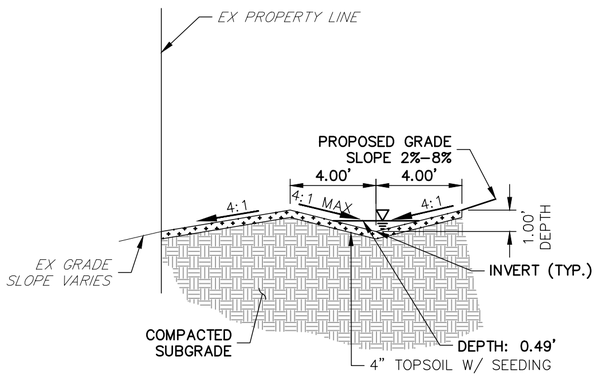
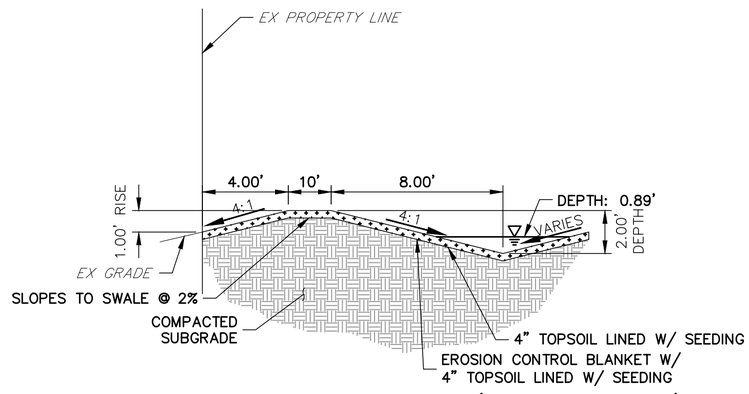
CLOVERLEAF SUBDIVISION

SWALE CROSS SECTIONS



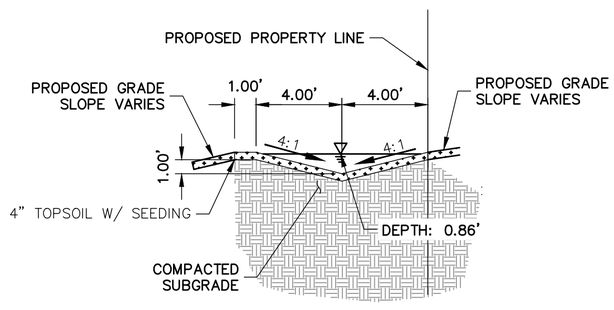
SWALE SECTION SA–SA (LOTS 1–21)

N.T.S.



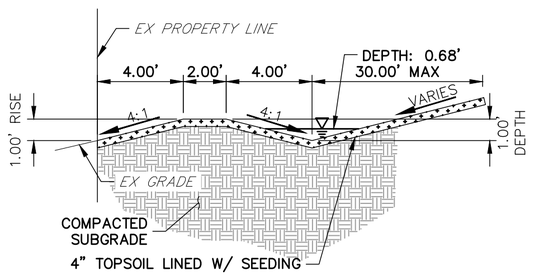
SWALE SECTION SD–SD (LOTS 127–122)

N.T.S.



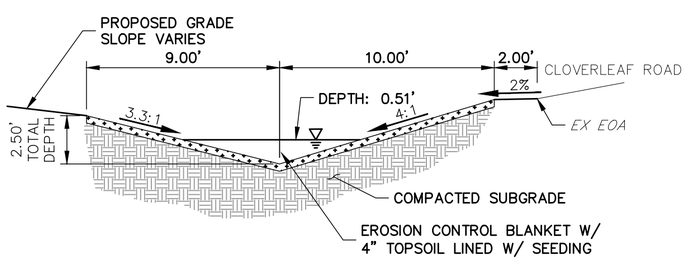
SWALE SECTION SA'–SA' (LOTS 22–25)

N.T.S.



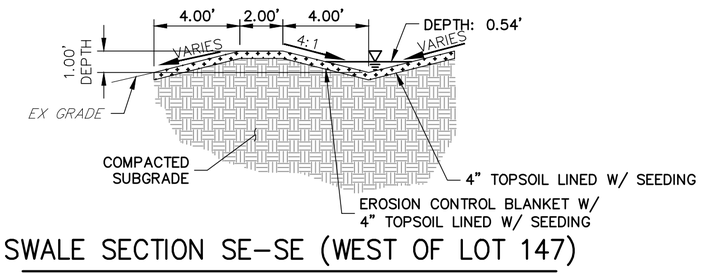
SWALE SECTION SD'–SD' (LOTS 118–120)

N.T.S.



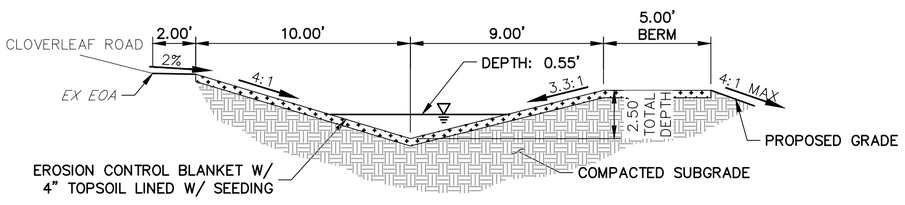
SWALE SECTION SB–SB

N.T.S.



SWALE SECTION SE–SE (WEST OF LOT 147)

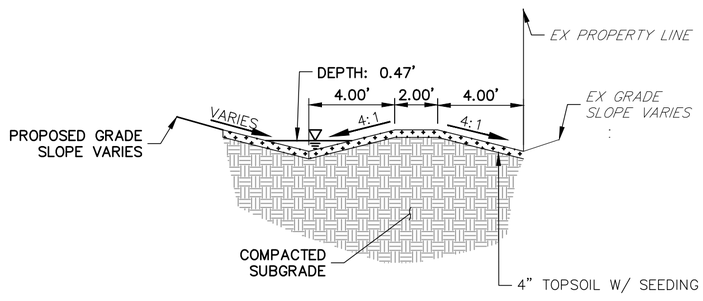
N.T.S.



SWALE SECTION SC–SC

N.T.S.

Update cross sections per review 2 redline comments on the preliminary plan cross sections



SWALE SECTION SF–SF (EAST OF LOT 142)

N.T.S.

SWALE NOTES

1. SWALE SECTIONS ARE FACING UPSTREAM.
2. FLOW DEPTHS ARE FOR THE 100–YEAR CONDITION.

SWALE CROSS SECTIONS
CLOVERLEAF SUBDIVISION
JOB NO. 25158.01
09/09/2020
SHEET 5 OF 6

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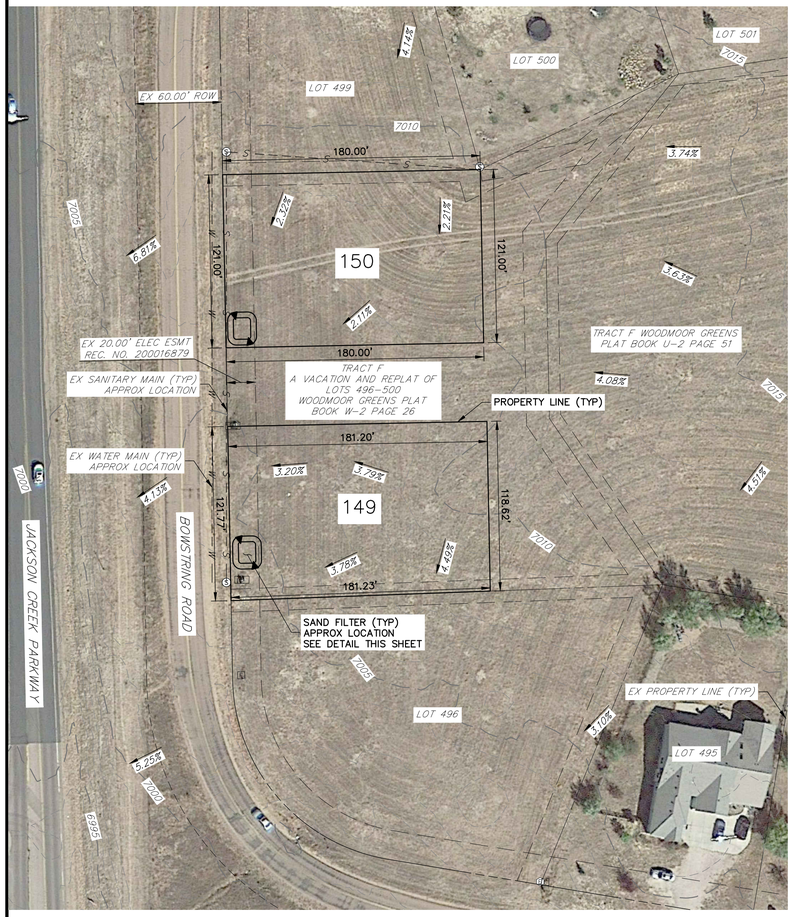
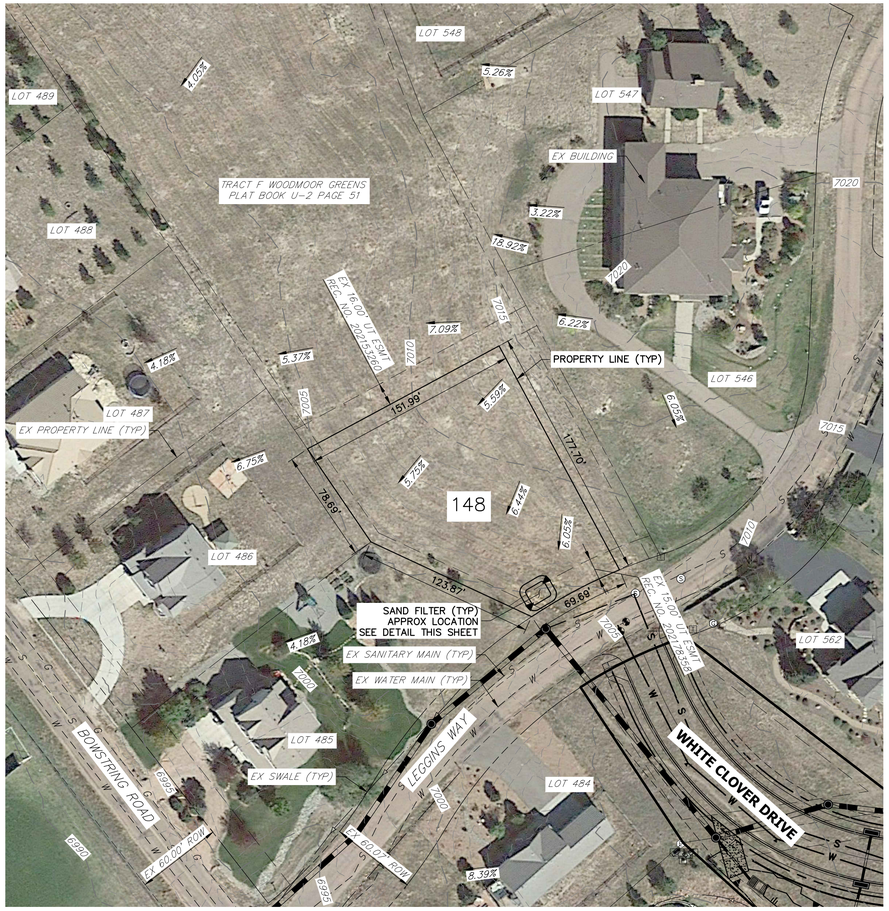
CLOVERLEAF SUBDIVISION

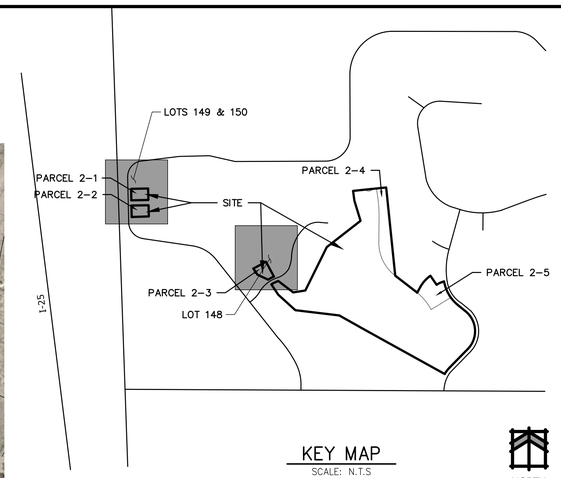
PROPOSED DRAINAGE MAP



LOTS 149 & 150



LOT 148

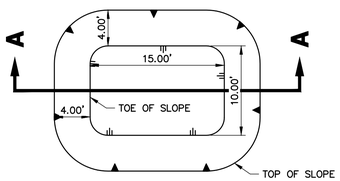


KEY MAP
SCALE: N.T.S

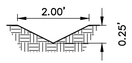
NORTH
Not to Scale

LEGEND

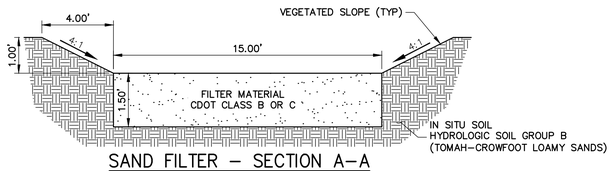
- CURB & GUTTER
- W — PROPOSED WATER LINE
- S — PROPOSED SANITARY SEWER LINE
- PROPOSED STORM SEWER W/MANHOLE
- PROPOSED TOP OF SLOPE
- PROPOSED TOE OF SLOPE
- PROPOSED RIGHT OF WAY
- EASEMENT LINE
- EXISTING RIGHT OF WAY
- EXISTING BOUNDARY LINE
- EXISTING PROPERTY LINE
- EXISTING CURB & GUTTER
- G — EXISTING GASLINE
- W — EXISTING WATERLINE
- E — EXISTING ELECTRIC LINE
- EXISTING FENCE
- S — EXISTING SANITARY SEWER W/MANHOLE
- D — EXISTING STORM SEWER W/MANHOLE
- EXISTING EDGE OF ASPHALT
- EXISTING EDGE OF CONCRETE
- EXISTING BOUNDARY LINE
- EXISTING PROPERTY LINE
- EXISTNG EASEMENT LINE
- PROPOSED PLUG W/ THRUST BLOCK
- PROPOSED FIRE HYDRANT
- PROPOSED WATER TEE
- PROPOSED WATER BEND
- PROPOSED FLARED END SECTION
- PROPOSED WATER VALVE
- EXISTING FIRE HYDRANT
- E — EXISTING ELECTRIC PEDESTAL
- W — EXISTING WATER MANHOLE
- T — EXISTING TELEPHONE PEDESTAL
- EXISTING WATER VALVE
- EXISTING FIRE HYDRANT
- EXISTING VALVE
- EXISTING STREET LIGHT
- EXISTING SIGN
- EXISTING TELEPHONE MANHOLE
- EXISTING FLARED END SECTION
- EXISTING WATER VALVE
- PROPOSED FLOW DIRECTION



SAND FILTER – PLAN VIEW
SCALE: N.T.S.



SAND FILTER – SPILLWAY NOTCH
SCALE: N.T.S.
NOTE: SPILLWAY NOTCH IS TO BE LOCATED ON THE SIDE OF THE POND CLOSEST TO THE EXISTING ROADSIDE DITCH.



SAND FILTER – SECTION A-A
SCALE: N.T.S.

ISOLATED LOTS PRELIMINARY GRADING & UTILITY NOTES

1. PROPOSED LOT GRADING IS NOT SHOWN ON THESE PLANS AND WILL ROUTE STORMWATER RUNOFF FROM EACH LOT TO THE PROPOSED SAND FILTER ON EACH LOT.
2. PROPOSED WATER AND SANITARY SERVICES ARE NOT SHOWN ON THESE PLANS AND WILL CONNECT TO THE EXISTING PUBLIC MAINS WITHIN THE ADJACENT ROADWAY.

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

Know what's below. Call before you dig.

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

PREPARED FOR
PT CLOVERLEAF, LLC
1864 WOODMOOR DRIVE, SUITE 100
COLORADO SPRINGS, CO 80920
ATTN: JOE DESJARDIN
719-476-0800
JDESJARDIN@PROTERRACO.COM

J·R ENGINEERING
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Fort Collins 970-491-9888 • www.jrengineering.com

No.	REVISION	BY	DATE

H-SCALE	1"=50'
V-SCALE	N/A
DATE	9/9/20
DESIGNED BY	RPD
DRAWN BY	RPD
CHECKED BY	

CLOVERLEAF SUBDIVISION

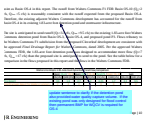
ISOLATED LOTS

SHEET 6 OF 6

JOB NO. 25158.01

Drainage Report_v2_redlines.pdf Markup Summary

Callout (7)



Subject: Callout
Page Label: 13
Author: dsdlaforce
Date: 10/6/2020 2:31:31 PM
Status:
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update sentence to clarify if the detention pond also provided water quality capture volume. If the existing pond was only designed for flood control then permanent BMP for WQCV is required for OS-4

Subject: Callout
Page Label: 12
Author: dsdlaforce
Date: 10/6/2020 3:58:58 PM
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- If the exclusion can be met, then update the narrative to explain why the basin is excluded from WQ (w/ reference to the pertinent section)

Unresolved. At the end of the paragraph identify that Basin OS-2 meets the criteria to exclude WQCV for up to 20% of the applicable site, not to exceed 1 acre per ECM Appendix I Section I.7.1.C.1.a

---

Subject: Callout
Page Label: 16
Author: dsdlaforce
Date: 10/6/2020 4:51:12 PM
Status:
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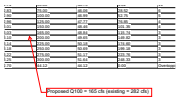
As part of determining whether the proposed outfall are suitable locations, update the narrative to analyze/describe whether or not the stormwater outfall to the existing man-made structures are hydraulically adequate.

Unresolved. Expand on the narrative. Identify the resulting depth of the 5yr and 100yr overtopping and whether or not it meets the allowable cross flow criteria per EPC DCM Table 6-1.

If the culvert does not meet criteria upgrade the culvert or submit a deviation request from ECM Section 3.2.4 for the ECM Administrators consideration.



Subject: Callout
Page Label: 101
Author: CS
Date: 9/9/2020 10:31:34 AM
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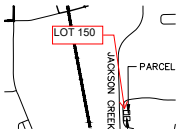
Proposed Q100 = 165 cfs (existing = 282 cfs)



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LOT 150

Subject: Callout
Page Label: 26
Author: CS
Date: 9/9/2020 12:32:33 PM
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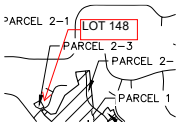
Space:

LOT 149



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LOT 148

Line (16)

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Subject: Line
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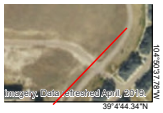

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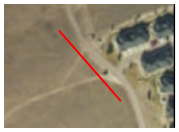

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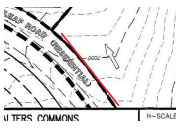

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Polygonal Line (4)

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Subject: Polygonal Line
Page Label: 115
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Date: 4/24/2020 2:52:58 PM
Status:
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Subject: Polygonal Line
Page Label: 116
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Subject: Polygonal Line
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Date: 4/24/2020 2:55:25 PM
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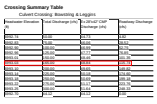
Rectangle (1)



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Stamp (1)

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Author: CS
Date: 9/9/2020 10:31:42 AM
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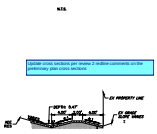
Text Box (7)



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Update cross sections per review 2 redline comments on the preliminary plan cross sections

---

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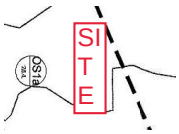
SWMM EXISTING CONDITIONS MODEL



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SITE

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SITE

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Sand Filter Sizing for lots 148-150 (Half Acre Lots)

TextBox (1)

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Author: CS
Date: 4/20/2020 2:34:54 PM
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Cloverleaf Subdivision